EFFECT OF THE SEX RATIO ON THE EGG FERTILITY OF MUSCOVY DUCK (CAIRINA MOSHCATA)
ВЛИЯНИЕ НА ПОЛОВОТО СЪОТНОШЕНИЕ ВЪРХУ ОПЛОДЕНОСТТА НА ЯЙЦАТА ПРИ МУСКУСНА ПАТИЦА (CAIRINA MOSHCATA)

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ABSTRACT

Study was carried out for establishing the optimal sex ratio in Muscovy duck breeding. Four variants of the ratio of the male to the female individuals were tested: 1:5(I), 1:6(II), 1:7(III) and 1:8(IV). In the frames of each sex ratio (variant), two subgroups (sub-variants) were formed with the aim of establishing the effect of the hierarchy relations among the drakes on egg fertility: with one male in a group (A) and with more than one male in a group (B).

The highest egg fertility – 97.09 % was achieved at 1:5 sex ratio (with more than one drake in a group) and the lowest – 93.41 % at 1:8 sex ratio (with a single male in a group).

Significant decrease in egg fertility was registered when increasing the sex ratio to 1:8, that effect being displayed more weakly at more than one male in the group. When increasing the ratio, the presence of more than one drake in the family group exerted a positive influence on egg fertility, due to the preference of the males to certain females and the distribution of the rest of the females among the drakes placed in the hierarchy below the "alpha", depending on their grade in the hierarchy order.

The most appropriate sex ratio for Muscovy duck species was 1:5, and, when there was shortage of the male reproduction material, 1:6 ratio was also acceptable, especially if more than one drakes were placed in the family group (effect of supporting the alpha).

KEY WORDS: Muscovy duck, sex ratio, hierarchial relations

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DETAILED ABSTRACT

Установяването и поддържането на оптимално полово съотношение при отглеждането на селскостопанските птици влияе по два основни начина върху икономическия резултат на птицевъдството – чрез постигането на максимална оплоденост на яйцата и чрез броя на отглежданите мъжки разплодници.

Оптимизирането на половото съотношение играе голяма роля за постигане на максимална оплоденост на яйцата, особено в случаи като този, когато живата маса на мъжките индивиди превъзхожда значително масата на женските. In that relation the most often sex ratio applied in breeding of the Muscovy duck species was 1:5 and, secondly, 1:4. В тази връзка най – често прилаганото полово съотношение при вида Мускусна патица е 1:5 ([1], [10], [11], [12]), и на второ място- 1:4 ([7], [8], [13]). За по- широко полово съотношение съобщават Wang and Xu (1989) [16], които са експериментирали при този вид водоплаващи полово съотношение от 1:4.3 до 1:10 и са получили оплоденост на яйцата от 75.9 до 94.6 %.

С настоящото проучване си поставихме за цел да установим в каква степен разширяването на половото съотношение при развъждане на вида Мускусна патица не влияе отрицателно върху оплодеността на яйцата, както и влиянието на йерархическите взаимоотношения между мъжките разплодници върху този признак.

Проучванията по настоящия труд се проведоха през 2002 г. в частно стадо, с 320 едногодишни носачки от вида Мускусна патица (White variety), разделени в зависимост от половото съотношение в четири експериментални групи, всяка от които на две подгрупи (подварианти) по следната схема:

Разделянето на всяка от четирите основни групи на две подгрупи се наложи от втората цел на проучването – отчитане влиянието на йерархическите взаимоотношения между мъжките разплодници върху оплодеността на яйцата.

Всички така сформирани 8 подгрупи се отглеждаха при екстензивна система на производство, в полуоткрита сграда, при гъстота 2 птици/m², като групите с по един паток в рамките на всяко полово съотношение се разделяха, а тези, с повече от един, се отглеждаха заедно.

 Най-висока оплоденост на яйцата за репродуктивния период е установена при полово съотношение 1:5 - 97.09 % (при повече от един мъжки разплодник в група), а най – ниска при 1:8 - 93.41 % (един мъжки разплодник в група).

Достоверно понижение в оплодеността на яйцата (93.41 %) се наблюдава при разширяване на половото съотношение на 1:8, като този ефект е по- слабо изразен при повече от един мъжки разплодници в групата.

С разширяване на половото съотношение, наличието на повече от един мъжки в група играе положителна роля върху оплодеността на яйцата поради разпределянето на непредпочетените женски от патоците-"алфи" между по- нискостоящите в йерархията мъжки индивиди.

Най-подходящото полово съотношение при вида Мускусна патица е 1:5, като при дефицит на мъжки разплоден материал е напълно приемливо и съотношение 1:6, особено ако в една семейна група се поставят повече от един патока (ефект на подпомагане на алфата).

