Influence of genotype on goose egg hatchability

Einfluß des Genotypen auf die Schlupffähigkeit von Gänseeiern

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Introduction

High laying performance (up to 70 eggs per layer), good livability and high body weight obtained in the recent years in geese resulted from the intensive breeding work (Rosiński and Wężyk, 1989; Rosiński et al., 1993) as well as from optimization of management conditions (Mazanowski et al., 1987; Rosiński et al., 1995).

However gosling hatchability still remains on a poor level (60–70 percent) despite the achievements in breeding work. Hatchability indices in water fowl have generally been dependent upon breed and management conditions of parent stock which determine the biological value of eggs as well as upon methods used prior to and during egg incubation.

Studies on the improvement of goose egg incubation technique comprised, a.o., the effect of hatching eggs storage time and warming up hatching eggs prior to setting; characteristics of egg shell microflora, and effectiveness of hatching eggs disinfection; causes of early embryonic mortality and influence of certain environmental factors on egg hatchability (Bednarczyk, 1984, 1986; Bednarczyk et al. 1985; Bogenfürst, 1988).

Relationships between microclimate parameters in the setter and egg shell quality, egg weight loss during incubation and hatching results were also studied (Bogenfürst, 1995; Meltzer, 1988).

Relatively less data is available on the effects of water fowl genotype on hatchability. It is known that goose breeds originating from the Anser cygnoides species generally demonstrate better reproduction level compared with breeds which come from the Anser anser species (Bednarczyk et al., 1985; Smalec, 1991). There is a commonly known antagonistic relationship between the traits of fast growth rate and high reproductive performance (Pingel, 1990).

Nowadays goose breeding has been conducted on the basis of specialized, closed masculine and feminine strains used for crossing. The studies which have been published so far demonstrated that an intense selection of poultry is affecting hatching egg quality (Coleman and Motto, 1992; Hulet, 1992).

In Poland breeding work has been carried out on the White Italian breed. At the Koluda Wielka Experimental Station the strains WD-1 (maternal) and WD-3 (paternal) have been improved in which the selection pressure has been directed towards the reproductive and meat performance traits respectively (Wężyk et al., 1993; Rosiński et al., 1994).

In the preliminary experiment Rosiński and Bednarczyk (1996) demonstrated significant differences between the WD-1 and WD-3 strain in regard to hatchability of the eggs set. The objective of their study was a detailed analysis of hatching results in the differently selected WD-1 and WD-3 strain of White Italian geese over the period of five years.

Materials and Methods

Material for this study was taken from hatching records being kept at Koluda Wielka Experimental Station of the Institute of Animal Husbandry in the years 1988–1994. The data comprised one-year-old (control population) and two-years-old geese (parental population) from the years 1987–1992. A total of 312,029 hatching eggs of the WD-1 strain and 146,683 hatching eggs of the WD-3 strain were subjected to analysis. The size of the experimental material in relation to genotype, population and age group is presented in Table 1.

Table 1. Size of the experimental material

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Year</th>
<th>WD-1</th>
<th>WD-3</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>control</td>
<td>parental</td>
</tr>
<tr>
<td></td>
<td>1987</td>
<td>33,538</td>
<td>14,326</td>
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<tr>
<td></td>
<td>1988</td>
<td>50,314</td>
<td>15,548</td>
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<td></td>
<td>1989</td>
<td>34,605</td>
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<tr>
<td></td>
<td>1991</td>
<td>53,698</td>
<td>14,103</td>
</tr>
<tr>
<td></td>
<td>1992</td>
<td>65,776</td>
<td>15,448</td>
</tr>
</tbody>
</table>

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Flocks of forty females and eight males, both one-year-old constituted the control populations. Parental populations were made up every year from selected two-years-old females and one-year-old males which were kept in groups comprising one male and six females.

Incubation of eggs was conducted in POLDROB-REFORM walkin incubators of 10 thou. egg capacity, according to standardised technique being used at Koluda Wielka Experimental Station (BADOWSKI, 1993). All eggs were candled at the seventh and twenty sixth day of incubation. The infertile eggs and eggs with dead embryos were removed. The number of non-hatched, crippled, weak and normal goslings were determined on the hatching day. The percentage egg fertility and indices of hatchability of the fertile eggs were calculated for each year. The mortality of embryos (in percent of fertile eggs) between the first and sixth; seventh and twenty-fifth; twenty-sixth and thirty-first (non-hatched goslings) day of incubation and the number of crippled and weak goslings were analysed separately (except the control population of both strains from 1987 year).

The experimental results were compared by the use of variance analysis.

