# THE PERFORMANCE OF DANISH WHITE AND PANNON WHITE PUREBRED AND RECIPROCAL CROSSBRED RABBITS

SZENDRÔ Zs.[1], BIRÓ-NÉMETH E.[1], RADNAI I.[1], JENSEN N.E.[2], KENESSEY A.[1]

[1] Pannon University of Agricultural Sciences, H-7401 KAPOSVAR, P.O.Box 16, Hungary
[2] Danish Institute of Animal Science, FOULUM, Denmark

**Abstract** - 20 Pannon White (P) and 19 Danish White (D) does were inseminated to bucks of the same and the other breed. 23 PxP, 41 DxP, 22 PxD and 23 DxD matings were studied (male x female). The conception rate was 87.0, 58.5, 72.7 and 52.2 % respectively, total number of young per litter averaged 8.30, 8.83, 7.56 and 6.92, litter weight at 21 days 2175, 2499, 2136 and 2196 g. The rabbits were weaned at 42 days of age. For 67 PP, 124 DP, 24 PD and 32 DD rabbits, body weight of the young averaged 1046, 1173, 1273 and 1189 g at 42 days, and 1947, 2224, 2270 and 2344 g at 70 days, and the daily weight gain between 6 and 10 weeks of age 32.2, 37.7, 35.9 and 41.9 g respectively. It was concluded that the production of Pannon White does and Danish White growing rabbits were better. Individual heterosis was found in the case of litter size (7.6-13.5 %), litter weight at birth and on the 21st day (15.5 % and 6.0 %). The maternal breed effect was significant in the case of litter size (live), total litter loss, litter weight at birth, body weight at 6 and 10 weeks of age, and daily weight gain between weeks 6-10.

## INTRODUCTION

Comparing the production of breeds and crossbreds combinations of different origin provides useful information from both the theoretical and the practical point of view.

The performance of Danish White rabbits has been followed since 1944 (JENSEN, 1983) - at the present time the main emphasis of the development of the breed is placed on the improvement of growth rate (weight gain) and vitality: this work involves three breeding lines. For the assessment of the figures it is important to know that the does are mated naturally after weaning, and the empty does and in the first half of pregnancy are submitted to a restricted feeding regime (130 g/day).

The Pannon White is a synthetic breed, which has been developed by crossing several populations. The beginning of the upgrading process goes back eight years. In the selection work the traits to be emphasized are weight gain and slaughter value (SZENDRÔ *et al.*, 1994). The does are bred artificially and fed a commercial compound feed ad libitum.
By comparing breeds and their crossbred combinations data can be obtained not only on the yields of the genotypes but also on the maternal and paternal breed effects and heterosis.

## MATERIAL AND METHODS

To complement our own experimental stock Pannon White (P) rabbit 20 does and 5 bucks of Danish White (D) were introduced from Denmark by air in 1991. After the quarantine period the Danish rabbits were placed in the same number and in the same barn as the Hungarian ones.

The animals were housed in a rabbit house with windows on flat deck cages (50x80 cm). A minimum temperature of 14°C was maintained during winter, while it could go up to 25-30 °C during summer. The commercial diet (CP: 17.1 %, CF: 13.2 %) was available ad libitum for the breeding and growing rabbits. The ration also included some hay.
The does were inseminated artifically using GnRH (Ovurellin) injection. The does found empty at the 11-12th day of pregnancy (palpation test) were rebred some days later, while those becaming pregnant were rebred approx. one month after delivery. The only case of fostering newborn rabbits was when litter size exceed ten. The young were weaned at the age of 6 weeks. At weaning the suckling rabbits remained in the old cage (5-6 animals per cage), whereas the does were transferred into a clean one.

