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Laying Characteristics of One- and Two-year Old Pheasants (*Phasianus colchicus*, L.)

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The aim of the study was to assess laying traits, the weight of eggs and characters of the laying rhythm of pheasants in the first and second years of reproduction. Pheasants (10 cockerels and 50 hens) were kept in aviaries. Daily, individual control of laying was performed beginning with the day of the first laying and ending with the last egg. The following parameters were evaluated: age at first laying, length of the laying period, number of laid eggs and the average weight of the egg in the 8th week of laying. The laying rhythm was also assessed and comprised: the number of egg clutches, the number of eggs in a clutch, the number of eggs in the longest clutch, the number of intervals, the length of intervals and the longest interval between clutches. During the first period of reproduction, in comparison with the second, pheasants laid slightly more eggs of similar average weight. The first laying period was longer than the second and was characterised by a greater number of egg clutches and greater number of intervals between clutches. The greatest number of eggs was laid in 10-egg and longer clutches, although the 1-egg clutches were the most numerous. A positive correlation was found between the number of eggs and the number of clutches, the greatest number of eggs in a clutch and the number of intervals between clutches. The similar values of the reproductive characters of one- and two-year old pheasants point to the possibility of longer utilization of these birds than only for one laying period. On the other hand, the considerable variability between the experimental hens with regard to the number and the length of egg clutches, as well as the intervals between them, indicate the possibility to carry out selection taking into account traits characterising the laying rhythm.

Key words: Pheasant, egg, laying rhythm, reproduction.

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One of the most important factors affecting the profitability of pheasant rearing is their reproductive value, i.e. the number of eggs obtained from one layer and, consequently, the number of healthy chicks. Investigations carried out so far concerning the reproductive characters of these birds usually dealt with group evaluation (MARSHALY *et al*. 1983; LEDVINKA & MANDAK 1990; TORGOWSKI *et al*. 1990; TORGOWSKI & KONTECKA 1998). Individual assessment allows determining the variability among birds (LABISKY & JACKSON 1969; KRYSTIANIAK *et al*. 1999) and, therefore, makes selection possible. The knowledge of the laying rhythm of hens, which consists of clutches of usually several to more than ten eggs laid everyday separated from one another by one- to several-day long intervals (GUMUŁKA & KAPKOWSKA 1996), can also be helpful in the breeding work (SHELDON *et al*. 1984). Experiments on laying hens showed that with age the number of eggs in one clutch decreased and the interval between clutches lengthened (ROBINSON *et al*. 1990). In addition, FASENKO *et al*. (1992) reported a correlation between the succession of eggs in a clutch and the vitality of embryos and their development. Therefore, adequate knowledge of the course of laying in pheasants can be helpful in explaining unsatisfactory reproduction results. Few studies on this subject, carried out on pheasants, have been found in the literature (LABISKY & JACKSON 1969; BEKLOVA & PIKULA 1992). In addition, experiments confirming the conclusions of other researchers (SMITH *et al*. 1968; LABISKY & JACKSON 1969), which indicate good results in the utilization of two-year old pheasants, could find practical application, for example in utilizing these birds for more than one reproductive season.

The aim of this experiment was to assess laying, weight of eggs and characters of the laying rhythm of pheasants during the first and second year of reproduction and to determine variation between hens with reference to the examined characters.

Material and Methods

Experiments were carried out in two consecutive years during the reproductive season of pheasants (April – August) on a farm belonging to the Agricultural University in Poznań. No selection work had been conducted previously on the flock reared on this farm for many years. Birds for the reproductive season were chosen each year in such a way as to represent the mean weights of the flock and to prevent inbreeding. During winter, birds were fed exclusively wheat grain. From March 1st wheat was gradually replaced by complete diets which contained: 19.1 % crude protein and 11.7 MJ ME and 2.6 % calcium, so that by March 21st, it was the exclusive feed fed *ad libitum*. From among birds kept in winter aviaries, in February sixty birds (10 cockerels and 50 hens), characterised by appropriate conformation and body weight, similar to the flock average, were chosen and marked. Birds were placed in ten aviaries which allowed for the individual control of laying (Fig. 1). One aviary housed one cockerel and 5 hens. Females were separated from one another. In order to restrict their freedom of movement, the primary remiges were cut, while cockerels had complete freedom of movement and access to females which permitted natural mating. No lighting program was employed during the trial. At the termination of the first reproductive period, the birds were transferred back into winter aviaries in which they remained until the end of February when they were moved to aviaries allowing individual control of laying.

During two consecutive reproductive periods, daily, individual control of laying was carried out which began on the day when the first egg was laid and ended on the day when the last was laid. The following parameters were assessed: age at first laying, length of the reproductive period, the number of eggs laid during the entire reproductive season and the mean weight of eggs in the 8th week of laying. In addition, traits characterising the laying rhythm were analysed: the number of egg clutches, mean number of eggs in one clutch, the number of eggs in the longest clutch, the number of intervals between clutches, the mean interval length between clutches and the longest interval between clutches.

The significance of differences between the first and second reproductive period with regard to the examined characters was verified by the Student's *t*-test. In the case of irregular characters (length of the laying period, number of eggs, number of egg clutches, number of eggs in the longest clutch, number of intervals between clutches, the longest interval between clutches), the Student's *t*-test was preceded by data transformation by calculating the correction: x = log 10 y, where y = character value. Coefficients of phenotype correlations were calculated between the chosen reproductive characters and the laying rhythm jointly for one- and two-year old pheasants. The performed calculations were carried out with the assistance of the SAS® statistical package (v. 9.1).

