ARTIFICIAL INSEMINATION IN PIG BREEDING IN ESTONIA

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Abstract. The role of a male breeding animal is highly significant in livestock breeding, particularly in pig production due to a very rapid turnover rate of pigs. Application of artificial insemination (AI) is increasing from year to year: in 1997 6 % of the total number of pigs were inseminated artificially, whereas in 2001 the percentage was high (46.5 %). Data of 6601 sows and 1015 boars with 10 411 litters, obtained from database of Animal Recording Centre from 1999 to 2001, was used to analyze heritability of litter size and effect of mating method on fertility traits. The following breed combinations were investigated: Estonian Landrace (EL), Estonian Large White (ELW), Hampshire (H), Piatrain (Pi), EP♂xELW♀, ELW♂xEP♀ and Pi♂xH♀. 9.80 piglets per litter were born by using AI, which was significantly lower (-0.44) than in case of natural mating. Significantly smaller litter size was observed in purebred EL (-0.39) and ELW (-0.62) breeds by using AI (P<0.001). H and Pi♂xH♀ combinations had larger litters at birth when AI was used. Natural mating showed superiority over parities, giving significantly larger litters from 1^{st} to 6^{th} parities. A rapid increase in application of AI shows that farmers have calculated advantages of AI and found that even in case of a smaller litter size, they do not lose their profit, as they can use better genetic material.
Keywords: artificial insemination, natural mating, litter size, breeds, parities.

DIRBTINIO KIAULIŲ APVAISINIMO TAIKYMAS ESTIJOS VEISLININKYSTĖS ŪKIUOSE

Santrauka. Gyvulininkystėje, ypač kiaulininkystėje, kur kiaulių produkcijos apyvarta itin didelė, labai svarbūs yra patinai. Kasmet vis dažniau taikomas dirbtinis apvaisinimas (DA): 1976 m. 6 % visų kiaulių buvo dirbtinai apsėklintos, o 2001 m – kur kas daugiau (46,5 %). 6601 kiaulės ir 1015 kuilių su 10 411 vadomis duomenys, gauti iš Gyvulių registravimo centro duomenų bazės 1999–2001 m. laikotarpiu, buvo panaudoti vados dydžio paveldimumo bei kergimo metodų poveikio vislumo savybėms analizei. Tirti tokie veislių deriniai: Estijos landrasų (EL), Estijos didžiųjų baltųjų (ELW), Hempšyrų (H), Pjetrenų (Pi), EP♂xELW♀, ELW♂xEP♀ ir Pi♂xH♀. Dirbtinai apvaisintų kiaulių vadose buvo po 9,8 paršelio, t.y. gerokai (-0,44) mažiau negu natūraliai sukergtų kiaulių vadose. Gerokai mažesnės buvo ir grynaveislių EL (-0,39) bei ELW (-0,62) veislių dirbtinai apvaisintų kiaulių vados (p<0,001).

H ir Pi♂xH♀ derinių natūraliai sukergtų kiaulių vados buvo didesnės. Vertinant apsiparšiavimų skaičių, natūralus kergimas buvo pranašesnis it nuo 1 iki 6 apsiparšiavimo davė žymiai didesnį vados skaičių. Dirbtinio apvaisinimo rezultatai rodo, kad ūkininkai įvertino jo privalumus ir suprato, kad dėl mažesnių vadų jie nepraranda pelno, nes gali pasinaudoti geresne genetine medžiaga.
Raktažodžiai: dirbtinis apvaisinimas, natūralus kergimas, vados dydis, veislės, paršiavimasis.

Introduction. The role of a male breeding animal is highly significant in livestock breeding, particularly in pig production due to very rapid turnover rate of pigs. Application of artificial insemination (AI) is increasing from year to year in Estonia: in 1997 6% of the total number of pigs were inseminated artificially, whereas in 2001 the percentage was higher (46.5%). The pioneer of the AI introduction was Kehtna AI Station, where 3068 sows were inseminated artificially in 1981. Today, there are four AI stations in Estonia, whereas the largest, Tartu AI station, produced about 26 000 sperm doses last year. Currently, there are 40 boars in the Tartu AI Station (16 Estonian Large White, 11 Estonian Landrace, 9 Pietrain and 4 Pietrain x Hampshire crossbred boars). Average breeding value of the boars is 120 points, being higher (155 points) in Norwegian Landrace Farm 4398. Farmers could also achieve nucleus farm breeding improvement also on their own farm, by using superior boar semen. Last year some Norwegian Landrace boar semen was imported and its offspring have a good body condition. More and more Pietrain boars are used to produce slaughter pigs. Farmers have a possibility to use Pietrain x Hampshire crossbred boars also (Rätsep, 2001).

Sows' fertility depends on many various factors (Clark & Leman, 1986), and in the previous studies the authors of the present paper found the influence of breed, parity, season and year on the fertility in purebred and crossbred pigs in Estonia (Tänavots, A. 1998[a], Tänavots, A. 1998[b], Tänavots *et. al*., 2001). Factors influencing sow fertility also include mating type. Several studies have shown significant effect of this factor (Ral *et al*., 1978; King *et al*., 1998), however, Flowers & Alhusen (1992) did not find any difference.

The objective of this retrospective study was to investigate heritability of litter size and the effect of mating type [natural mating (NM) vs. artificial insemination (AI)] on fertility traits.