Results

Percentage values of fertile eggs of WD-1 and WD-3 strains from the years 1987–1992 are presented in Table 2. In both strains of each year a higher fertility was found in the control populations than in the parental ones. Only small, non significant differences were noted between strains since mean fertility of eggs attained 80.1% for WD-1 strain and 78.4% for WD-3 strain. In the parent flock of the WD-1 strain the highest egg fertility (79.6%) was found in the year 1987. In the successive years it was markedly lower and varied from 68.1% to 71.8%. The respective values for strain WD-3 were lower and varied from 64.8% in 1992 to 73.1% in 1991. Statistically significant differences between strains were noted for the years 1987, 1988 and 1992 (see Table 2).

The embryonic mortality until the sixth day of incubation of eggs from the parental flock was lower in the WD-1 strain (5.3 to 7.0%) than in the WD-3 strain (6.4 to 8.9%) (see Figure 1). The observed differences were statistically highly significant for mean values from the five analysed years. Strain WD-3 demonstrated also higher (P < .01) than strain WD-1 embryonic mortality in the control populations. The percentage of embryonic mortality in strain WD-3 increased in a regular way over the period 1987–1992. The estimated regression coefficient attained 0.62 and 0.65 per year in the parental and control population, respectively.

Mean percentage of embryonic mortality between the seventh and twenty-fifth day of incubation (Figure 2) amounted to 7.1 in the parental flocks of WD-3 strain and 7.0 in the control populations and was significantly higher than that in WD-1 strain, 6.0 and 5.9, respectively. Those values have shown no greater changes in the successive years.
Regardless of the genotype (WD-1 and WD-3) and population (control, parental) studied, the percentage of the non-hatched embryos was decreasing in the period 1987–1992 (Figure 3). Regression coefficient of that trait varied from -0.99 to -1.27 per year. However, the goose genotype affected in a statistically significant way (P < 0.05 and P < 0.01) the value of the trait concerned (WD-1: 7.8% and 6.9%; WD-3: 9.0% and 9.0%).

Mean percentage of crippled and weak goslings (Figure 4) was higher in strain WD-3 (P < .01) compared with strain WD-1 and attained 5.1 and 4.1 (control) and 4.1 and 3.2 (parental flock), respectively. That trait being analysed in parental flocks of strain WD-3 was found to diminish in the successive years from 4.9 to 3.1% (regression coefficient: -0.45). This tendency was not observed in strain WD-1 in which the percentage of crippled goslings was at similar level (3.4–3.0%).

The hatching results from fertile eggs shown in Table 3 indicate that both the parental and control flocks of strain WD-1 demonstrated, in each year, higher values compared to those of strain WD-3. This was statistically significant (P < 0.05 and P < 0.01) for the control and parental flocks of strain WD-1 and WD-3, respectively.
with the respective years for strain WD-3. Differences between strains in all cases, except one found in the control population from 1989, were statistically significant (P < .05 or P < .01). Mean hatchability of fertile eggs was 77.5% in strain WD-1 (parental flocks) and varied in the particular years in the range from 75.9% (1989) to 78.5% (1991). In the control populations a broader range was noted (from 72.9% to 79.9%), with mean value of 76.0%. The respective values in strain WD-3 varied from 70.3% to 74.3% (mean value for the parental stock: 72.5%) and from 69.9% to 73.7% (mean value for the control population: 71.1%).

Discussion

A higher egg fertility (Table 2) regardless of genotype and age was found in the control (one year old geese), than in the parental populations (two years old geese). However, it has been known, that two or three years old geese demonstrate a higher egg fertility compared with one year old birds. In the Bíloraj geese (Puchajda, 1991) the respective figures were 75.3–90.7% (two years old), and 54.5–79.7% (one year old). Similarly Bielinski and Rosiński (1988) investigated the effect of age on reproduction

Table 3. Percentage of hatched goslings from fertilized eggs in the control and parental flocks of geese of WD-1 and WD-3 strains from the years 1987–1992

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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>CV</td>
<td>x</td>
<td>CV</td>
<td>x</td>
<td>CV</td>
</tr>
<tr>
<td>WD-1</td>
<td>control</td>
<td>76,0</td>
<td>9,0</td>
<td>74,8</td>
<td>5,9</td>
<td>72,9</td>
<td>3,7</td>
<td>76,6</td>
</tr>
<tr>
<td>WD-3</td>
<td>control</td>
<td>70,0</td>
<td>12,3</td>
<td>70,9</td>
<td>12,1</td>
<td>69,9</td>
<td>7,3</td>
<td>70,8</td>
</tr>
<tr>
<td>WD-1</td>
<td>parental</td>
<td>76,4</td>
<td>13,9</td>
<td>78,4</td>
<td>7,8</td>
<td>75,9</td>
<td>11,8</td>
<td>78,5</td>
</tr>
<tr>
<td>WD-3</td>
<td>parental</td>
<td>70,7</td>
<td>18,4</td>
<td>72,1</td>
<td>11,2</td>
<td>70,3</td>
<td>17,4</td>
<td>74,1</td>
</tr>
</tbody>
</table>