**Table 1 - Effect of mating combination, maternal and paternal breed and individual heterosis on the productive traits**

| Traits | n | Overall | Effect ofmating combinations (deviation from mean value) | | | | Effect of materal breed D-P | Effect of paternal breed D-P | Effect of cross-breeding | | Indivi-dual heterosis % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DD+PD+ DP+PP | DxD | PxD | DxP | PxP | | | cross bred | pure bred | |
| Conception rate, % | 109 | 67.7 | -15.2$^{a}$ | +5.0$^{ab}$ | -9.2a | +19.3$^{b}$ | -10.1 | -24.4 | -4.2 | | - |
| Litter size | | | | | | | | | | | |
| total | 72 | 7.90 | -0.98 | -0.34 | +0.93 | +0.40 | -1.32 | -0.06 | +0.58 | | 7.6 |
| live | 66 | 7.51 | -1.69$^{a}$ | -0.43$^{ab}$ | +1.36$^{b}$ | +0.75$^{b}$ | -2.12* | -0.32 | +0.95 | | 13.5 |
| Total litter loss % | 72 | 21.2 | +12.1$^{ab}$ | +16.3$^{a}$ | -17.0$^{b}$ | -11.2$^{ab}$ | +28.3$^{+}$ | -5.0 | -0.8 | | - |
| Suckling mortality, % | | | | | | | | | | | |
| between day 0-21 | 510 | 15.0 | +4.7 | -4.3 | -0.1 | -0.3 | +0.4 | +4.6 | -4.4 | | - |
| Litter weight, g | | | | | | | | | | | |
| at birth | 66 | 432 | -67$^{a}$ | -58$^{a}$ | +122$^{b}$ | +4$^{a}$ | -125 | +55 | +63 | | 15.5 |
| on 21st day | 58 | 2251 | -55 | -115 | +303 | -76 | -171 | +192 | +132 | | 6.0 |
| Body weight, g | | | | | | | | | | | |
| at birth | 496 | 57.7 | +4.9 | -4.9 | +4.8 | -4.9 | 0.0 | +9.7 | 0.0 | | 0.0 |
| 3 weeks old | 398 | 329 | +30 | -10 | +8 | -27 | +19 | +37 | -3 | | -0.3 |
| 6 weeks old | 247 | 1170 | +19$^{acd}$ | +103$^{c}$ | +3$^{d}$ | -124$^{b}$ | +122* | +22 | +106 | | 4.7 |
| 10 weeks old | 247 | 2196 | +148$^{a}$ | +74$^{a}$ | +28$^{a}$ | -249$^{b}$ | +222* | +176* | +102 | | 2.4 |
| Daily weight gain, g | | | | | | | | | | | - |
| (between weeks 6-10) | 247 | 36.8 | +4.4$^{a}$ | -0.9$^{bd}$ | +0.9$^{c}$ | -4.6$^{b}$ | +3.6* | +5.4* | +0.1 | | |
| Mortality between 6- | | | | | | | | | | | - |
| 12 weeks of age, % | 308 | 20.1 | -4.7 | +9.3 | -3.4 | -1.3 | +4.6 | -8.0 | +6.0 | | |

Values on the same line with different letters are significantly different (P<0.05). ; +: P<0.01; *: P<0.05

**The experimental groups**. Half of the does were inseminated with the semen of the bucks of the same breed, the rest with the semen of the other breed. As far as was feasible, the paternal breed was changed after each kindling, so the offspring from one doe were purebred at one time and crossbred at other time.
During the experimental period 5 Danish White does did not produce a litter. The data for these were excluded from the evaluations.
The following data were recorded: weight of does, mortality of does, conception rate, litter size, litter weight, mortality of suckling and growing rabbits, individual weight and daily weight gain of suckling and growing rabbits.
Date were statistically analysed using one-way analysis of variance by Statgraphics ver. 5.0.

## RESULTS AND DISCUSSION

The performance of the rabbits is summarized in Table 1.

