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EFFECT OF BODY WEIGHT OF LAYING HENS ON PRODUCTION TRAITS OF BROILER PARENTS

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Abstract: Certain investigations have been conducted in two broiler breeder flocks of Ross 308 and Cobb 500 hybrids. At the beginning of the production cycle (24 weeks of age), an average laying hens' body weight of 2680.40 g was found in the case of Ross 308 hybrid, and 2697.80 g in the case of Cobb 500 hybrid. During 42nd week of age (the middle of the production cycle), the body weight of laying hens was 3565.10 g (Ross 308) and 3599.05 g (Cobb 500), while at the end of the production cycle (61 weeks of age) the body weight of laying hens of Ross 308 hybrid was 3841.50 g, and 3850.00 g of Cobb 500. Identified differences in body weight of laying hens (17.40 g, 33.95 g, 8.50 g) in certain periods of the production cycle, as well as the difference in body weight of laying hens for the entire production cycle (23.26 g) were not statistically significant (P>0.05). More specific observation of the effect of body weight of laying hens on productive capacity of broiler breeders was determined by calculating the coefficients of phenotype correlation between the indicators studied. Thus, statistically significant (P<0.001, P<0.01, P<0.05) coefficients of phenotype correlation between the body weight of laying hens and the majority of production indicators have been determined, while statistically significant (P<0.001, P<0.01, P<0.05) correlation coefficients between the body weight of laying hens and the intensity of laying capacity for hatching and fertilized eggs have been determined, but for a shorter period of the production cycle.

Keywords: Laying hens, body weight, production traits, broiler breeders, correlation

Introduction

In addition to the age and optimal sex ratio, the body weight of laying hens during the production cycle also significantly influences the productive capacities of broiler breeders (*Savic et al., 2004; Đermanović et al., 2005; Đermanović et al., 2008; Djermanovic et al., 2009; Djermanovic, 2010; Đermanović et al., 2010;*

Đermanović et al., 2012; Mitrovic et al., 2005; Mitrovic et al., 2009; Mitrovic et al., 2010; Mitrovic et al., 2011; Pandurevic et al., 2013). Proper hormonal functioning of the endocrine system of the laying hens in addition to their age and photostimulation (*Lewis et al., 2005; Lewis and Gous, 2006, 2007; Usturoi et al., 2007*) depends very much on the physical development of breeding birds. When the body weight is optimal at the certain age, the function of the ovaries is stimulated, and hence the maturation of the ovum, i.e. the production of eggs is accelerated.

Only proper nutrition and technology of exploitation of the parent flock can provide the precondition for the necessary vitality and quality of eggs for incubation (*Suarez et al., 1997; Sahin et al., 2009*). In order to make the production of fertilized eggs last for a long time period, it is necessary to constantly keep hens in breeding condition, paying particular attention to their physical development. It should also be borne in mind that the uniformity of the flock in terms of weight is especially significant factor in the second half of the production cycle.

In the case of the majority of heavy line hybrids, the production of eggs for the purpose of incubation starts at the 24th week of age, when the intensity of laying capacity is about 5% and more. From this period on, the egg production gradually increases to the maximum, and then the productivity of broiler breeders decreases more or less. Therefore, we can say that the period of exploitation of broiler breeders significantly depends on that time period. As an indicator for estimation of the period up to which it is justified to use broiler breeders in the production of hatching eggs, the calculated coefficients of phenotype correlation between body weight and productive traits of laying hens in the final period of the production cycle, which represents a turning stage in the utilization of parent flocks, can make a significant contribution.

Material and Methods

The studies cover two parent flocks of broiler breeders of Ross 308 and Cobb 500 heavy hybrids. During the production cycle, the technology suggested by the breeders of the respective hybrids was used. Broiler parents of both flocks were kept on floor in deep litter, and feeding, watering, ventilation and lighting were automatically regulated. The studied flocks were grown up to 61st week of age, i.e. both flocks began to lay eggs at the beginning of the 22nd week, and the eggs laid from the 24th week of age, and later, until the end of the production cycle were used for incubation, because in that period they satisfied a minimum weight suitable for incubation (>50.00 g). The presented results indicate that the egg production period lasted for 38 weeks.

The total of 5200 birds of both sexes of Ross 308 hybrid and 5430 birds of broiler parents of Cobb 500 hybrid, reared in two separate buildings, were used as the initial experimental material. 4750 ♀ and 450 ♂ birds of Ross 308 hybrid were placed in the first building, and another 4960 ♀ and 470 ♂ of Cobb 500 hybrid in the second one, so that the sex ratio was 1 : 10.56 (Ross 308) and 1 : 10.55 (Cobb 500). In the preparatory period between 21st and 24th week of age of flock, mortality and culling of the laying hens of the hybrid Ross 308 was 13 birds (0.279 %), and in the case of the Cobb 500 hybrid, it was 12 birds (0.24 %). This means that there were 4737 laying hens in the flock of broiler parents of Ross 308 hybrid, i.e. 4948 laying hens of Cobb 500 hybrid, at the beginning of the use of eggs for incubation.