Statistical differences between genotypes are marked:

a, b – p < .05
A, B – p < .01

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results in the White Italian geese and found higher by 10–12% egg fertility in two years old birds. Experimental findings in our study can be explained by the management systems — in groups with one year old birds and in the harem system with two years old ones. In an earlier study Rosiński et al. (1986) found that the fertility level was higher in groups than in the harem system, due to a free mating of females and males during reproduction. A significant role of the behavioral factors in goose reproduction was reported by ROHVER and ANDERSON (1988) and ROSINSKI (1986).

The percentage of fertile eggs in the strain WD-1 was higher, in general, than in the WD-3 strain, particularly in the parental populations. Selection being carried out over five years period, in each of the strain for different traits, has not changed that tendency. It has to be stressed, however, that in the parental populations the difference in egg fertility (9.9%) between strains diminished, particularly due to a lower egg fertility in WD-1 strain and reached 4.9% after five years of selection work. ROUVIER et al. (1990) reported that in Landaise geese the selection for increasing number of goslings per layer resulted in a decrease of fertility percentage (regression coefficient: -2.6 per generation).

In our own study it is worth to emphasize that in WD-1 strain being selected for reproductive traits, the percentage of early embryonic mortality demonstrated no major changes in the successive years. Unlike in the WD-3 strain selected for meat yield, that trait was found to increase by more than 0.6% per year, on the average. The embryonic mortality till the sixth day of incubation was in the paternal WD-3 strain significantly higher than that in the maternal WD-1 strain. Similarly PINGEL et al. (1992) pointed to higher hatching losses, particularly the early embryonic mortality in the male lines selected for high body weight. Early embryonic mortality can be caused, in part, by chromosomal abnormalities. VAGT (1988), after PINGEL et al. (1992) reported that a heavy line of ducks showed a high (8.2%) percentage of chromosomal abnormalities compared with a light line (5.6%).

The mortality of waterfowl embryos in the late stage of incubation is associated, most frequently, with hatching egg quality and incubation technique (BEDNARCZYK, 1988). A significant role is played by adequate adjustment of setter microclimate to the quality features of hatching eggs. CHRISTENSEN and McCORKLE (1982) found that the late embryonic mortality was associated with low shell permeability, insufficient for an adequate gas exchange. The authors suggested that the egg weight is increasing at a higher rate than shell permeability. BEDNARCZYK et al. (1985) demonstrated the relationships between the weight of goose hatching eggs, egg weight loss during incubation and hatching results. The non-hatched goslings of the White Italian breed were found in the eggs of the highest mean weight. The cause of a higher mortality in the later stages of embryogenesis in the WD-3 strain could be the higher egg weight of that strain, compared with WD-1 strain (ROSINSKI et al., 1995). Undoubtedly the interpretation given above does not explain all causes since in our own study the percentage of non-hatched embryos diminished in both strains in the successive years (negative values of regression coefficients).
The demonstrated above difference between strains in embryonic mortality in the particular incubation periods brought about significantly better hatching results of goslings from fertilized eggs in the WD-1 strain.

**Summary**

The purpose of study was an analysis of hatching results of differently selected strains: WD-1 (selection for reproduction traits) and WD-3 (selection for meat yield) of the White Italian breed of geese. During the five years period 312,029 hatching eggs of WD-1 strain and 146,683 hatching eggs of WD-3 strain, both egg groups from control populations (one year old birds) and parental populations (two years old birds) were analysed. Genotype was found to affect egg fertility which was better in strain WD-1 than in WD-3 strain, and attained 71.7% to 80.1% and 69.0% to 78.4%, respectively. Genotype also influenced embryonic mortality during incubation and hatching results of goslings from fertilized eggs. Percentage of early embryonic mortality was in WD-1 strain significantly lower (6.0–6.3) in comparison with WD-3 strain (7.6–7.7) and demonstrated no significant changes in the five years period studied. In WD-3, however, that percentage was increasing regularly by 0.6% per year, on the average. Similarly embryonic mortality at the later age (7–25 and 26–31 days), and percentage of crippled and weak goslings was significantly lower in WD-1 strain. Regardless of genotype, the percentage of non-hatched embryos (26–31 days) was decreasing in the successive years (regression coefficient −0.99 to −1.27). Mean percentage of hatched goslings from fertilized eggs attained in WD-1 strain 76.0–77.5, and in WD-3 strain 71.1–72.3.