**Body weight of the does.**

The D does were heavier than the P ones by on average 0.87 kg at parturition, 1.02 kg on the 21st day of nursing and 0.92 kg at weaning. The body weight at kindling, on 21st day and at weaning averaged 5.14, 5.44 and 5.06 kg respectively for D vs. 4.27, 4.42 and 4.36 kg for P breed. These differences may partly be attributed to genetic factors, as supported by the results obtained in Denmark almost simultaneously, although the differences varied only between 0.26 and 0.49 kg in that case, in favour of the D does (JENSEN *et al.*, 1996). It was observed that most of the D does put on excess weight during the experiment. Poor conception also contributed to the animals' becoming too fat since empty does are apt to become fat.

**Mortality of the does.**

During the six months of the experiment 60 % of the D and 25 % of the P does died. Some causes for this relatively high mortality in the D breed could be the heavier body of the does and, as a consequence, the higher incidence of sore hocks.

**Conception rate.**

The rate of conception was highest (87.0 %) in the PxP group and lowest (52.5 %) in the DxD group (Table 1). Both the does and the bucks were responsible for the 34.5 % difference between these two groups. Conception in the D does was 20 % higher, the P does by nearly 30 % lower when the semen of the buck of the other breed was used. So in this trait the effect of the paternal breed seems to be stronger than that of the doe (Table 1).

**Litter size**

In terms of total litter size and number of live progeny at birth the highest values were obtained in the DxP, while the lowest were in the DxD breeding combinations (Table 1).

Litter size was primarily determined by the maternal genotype. The second most important influencing factor was the effect on litter size of individual (relative) heterosis (7.6-13.5 %). A similar extent of heterosis has been reported by LUKEFAHR *et al.* (1983, 1984), BRUN and ROUVIER (1984), BRUN *et al.* (1992), KROGMEIER and DZAPO (1991), HACKMANN *et al.* (1993). As reported by BOLET *et al.* (1988), the crossbred does performed better in terms of the number of ovulated eggs, number of implantation sites, number of live embryos and mortality before and after implantation.

The influence of the paternal breed can also be detected, although its role is insignificant. One reason for this difference could be the higher quantity and better quality of the semen of the P bucks, as macroscopic and microscopic examination of semen showed.
It is also worth noting that in the Danish experiment (JENSEN *et al.*, 1996) the total litter size was higher in every genotype in the order of the breeding combinations as follows: DxD:9.4, PxD:10.2, DxP:9.8, PxP: 10.8. As there had not been so large litters in the Pannon White stock before (fed ad libitum) and, at the same time, such figures are characteristic of the Danish White breed (under restricted feeding regime) (JENSEN, 1992/a,b, 1993), the feeding of limited portions was the primary factor.

**Mortality of the suckling rabbits.**

Suckling mortalities were divided into two categories: a/total litter loss was the definition when the whole litter died by 21 days of age. b/ In the case of mortality during nursing one or more suckling rabbits may die in the litter in question but there is/are living individual(s) at the age of 21 days.

Five times more litters were lost in the case of the D does as compared to the P ones ($P \leq 0.01$, Table 1). A poorer maternal performance because of overweight and sore hocks could be the main indications for the causes of the poor results. As shown in Table 1 the maternal genotype has a decisive impact on total litter losses.

The differences between the mortality of the genotypes during suckling were probably accidental (Table 1). An effect of the maternal breed could not be detected, and also, the low paternal influence and heterosis could be accidental, although some heterosis effect has been observed by some authors (BASELGA *et al.*, 1982, KROGMEIER and DZAPO, 1991, NOFAL *et al.*, 1995) in terms of the vitality of the suckling rabbits.

**Litter weight.**

The differences observed in terms of litter weight at birth and at 21 days between the mating combinations are related partly to litter size, that is to say, there is a positive correlation between litter size and litter weight (SZENDRÔ *et al.*, 1988, LUKEFAHR *et al.*, 1990, KROGMEIER and DZAPO, 1991).