INTRODUCTION

Establishing and maintaining the optimal sex ratio in agricultural poultry raising affect the economic results of poultry breeding in two ways: by achieving maximal egg fertility and by the number of the drakes raised.

One of the characteristics of the Muscovy duck is the obviously expressed sexual dimorphism in the live weight. According to data of Stevens & Sauveur (1985) [15] it was reported as early as the 10-day age of the ducklings and according to Gerzilov (1999) [4] – at 3-4 weeks of age. After the 10th-12th week the live weight of the female ducklings was only about 65 % of the male ([2], [15], [11]). The male individuals, which had completed their growthp reached 4.500 – 5.000 kg and over, while the females – hardly up to 2.200 - 3.000 kg [9]. That fact reflected on the necessity of bigger amounts of nutrient substances for maintaining life. Thus, during the reproductive period the Muscovy drake consumed about 250 – 280 g and during the non-reproductive period – about 200 g of combined forage daily, which was twice more compared to the daily consumption of the female individuals ([6], [13], [14]).

Optimizing the sex ratio played an important role for achieving the maximal egg fertility especially in cases, when the live weight of the male individuals significantly surpassed that of the female ones. In that relation the most often sex ratio applied in breeding of Muscovy duck species was 1:5 ([1], [10], [11], [12]), and, secondly - 1:4 ([7], [8], [13]). Wang and Xu (1989) [16] mentioned about bigger ratio, experimenting sex ratios from 1:4.3 to 1:10 for waterfowl species, obtaining egg fertility from 75.9 to 94.6 %.

The aim of the present study was to establish to what extent the increased sex ratio in breeding Muscovy duck

species did not affect negatively the percentage of egg fertility, as well as the effect of the hierarchial relations among the male individuals on that characteristic.

MATERIAL AND METHODS

The experiments described in the present paper were carried out in 2002 in a private herd with 320 one-year old layers of Muscovy duck species (White variety), distributed according to the sex ratio in four experimental groups, each of them split into two subgroups (sub-variants), following the scheme (Table 1).

Splitting each of the four major groups into two subgroups was necessitated by the second aim of the study, i.e. to follow up the effect of the hierarchial relations among the drakes on egg fertility.

All the formed 8 subgroups were bred applying the extensive production system in a semi-open building at a density of 2 ducks/m^2. The groups with a single drake in the frames of each sexual ratio were separated and those with more than one male were bred together. All the year round the ducks had an unlimited access to grassy yards without water ponds, at a density of 1 duck/m^2. During the reproduction period they were fed on combined forage based on cereals, soya and sunflower groats and additives containing 12 MJ of metabolizable energy (ME) and 16.0 % of crude protein.

All the eggs laid before and after the laying peak were included in the studies, as well as by 500 eggs from each subgroup, laid during the peak. Egg fertility was reported in a private hatchery using ovoscoping methods on the 9th day of the embryonic development.

RESULTS AND DISCUSSION

Table 2 presents data about the fertility of the Muscovy duck eggs depending on the sex ratio. In all the experimental groups the studied characteristic reached the highest values in the laying peak, the difference between the laying periods within the group being significant only in the subgroups of the first major group, at sex ratio of 1:5 ($p<0.05$). In all the other cases the difference was below or not more than 1 %. It means that egg fertility for that waterfowl species was hardly affected by the laying period. The conclusion mentioned was also confirmed by previous studies of the author (Nickolova, 2003).

At all the phases of egg laying the differences between subgroups A and B in the same sex ratio were within the limits of about 0.5 % in average and they were statistically insignificant, however, they were in favour of the groups with more than one drake. The tendency was most obvious for the biggest sex ratio and in the period of the laying peak. It could be explained by the big number of ova to be fertilized in the phase of the laying peak and the big number of females per male in subgroups A.

At the same time the bigger number of males in the group (subgroups B) in the frames of the sex ratio had a positive effect on egg fertility because the females not preferred by the "alpha" drakes, were distributed among the males placed lower in the hierarchy. What is more that distribution of the females was a result of three factors: personal preferences of the male to certain ducks (they

Table 1. Scheme of experiment

Sex ratio	I (1:5)		II (1:6)		III (1:7)		IV (1:8)	
	A (1♂+5♀)	B (3♂+15♀)	A (1♂+6♀)	B (3♂+18♀)	A (1♂+7♀)	B (3♂+21♀)	A (1♂+8♀)	B (3♂+24♀)
Number of groups	8	2	7	2	6	2	5	2
Number of females	40	30	42	36	42	42	40	48

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the negative effect of the more ducks per drake and the preferences of the male to a certain number of the females was reported. As a result of that the "non-preferred" females were more rarely fertilized and egg fertility was maintained lower.