In order to control body weight, 200 laying hens of Ross 308 and Cobb 500 hybrids, selected randomly, were weighed individually every week. By the means of these measurements, the uniformity of laying hens of the tested flocks was observed in the production cycle, after which the effect of the weight of the laying hens on the productive parameters of the broiler parents was examined: the intensity of laying capacity for hatching eggs (%), the intensity of laying capacity for fertilized eggs (%), egg weight (g), daily consumption of food per bird (g/day), food consumption per hatching egg (g/egg) and food consumption per fertilized egg (g/egg). Primary data processing was performed using variation - statistical methods, and testing of the difference between hybrids was done using the t -test. In addition, the obtained results were used to calculate the correlation of the tested characteristics per week of production in the last third of the production cycle, i.e. from 50th to 61st week of age, using the correlation analysis. Statistical data processing was performed using the software program SAS/STAT (*SAS Institute, 2000*).

Results and Discussion

The average values, variability and significance of differences in body weight of laying hens during certain periods of the production cycle, as well as for the entire egg production period, are shown in Table 1.

Table 1. The average values, variability and significance of differences in body weight of laying hens (g) at certain periods of the production cycle (*Pandurevic et al., 2013*)

Production cycle period	Weeks of age (production)	Hybrid	$\bar{x}$ ±SEM	S	$\bar{d}$
Beginning	24 (1)	Ross 308	2680.40±14.63	206.93	17.40^{ns}
		Cobb 500	2697.80±17.09	241.66	
Middle	42 (19)	Ross 308	3565.10±19.86	280.92	33.95^{ns}
		Cobb 500	3599.05±20.12	275.28	
End	61 (38)	Ross 308	3841.50±21.39	302.56	8.50^{ns}
		Cobb 500	3850.00±21.68	306.59	
Entire production cycle	61 (38)	Ross 308	3411.15±61.58	394.33	23.26^{ns}
		Cobb 500	3434.41±61.03	390.76	

^{ns} P>0.05.

The data in Table 1 show that the average body weight of laying hens of each hybrid was gradually increasing during the production cycle. Body weight of hens at 24th week was 2680.40 g (Ross 308) and 2697.80 g (Cobb 500), and at the end of exploitation, it was 3841.50 g in the case of Ross 308 and 3850.00 g in Cobb 500 hybrids. During the production cycle, laying hens of Cobb 500 hybrid compared to the hens of Ross 308 hybrid had a higher average body weight which was not statistically confirmed ($P<0.05$). The average body weight of laying hens of Ross 308 hybrid for the entire period of exploitation was 3411.15 g, and of Cobb 500 hybrid, it was 3434.41 g, where the difference in body weight between the laying hens (23.26 g) of the studied hybrids was not statistically significant ($P>0.05$), indicating that genotype had no significant effect on body weight of laying hens.

Body weight of lying hens of the studied hybrids was slightly higher than the norms predicted by the genetic potential. *Djermanovic et al. (2009), Djermanovic (2010), Mitrovic et al. (2010)* and *Pandurevic et al. (2013)* came to the similar results, in terms of average body weight of laying hens. *Usturoi et al. (2007)*, in the course of rearing of broiler parents of Ross 308 hybrid, found slightly lower average body weight of laying hens, which, depending on the groups of hens, varied between 3988.95 g and 3990.44 g in the 60th week of age. *Lewis et al. (2005)* and *Lewis and Gous (2006)*, in the 60th week of age of Cobb 500 laying hens, found a significantly higher average body weight of laying hens, between 4.21 and 4.25 kg, while *Lewis and Gous (2007)*, in the 59th week of age, found a significantly higher average body weight of laying hens of hybrids Ross 308 (4.43 kg) and Cobb 500 (4.56 kg).

In addition to the established measures of variation in body weight of laying hens belonging to the analyzed parent flocks, and in order to better analyze the impact of body weight of laying hens on productive performances, the coefficients of phenotypic correlation relationship between the examined traits in the last third of the production cycle (Table 2) were calculated.