The influence of the maternal breed on the litter weight at birth was significant(Table 1), and the extent of individual (relative) heterosis was also considerable (15.5 %). Pannon White parentage was more advantageous on the maternal side and Danish White parentage was more favourable on the paternal side. A similar heterosis in litter weight at birth, at 21 days or at weaning has also been reported by several other authors (BASELGA *et al.*, 1982, BRUN and ROUVIER, 1984., LUKEFAHR *et al.*, 1983, 1984, KROGMEIER and DZAPO, 1991, HACKMAN *et al.*, 1993).

**Individual body weight and weight gain.**

The individual body weight of the suckling rabbits is determined primarily by the size of the litter: the larger the litter, the smaller the individual body weight at birth, at 21 days and at weaning (SZENDRÔ *et al.*, 1988, KROGMEIER and DZAPO, 1991). That is why it was surprising that the largest rabbits were born in the litters of the DxD and DxP combinations (DD = 62.7 g, DP = 62.5 g, Table 1) in spite of the fact that these litters were the smallest and the largest ones respectively in terms of litter size. Neither the maternal effect nor heterosis could be detected (Table 1), but the genotype of the bucks had a non-significant impact. It is probable that the differences between the genotypes were accidental.

A considerable difference was already found between the body weight of the DD and PP purebred suckling rabbits by the age of 3 weeks (57 g), whereas the heterozygous combinations fell between DD and PP genotypes (Table 1). The ever-increasing body weight of the D suckling rabbits could be attributed both to the maternal and to the paternal genotype (Table 1).

The situation was similar in terms of body weight measured at 6 weeks of age. In this case the difference found between the DD and PP genotypes was significant (143 g, $P \leq 0.05$). The effect of the maternal breed was more remarkable ($P \leq 0.05$) than that of the paternal one, while the extent of individual heterosis proved to be 4.7 % (Tables 1).
Concerning the body weight at 10 weeks of age, a marked difference was found in relation to the DD (2344 g) and PP (1947 g) of purebred growing rabbits. The crossbred individuals were intermediate in this respect (Table1). The effect of the maternal breed was large, and of the paternal breed was also significant ($P \leq 0.05$), and the heterosis effect proved to be 2.4 %.

Regarding the weight gain between the 6th and 10th weeks the advantage to the DD rabbits was also considerable (DD = 41.2 g/d, PP = 32.2 g/d, $P \leq 0.01$). Both the paternal and the maternal breed had a significant ($P \leq 0.05$) influence, but at this age the effect of the paternal side was already greater (Table 1). In contrast with our results, in the experiment by BRUN and OUHAYOUN (1988) only the effect of the maternal line was significant in most cases, in terms of body weight at 30 and 79 days of age and weight gain between these two days in question. The data published by other authors regarding the heterosis effect are similar to ours. As far as weaning and finishing weight and weight gain during fattening are concerned, most researchers have reported data varying from 3 to 5 % (BASELGA *et al.*, 1982, BRUN and ROUVIER, 1984, SLAWINSKI and ARIAS, 1988, KROGMEIER and DZAPO, 1991, BRUN *et al.*, 1992, BRUN and OUHAYOUN, 1994).

In the experiment carried out by JENSEN *et al.* (1996) in Denmark the best results were obtained from the PD rabbits (average daily weight gain: 46.1 g/d, 10 week body weight: 2.37 kg) followed by the DD (44.2 g/d, 2.27 kg), DP (43.8 g/d, 2.66 kg) and PP (41.2 g/d, 2.20 kg) genotypes. In this investigation the effect of maternal breed and heterosis was greater, while the influence of the paternal breed was insignificant. We could not explain our finding that the P rabbits grew much more slowly in Kaposvár than in Foulum as compared to the D rabbits. The difference between the two purebred genotypes (DD and PP) were 21.8 % in Hungary and 6.8 % in Denmark. It is true that experimental results for Pannon White rabbits were inferior to the average daily weight gain (36-38 g/d) of our breed at that time.

**Mortality of growing rabbits.**

Mortality reached a high level (20.1 %) during the period from 6 to 12 weeks of age (Table 1). The differences between the genotypes were accidental, while the effects of the maternal and paternal breed and heterosis were slight and insignificant.