In the second case (subgroups B), the females non-preferred by the "alphas", were distributed among the drakes of the lower order and, most probably, they remained non-fertilized for not more than 3 – 5 days. That explained the better results in subgroups B in the frames of one and the same sex ratio. We think that effect is only possible when there are enough area for the waterfowls. The results discussed below confirm that assumption.

In the subgroups with a single drake in the period of egg laying peak the reported egg fertility was practically one and the same at sex ratios 1:5 and 1:6 – 95.84 and 95.81 %, respectively. The reduction by about 0.96 %, at sex ratio of 1:7, was mathematically proven. Just when the sex ratio increased to 1:8, a significant decrease of the values of that characteristic was reported: by 3.14 – 3.11 % compared to the first (p<0.05) and to the second (p<0.05), and, by 2.18 % compared to the third group. In the subgroups with more than one drake in the same laying period the highest egg fertility was registered in the second group - 96.53 %. Here also the differences of the values were small and statistically insignificant, with an exception of the difference between second and fourth groups (p<0.05).

At the egg laying peak the highest percentage of fertile eggs was obtained at male to female sex ratio of 1:5, the difference between the subgroups in the frames of the sex ratio being insignificant, but also in favour of the second subgroup - 98.37 versus 97.93 %. The same tendency was reported in the rest of the experimental groups, the most obvious being in the fourth group - 94.82 versus 93.78 %. Statistically significant differences between the values were established between the first subgroups at sex ratios of 1:5 and 1:7 (p<0.05), and, at 1:5 and 1:8 (p<0.001), as well as between the second subgroups in the frames of the same sex ratios: p<0.05 at 1:5 and 1:7, and p<0.01 at 1:5 and 1:8.

After the egg laying peak the percentage of egg fertility was very close for the separate subgroups in the frames of the same sex ratio, varying between 96.64 % in subgroup B of the first major group and 93.29 % in subgroup A of the fourth major group. The slight differences between the subgroups at the different sex ratios during that laying period could be explained by the decreasing number of eggs to be fertilized. Mathematically proven differences between the values of that characteristic were detected between the respective subgroups at sex ratios 1:5 and

formed a family together), the individual potency of the drake and its place in the hierarchial order in the group.

Consequently, in the subgroups with a single male the selection was artificially induced by the breeder with an experimental purpose, while in the subgroups of more than one male a natural selection was established in the frames of the group, resulting from the interaction of the three factors listed above.

In the first case of a bigger sex ratio (subgroups A),

Table 2. Muscovy duck egg fertility (%) depending on the sex ratio

Group	I		II		III		IV	
Sex ratio	1:5		1:6		1:7		1:8	
	A (1♂+5♀)	B (3♂+15♀)	A (1♂+6♀)	B (3♂+18♀)	A (1♂+7♀)	B (3♂+21♀)	A (1♂+8♀)	B (3♂+24♀)
up to egg laying peak	95.84 c1 *	96.18 *	95.81 c2	96.53 c3	94.88	95.33	92.70 c1c2	93.55 c3
at egg laying peak	97.93 a1c3 *	98.37 b1c4 *	96.84	97.21 c3	95.05 c3	95.95 c4	93.78 a1	94.82 b1
after egg laying peak	96.08 c4	96.64 c5	96.23	96.78	94.70 c4	94.82	93.29 c4	93.85 c5
for the whole laying period	96.78 b1	97.09 b2c1	96.17	96.58	94.56	95.00 c1	93.41 b1	94.15 b2

Differences were significant at: a, *** - p<0.001; b, ** - p<0.01; c, * - p<0.05.

1:8 ($p < 0.05$).

CONCLUSIONS

1. The highest egg fertility for the reproductive season was established at sex ratio of 1:5 - 97.09 % (for more than one male in the group) and the lowest – at 1:8 - 93.41 % (one male in the group).

2. Significant decrease in egg fertility (93.41 %) was reported at increasing the sex ratio to 1:8, the effect being slightly expressed at more than one drake in the group.

3. At increasing the sex ratio the presence of more than one male in the group played a positive role on egg fertility due to the distribution of the females non-preferred by the "alpha" drakes among the males placed lower in the hierarchy.

4. The most appropriate sex ratio for Muscovy duck species is 1:5, and, when there is a shortage of male reproduction material, 1:6 ratio is also admissible, especially when more than one drake are included in the family group (an effect of helping the alpha).

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