Table 2. Phenotypic correlation relationship between body weight of lying hens and productive traits

Age (weeks)	Hybrid	BW, g	Coefficients of phenotypic correlation					
			r_1	r_2	r_3	r_4	r_5	r_6
50	Ross 308	3685.50	0.617^{***}	0.618^{***}	0.989^{***}	0.763^{***}	-0.643^{***}	-0.644^{***}
	Cobb 500	3710.00	0.663^{***}	0.662^{***}	0.989^{***}	0.797^{***}	-0.658^{***}	-0.659^{***}
51	Ross 308	3703.50	0.580^{***}	0.581^{***}	0.992^{***}	0.749^{***}	-0.625^{***}	-0.627^{***}
	Cobb 500	3722.00	0.633^{***}	0.632^{***}	0.994^{***}	0.792^{***}	-0.642^{***}	-0.643^{***}
52	Ross 308	3710.50	0.539^{**}	0.540^{**}	0.991^{***}	0.743^{***}	-0.605^{***}	-0.607^{***}
	Cobb 500	3732.50	0.603^{***}	0.602^{***}	0.994^{***}	0.788^{***}	-0.626^{***}	-0.628^{***}
53	Ross 308	3743.00	0.499^{**}	0.499^{**}	0.989^{***}	0.732^{***}	-0.585^{***}	-0.586^{***}
	Cobb 500	3755.00	0.570^{***}	0.569^{***}	0.993^{***}	0.786^{***}	-0.608^{***}	-0.610^{***}
54	Ross 308	3754.00	0.459^{**}	0.458^{**}	0.989^{***}	0.727^{***}	-0.563^{***}	-0.564^{***}
	Cobb 500	3767.50	0.535^{***}	0.534^{***}	0.992^{***}	0.785^{***}	-0.589^{***}	-0.590^{***}
55	Ross 308	3770.00	0.410^{**}	0.411^{**}	0.987^{***}	0.708^{***}	-0.538^{***}	-0.541^{***}
	Cobb 500	3777.50	0.495^{**}	0.494^{**}	0.991^{***}	0.786^{***}	-0.567^{***}	-0.568^{***}
56	Ross 308	3782.50	0.349^{*}	0.347^{*}	0.986^{***}	0.673^{***}	-0.507^{**}	-0.509^{**}
	Cobb 500	3792.50	0.451^{**}	0.450^{**}	0.991^{***}	0.790^{***}	-0.540^{***}	-0.541^{***}
57	Ross 308	3797.00	0.293^{*}	0.291^{*}	0.988^{***}	0.624^{***}	-0.480^{**}	-0.481^{**}
	Cobb 500	3805.00	0.402^{**}	0.401^{**}	0.991^{***}	0.792^{***}	-0.509^{**}	-0.509^{**}
58	Ross 308	3805.50	0.232^{ns}	0.230^{ns}	0.986^{***}	0.562^{***}	-0.447^{**}	-0.448^{**}
	Cobb 500	3812.50	0.347^{*}	0.346^{*}	0.989^{***}	0.792^{***}	-0.473^{**}	-0.473^{**}
59	Ross 308	3812.50	0.174^{ns}	0.172^{ns}	0.985^{***}	0.486^{**}	-0.415^{**}	-0.416^{**}
	Cobb 500	3825.00	0.278^{ns}	0.277^{ns}	0.987^{***}	0.790^{***}	-0.419^{**}	-0.418^{**}
60	Ross 308	3827.50	0.110^{ns}	0.109^{ns}	0.983^{***}	0.429^{**}	-0.367^{*}	-0.368^{*}
	Cobb 500	3835.00	0.206^{ns}	0.205^{ns}	0.984^{***}	0.777^{***}	-0.355^{*}	-0.354^{*}
61	Ross 308	3841.50	0.046^{ns}	0.045^{ns}	0.986^{***}	0.376^{**}	-0.305^{*}	-0.307^{*}
	Cobb 500	3850.00	0.122^{ns}	0.122^{ns}	0.981^{***}	0.669^{***}	-0.272^{*}	-0.270^{*}

BW – Body weight (g). * $P<0.05$; ** $P<0.01$; *** $P<0.001$; ^{ns} $P>0.05$.
r_1 – Body weight of lying hens (g) x Intensity of the laying capacity for hatching eggs (%); r_2 – Body weight of the laying hens (g) x Intensity of the laying capacity for fertilized eggs (%); r_3 – Body weight of the laying hens (g) x Egg weight (g); r_4 – Body weight of laying hens (g) x Daily consumption of food per bird (g/day); r_5 – Body weight of laying hens (g) x Consumption of food per hatching egg (g/egg); r_6 – Body weight of laying hens (g) x Consumption of food per fertilized egg (g/egg).