## CONCLUSIONS

The Danish White does have higher adult body weight than the Pannon White ones.

The low conception rate observed in the Danish White breed can be explained by the poor conception of the does and poor fecundity of the bucks. The effect of the paternal breed is greater than that of the maternal side.

The Pannon White does produced larger litters than the Danish White ones. Litter size was primarily determined by the maternal side, while the extent of individual heterosis was less significant (7.6-13.5 %).

The incidence of total litter losses was five times higher in the case of the Danish White does. This was determined primarily by the maternal genotype. There was no considerable difference between the breeding combinations concerning mortality during the suckling period.

Pannon White maternal and Danish White paternal ancestry is advantageous from the point of view of litter weight at birth, the individual heterosis proving to be 15.5 %.

Danish White parentage had: a favourable influence on the body weight of the suckling rabbits. Also, their weight gain between the 6th and 10th weeks and body weight at the age of 10 weeks was highest in the case of the purebred Danish White rabbits and lowest in the case of the Pannon White ones. The crossbreds (PD and DP) fell between the purebreds.

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## REFERENCES

BASELGA M., BLASCO A., GARCIA F., 1982. Parametros geneticos de carcteres economicos en poblaciones de conejos. 2nd World Congr. Gen. appl. Liv. Prod., Madrid, 471-480.

BOLET G., BRUN J.M., HULOT F., 1988. Relationships between ovulation rate and embryonic survival in various strains of rabbits. *4th World Rabbit Congress, Budapest*, **Vol 2**, 149-157.

BRUN J.M., BOLET G., OUHAYOUN J., 1992. The effects of crossbreeding and selection on productive and reproductive traits in a triallel experiment between three strains of rabbits. *5th World Rabbit Congress, Corvallis*, **Vol. A**, 181-189.

BRUN J.M., OUHAYOUN J., 1988. Growth performances and carcass traits in three strains of rabbits and their two-way crosses. *4th World Rabbit Congress, Budapest*, **Vol.2**, 168-175.

BRUN J.M., OUHAYOUN J., 1994. Qualités bouchères de lapereaux issus d'un croisement diallèle de 3 souches: interaction du type génétique et de la taille de portée d'origine. *Ann. Zootech.*, **43**, 173-183.

BRUN J.M., ROUVIER R., 1984. Effets génétiques sur les caractères des portées issues de trois souches de lapins utilisées en croisement. *Génét. Sél. Evol.*, **16.3**, 367-384.

HACKMANN P.G., GÖRSE C., HEINE WIEBERNEIT D., WEGNER W., 1993: Reproduktions- und Mastleistungen von Kaninchen aus Punkschecken- Neuseeländekrezungen. 8th Symp. Housing and Diseases of Rabbits..., Celle, 57-66.

JENSEN N.E., 1992/a. Kaninforsogsstationen 1990-91. *Beretning fra Statens Husdyrbrugsforsog*, **No 705**.

JENSEN N.E., 1992/b. Kaninforsogsstationen 1991-92. *Beretning fra Statens Husdyrbrugsforsog*, **No 716**.

JENSEN N.E., 1993. Line and crossbreeding in a rabbit population. *8th Symp. Housing and Diseases of Rabbits, Celle*, 276-283.

JENSEN N.E., JENSEN J.A., JENSEN J.F., 1996. Line and crossbreeding experiment in Danish and Hungarian meat rabbits. *World Rabbit Sci.* (in press)

JENSEN J.F., 1983. Ergebnisse der Dänischen nachkommenprüfung für Mastkaninchen. Das Kaninchen als Modelltier und Züchtungsobjekt, *II. Intern. Koll., Rostock*, **Teil 1**, 49-55.

KROGMEIER D., DZAPO V., 1991. Leistungsmerkmale von Kaninchen der Rassen Weisse Neuseeländer, Halle Grossilber sowie deren reziproker Krenzungen. Arch. Geflügelk., **55.4**, 158-162.