Material and Methods. The analysed data comprised 6601 sows and 1015 boars with 10 411 litters from 39 farms throughout Estonia (obtained from database of Animal Recording Centre from 1999 to 2001). Completed dataset included breed, insemination method, farm, parity, season of birth and year of birth, which was collected by PC program DB-Planer. The following breed (litter) combinations were investigated: Estonian Landrace (EL), Estonian Large White (ELW), Hampshire (H), Piatrain (Pi), EP♂xELW♀, ELW♂xEP♀ and Pi♂xH♀. The testing year was divided into four parts: spring - March, April, May; summer - June, July, August, fall - September, October, November and winter - December, January, February.

General Linear Model (GLM) was used to analyse dataset by SAS software (SAS Inst. Inc., 1991).

$$Y_{ijkemnl}=\mu+T_i+M_j+K_k+S_e+A_m+P_n+e_{ijkemnl},$$

Y= dependent variable;
K_k = boar (n=1...1015);
μ = general mean;
S_e = birth season (n=1...4);
T_i = farm (n=1...38);
A_m = birth year (n=1...3);
M_j = insemination method (n=1...2);
P_n = breed (n=1...7);
$e_{ijkemnl}$ = random residual effect

The results are given as least-square means (Parring *et al.*, 1997). Level of significances expressed conventionally: *** - P<0.001, ** - P<0.01, * - P<0.05, # - P<0.1.

Results and Discussion. The average ratio of litters obtained through NM to litters obtained through AI was about 53% NM:47% AI (Figure 1). Distribution of breed groups is shown in Table 1.

From total 10 411 litters, 9.80 piglets per litter were born by using AI, which was significantly lower (-0.44) than in case of natural mating. Similar results were obtained by Tummaruk *et. al*. (2000). In their trials NM resulted in larger litters (0.2; P<0.001), compared with AI. By using AI a significantly smaller litter size was observed in purebred EL (-0.39) and ELW (-0.62) breeds (P<0.001) and a little larger litters had H and Pi♂xH♀ combinations. As EL and ELW are the main breeds used in Estonia; they have a considerable influence on total variation. In Swedish study, larger litters had also purebred Swedish Landrace and Swedish Yorkshire by using NM (Tummaruk *et. al*., 2000). There is no explanation, why there are no differences in litter size between mating methods while crossing white breeds.

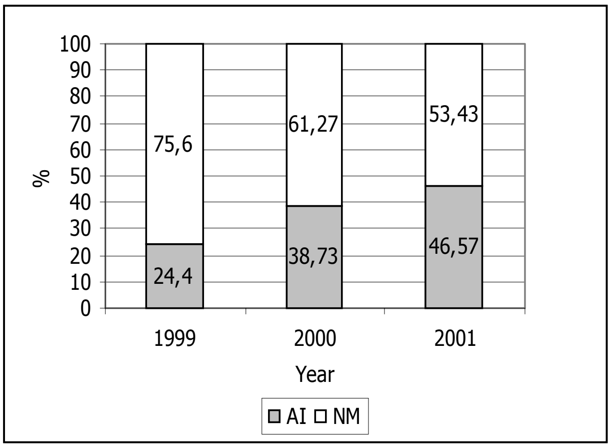

Figure 1. **Development of AI usage from 1999 to 2001**

As the effect of litter reduction caused by AI is considered not to be significant on crossbreeding, it is suggested to use AI to produce slaughter pigs to achieve gain from better genetic material collected into AI stations.

Natural mating showed superiority among parities, giving significantly larger litters from 1st to 6th parities, whereas for the higher parities no significant difference was found. Compared with Tummaruk *et. al.* (2000) study, using AI resulted in a significantly smaller litter size of 1, 2 and 3 parities.

The difference between NM and AI varied with a piglet breed and parity number.

A rapid increase in application of AI shows that farmers have calculated advantages of AI and found that even in case of smaller litter size, they do not lose their profit, as they can use better genetic material.

Table 1. **Usage of AI in percentages, distributed by breeds**

Traits	EL	ELW	H	Pi	ELxELW	ELWxEL	PixH
n	3428	4654	37	69	1515	682	26
AI	36.73	22.26	16.22	21.74	49.83	75.95	76.92
NM	63.27	77.74	83.78	78.26	50.17	24.05	23.08

Table 2. **Differences between artificial insemination (AI) and natural mating (NM) among breeds**

Traits	n	AI	NM	Difference	Significance
Total	10 411	9.80	10.25	-0.44	***
EL	3428	10.46	10.85	-0.39	***
ELW	4654	10.63	11.25	-0.62	***
H	37	10.19	9.12	1.07	n.s.
Pi	69	8.10	9.37	-1.27	n.s.
EP♂xELW♀	1515	10.52	10.64	-0.12	n.s.
ELW♂xEP♀	682	10.51	10.88	-0.38	n.s.
Pi♂xH♀	26	11.49	9.39	2.10	n.s.

Table 3. **Differences between artificial insemination (AI) and natural mating (NM) among parities**

Parities	n	AI	NM	Difference	Significance
1	1774	9.01	9.40	-0.39	*
2	1928	9.83	10.09	-0.26	#
3	1940	10.31	10.56	-0.25	#
4	1607	10.71	11.12	-0.41	**
5	1240	10.42	11.18	-0.76	***
6	795	10.58	11.04	-0.45	*
7	489	10.86	11.01	-0.15	n.s.
8	323	11.06	11.30	-0.24	n.s.
9	174	10.89	11.29	-0.40	n.s.
10...15	141	10.58	10.96	-0.38	n.s.

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2002 09 11