Statistically significant ($P<0.001$; $P<0.01$; $P<0.05$) correlation relationship between the body weight of laying hens and the intensity of the laying capacity for hatching eggs, i.e. fertilized eggs in the case of Ross 308 hybrid has been determined by the 34th week of the production cycle (57 weeks of age), and in the case of Cobb 500 hybrid, it was determined by the 35th week of the production cycle (58 weeks of age). From that period until the end of the production cycle no statistically significant ($P>0.05$) correlation relationship has been determined between the examined parameters. However, the absolute correlation relationship ($P<0.001$) has been determined between the body weight of laying hens and the weight of eggs in both cases of the studied hybrids. During the production cycle, Cobb 500 hybrid

hens were consuming more food compared to the hens of Ross 308 hybrid, which indicates a statistically significant correlation relationship ($P<0.001$ - Cobb 500 and $P<0.001$, $P<0.01$ - Ross 308) between the studied parameters. Similar to the food consumption per bird, in both analyzed hybrids, food consumption per hatching and the fertilized egg was statistically significant ($P<0.001$, $P<0.01$, $P<0.05$) during the entire production cycle (Table 2).
In their researches, most of the authors dealt more with the effect of the age of laying hens on the productive indicators of broiler parents, and somewhat less with the effect of the body weight of laying hens. However, *Djermanovic et al. (2009), Djermanovic (2010), Djermanovic et al. (2012), Đermanović et al. (2005), Djermanovic et al. (2008), Djermanovic et al. (2010), Mitrovic et al. (2005), Mitrovic et al. (2009), Mitrovic et al. (2011), Sahin et al. (2009), Savic et al. (2004)* and *Suarez et al. (1997)* came to the similar, but also to the conflicting results, regarding the correlation relationship between body weight of laying hens and production indicators.

Conclusion

In comparison with the technological standards of the studied hybrids, the average body weight of the laying hens was also lower, both at the beginning and at the end of the production cycle. However, the differences between the body weights of laying hens belonging to both hybrids were not statistically significant ($p>0.05$), i.e. a genotype did not significantly affect the body weight of hens.
Based on the calculated coefficients of phenotypic correlations and their significance, it can be concluded that the body weight of laying hens significantly affected the production performances because in both cases of parent flocks, and for the entire production cycle, statistically significant ($P<0.001$, $P<0.01$, $P<0.05$) correlation coefficients have been determined between body weight of laying hens and the majority of the observed indicators, while for the shorter period, statistically significant ($P<0.001$, $P<0.01$, $P<0.05$) correlation coefficients have been determined between the body weight of laying hens and the intensity of the laying capacity for hatching and fertilized eggs. Based on the aforesaid, it can be seen that the productive capacity of laying hens decreases with the increase in body weight. Also, the aforementioned indicates that the increase in body weight of laying hens causes shortening of the production cycle than anticipated, i.e. the existence of the turning phase in the last third of the production cycle.

Uticaj telesne težine nosilja i proizvodnih osobina brojlerskih roditelja

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Rezime

Ispitivanja su sprovedena na dva jata brojlerskih roditelja hibrida Ross 308 i Cobb 500. Na početku proizvodnog ciklusa (24. nedelja starosti) kod hibrida Ross 308 utvrđena je prosečna telesna težina nosilja 2680.40 g, a hibrida Cobb 500 2697.80 g. U 42. nedelji starosti (sredina proizvodnog ciklusa) telesna težina nosilja iznosila je 3565.10 g (Ross 308) i 3599.05 g (Cobb 500), dok je na kraju proizvodnog ciklusa (61. nedelja starosti) telesna težina nosilja hibrida Ross 308 iznosila 3841.50 g, a Cobb 500 3850.00 g. Utvrđene razlike telesne težine nosillja (17.40 g, 33.95 g i 8.50 g) u određenim periodima proizvodnog ciklusa, kao i razlika u telesnoj težini nosilja za ceo proizvodni ciklus (23.26 g) nisu bile statistički signifikantne (P>0.05). Konkretnije sagledavanje uticaja telesne težine nosilja na proizvodne sposobnosti brojlerskih roditelja utvrđeno je izračunavanjem koeficijenata fenotipske korelacije između ispitivanih pokazatelja. Tako su između telesne težine nosilja i većine proizvodnih pokazatelja utvrđeni statistički signifikantni (P<0,001; P<0,01; P<0,05) koeficijenti fenotipske korelacione povezanosti, dok su između telesne težine nosilja i intenziteta nosivosti priplodnih i oplođenih jaja utvrđeni statistički signifikantni (P<0,001; P<0,01; P<0,05) koeficijenti korelacije, ali za nešto kraći period proizvodnog ciklusa.

Ključne reči: kokoši nosilje, telesna masa, proizvodne osobine, odgajivači brojlera, korelacija

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