LUKEFAHR S.D., CHEEKE P.R., PATTON N.M., 1990. Prediction and causation of litter market traits from preweaning and weaning characteristics in commercial meat rabbits. *J.Anim. Sci.*, **68**, 2222-2234.

LUKEFAHR S.D., HOHENBOKEN W.D., CHEEKE P.R., PATTON N.M., 1983. Doe reproduction and preweaning litter performance of straightbred and crossbred rabbits. *J.Anim. Sci.*, **57.5**, 1090-1099.

LUKEFAHR S.D., HOHENBOKEN W.D., CHEEKE P.R., PATTON N.M., 1984. Genetic component estimations and diatery influence for and on milk production and associative traits in rabbit breeds and specific crosses. *3rd World Rabbit Congress, Roma*, **Proc. I.**, 98-106.

NOFAL R.Y., TÓTH S., VIRÁG GY., 1995. Effects of crossbreeding on some reproductive traits. *Állattenyésztés és Takarmányozás*, **44.3**, 243-248.

SLAWINSKI T., ARIAS E.H., 1988. Effect of genotype, mother's genotype and environment on body and carcass weights in young rabbits. *Anim. Sci. Papers and Reports*, **4**, 121-131.

SZENDRÔ ZS., KUSTOS K., RICHTER J., 1988. Study of the relationships between production characteristics of rabbit does. *4th World Rabbit Congress, Budapest*, **Vol. 2**, 276-283.

SZENDRÔ ZS., ROMVÁRI R., HORN P., RADNAI I., BIRÓNÉ NÉMETH E., 1994. Selectim for slaughter value by computerised tomography. (in Hung.) *Nyúltenyésztési Tudományos Nap, Kaposvár*, 96-105.

**Reproductionsleistungen von reinrassigen und gekreuzten weißen dänischen- und weißen pannon-kaninchen** - 20 WEIßE Pannon-Häsinnen (P) und 19 Weiße Dänische-Häsinnen (D) wurden teilweise mit Rammlern der eigenen und teilweise mit Rammlern der anderen Rasse besamt. Untersucht wurden 23 PxP, 41 DxP, 22 PxD und 23 DxD.
In der angegebenen Reihenfolge lag die Trächtigkeitsrate bei 87.0, 58.5, 72.7 und 52.2 %; die Wurfgröße zur Geburt bei 8.30, 8.83, 7.56 und 6.92 Stück; die Wurfgröße am 21. Lebenstag bei 7.18, 7.43, 6.70 und 6.12 Stück; das Wurfgewicht am 21. Lebenstag bei 2175, 2499, 1936 und 2196 g.
Alle Kaninchen wurden am 42. Lebenstag entwöhnt. Bei den 67 PP, 124 DP, 24 PD und 32 DD Jungkaninchen betrug das 6-Wochen-Gewicht in der angegebenen Reihenfolge 1046, 1173, 1273 und 1189 g; ebenso das 10-Wochen-Gewicht 1947, 2224, 2270 und 2344 g; der Gewichtsunterschied zwischen der 6. und 10. Woche 32.2, 37.7, 35.9 und 41.9 g/Tag.
Als Schlußfolgerung ergab sich, daß die Häsinnen der Rasse Weiße Pannon und die Jungtiere der Rasse Weiße Dänische die besseren Ergebnisse erreichten. Individuelle Heterosis zeigte sich in der Wurfgröße (6,5-13,4 %) und im Wurfgewicht bei der Geburt und im Alter von 21 Tagen (15,5 und 6,0 %). Ein signifikanter Einfluß der Mutterrasse war hinsichtlich der Wurfgröße (lebend geborene), der Mortalität des gesamten Wurfes, des Geburts-Wurfgewichtes, des Lebendgewichtes in der 6. und 10. Lebenswoche sowie der Gewichtszunahme zwischen 6. und 10. Lebenswoche festzustellen.