**Zusammenfassung**

Einfluß des Genotyps auf die Schlupffähigkeit von Gänse- 

A. Rosiński und M. Bednarczyk

Zwei Stämme der Gänserasse Weiße Italiener: WD-1 (selektiert auf Reproduktionserfolgsmerkmale) und WD-3 (selektiert auf Fleischcharakter) wurden im Bezug auf Schlupfergebnisse untersucht. Daten über 312029 Bruteier vom Stamm WD-1 und über 146683 Bruteier vom Stamm WD-3, beide Eiergruppen von einjährigen Kontrollpopulationen und zwei- jährigen Elterntierpopulationen, wurden gesammelt und analysiert. Es wurde festgestellt, daß der Genotyp die Befruchtung der Eier beeinflußte. Sie lag höher im Stamm WD-1 (71,7–80,1%) als im Stamm WD-3 (69,0–78,4%). Der Genotyp hatte auch einen Einfluß auf die Zahl der während der Brut abgestorbenen Embryonen sowie auf den Brutverlust (Kückenzahl der befruchteten Eier). Der Prozentsatz der früh abgestorbenen Embryonen lag im Stamm WD-1 signifikant niedriger (6,0–6,3) als im Stamm WD-3 (7,6–7,7), die Veränderungen über die fünfjährige Versuchsperiode waren statistisch nicht signifikant. Im Stamm WD-3 stieg jedoch dieses Merkmal regelmäßig um 0,6% pro Jahr in Durchschnitt. Gleicherweise war der Prozentsatz der später abgestorbenen Embryonen (nach 7–25 und 26–31 Tagen) sowie der lahm und schwachen Gänseküken signifikant kleiner im Stamm WD-1. Unabhängig vom Genotyp, verringerte sich der Prozentsatz der nicht ausgeschlüpften Gänseküken (26–31 Tage) in den aufeinander folgenden Jahren (Regressionsskoeffizient −0,99 bis −1,27). Der Prozentsatz der aus den befruchteten Eiern ausgeschlüpften Gänseküken betrug durchschnittlich 76,0–77,5 im Stamm WD-1 und 71,1–72,3 im Stamm WD-3.

**Stichworte**

Gans, Genotyp, Fruchtbarkeit, Kunstbrut, Schlupfergebnis

**References**


ROSIŃSKI, A., KŁOSOWSKA, S., SŁABKA-BŁOTNICKA, T., WĘŻYK, S., KJOWSKI, J., 1994: Badania nad metodami
Untersuchungen zur Leberfunktion während und nach der Zwangsmast bei Entenbastarden (Cairina moschata × Anas platyrhynchos)

Investigations about liver function carried out with mule ducks (Cairina moschata × Anas platyrhynchos) during and after cramping (forced feeding)

D. Prehn¹, T. Bengone-Ndong², G. Benard², P. Benard², F. Grimm¹

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Einleitung


Heute wird dieses Verfahren hauptsächlich noch in Frankreich und dort vorwiegend im Südwesten sowie im Elsass zur Erzeugung von Stopp- oder Fettlebern durchgeführt. Daneben werden große Mengen Geflügelfettleber in Israel, Ungarn, Polen, der Tschechischen und der Slowakischen Republik produziert.

Die Weltproduktion an Geflügelfettleber beträgt etwa 9000 t bis 10000 t jährlich. Bei einem angenommenen Preis von DM 100,00 pro kg Fettleber, beträgt allein der Umsatz für die Fettlebern etwa 1 Mrd. DM, zuzüglich der Erlöse aus der Schlachtungswirtschaft. Es handelt sich also bei der Mastleber des Wassergeflügels nicht um ein Marginalprodukt, sondern um einen bedeutenden Wirtschaftszweig der französischen Landwirtschaft.

Heute werden zur Mastleberproduktion hauptsächlich Entenbastarde herangezogen. Grund dafür sind die arbeitswirtschaftlichen Vorteile (Enten müssen im Gegensatz zu Gänsen lediglich zweimal täglich und außerdem nur etwa 1–2 Wochen gestopft werden) sowie die Tatsache, daß Enten je kg verabreichtem Mais mehr Fett in die Leber einlagern (1).


In der nahen Vergangenheit ist die Mastleberproduktion wieder Gegenstand der Diskussion auf europäischer Ebene geworden. In Deutschland ist das Stopfen von Zwangs- masten von Geflügel nach § 3 Absatz 9 TschG verboten, was in anderen Ländern der EU nicht der Fall ist. Des weiteren wurde auch die Verkehrsähnlichkeit dieses Organs aus lebensmittelhygienischer Sicht in Frage gestellt.

Aus diesem Grund sollte die Stoffwechselsituation der Entenleber während und nach der Zwangsmast untersucht werden.