Results

Pheasant hens laid their first egg, on average, on their 282.6 day of life (Table 1). In the group of

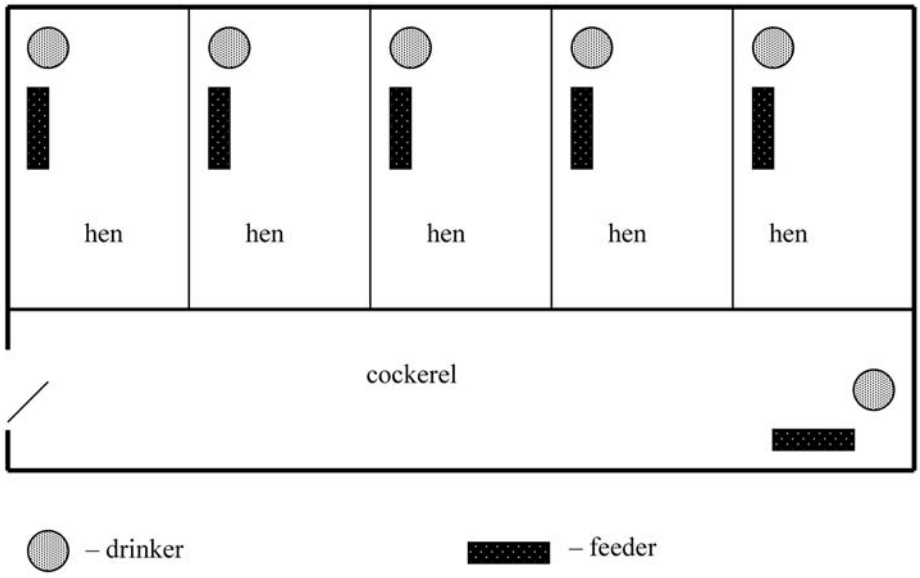

Fig. 1. Outline of the one aviary.

Table 1

Characteristics of reproductive traits and laying rhythm in pheasants during the first and second reproductive periods

Trait	Reproduction period							
	first				second			
	$\bar{x}$	CV	min	max	$\bar{x}$	CV	min	max
Age at first laying (days)	282.6	3.0	269	298	-	-	-	-
Length of the reproductive period (days)	109.3 *	16.0	25	127	88.3 *	31.2	1	123
No of eggs per 1 layer	71.4	28.9	5	96	61.2	38.9	1	107
No of egg clutches	20.9 *	30.1	4	34	17.1 *	35.6	1	28
No of eggs in clutches	3.4	37.5	1	7.3	3.7	43.2	1	7.8
The largest number of eggs in clutches	13.5	52.7	1	37	13.1	66.7	1	42
No of intervals	19.9*	31.6	3	33	15.9*	40.1	0	27
Length of interval (days)	2.2	81.8	1.1	12.0	2.1	83.2	0.5	11.5
The longest interval (days)	8.5 *	80.1	2	42	5.7 *	105.3	0	41
Egg weight in 8th week of laying (g)	29.4 *	8.8	18.8	33.9	30.5 *	8.3	25.6	39.8

* Means in rows are significantly different at $P \leq 0.05$.

one-year old hens, the first egg was laid between the 3rd and 16th of April, while in the group of two-year old hens – between the 1st and 24th of April. One-year old birds terminated laying between the 4th of May and 8th of August, while the two-year old hens – between the 20th of May and 3rd of August. The first laying period was significantly longer (by 21 days) than the second (Table 1). The longest laying period in the one-year old birds was longer only by 4 days than the same period in the two-year old birds. On the other hand, the shortest laying period lasted 25 and only 1 day, respectively in the one- and two-year old birds. High variability was found between laying hens with regard to the length of the laying period, especially during the second reproductive period (v = 31.2 %). In the first reproductive period, on average, 10.2 more eggs were obtained from one layer than in the second, although this difference was not confirmed statistically. During the first reproductive period, pheasants reached 16 % of laying in the first week, and in the second period – 30 % of laying during the first week (Fig. 2). In both reproductive periods, the laying peak occurred in the 4th week of laying and amounted to over 70 %. A rapid decrease in laying occurred from the 14th and from the 11th week, respectively, during the I and II reproductive periods. The mean weight of one egg in the 8th week of the first reproductive period was about 1.1 g lower ($P \leq 0.05$) than in the second period (Table 1).

The one-year old pheasants were characterised by a significantly higher (by 3.8) mean number of egg clutches than the two-year old birds (Table 1). On the other hand, an average of 3.6 eggs was recorded in both the first and second reproductive periods. The number of intervals between clutches in the first reproductive period was higher by 4 as compared to the second period. On the other hand, the longest interval between clutches was significantly longer by 2.8 days in the first than in the second period of reproduction. Both in the I and II periods of reproduction, pheasants were characterised by the highest number of 1-egg clutches (about 34.5 %; Fig. 3). However, the two-year old birds were characterised by a distinctly smaller number of 1-egg clutches and a higher number of 2-, 4- and 6-egg clutches. Both one- and two-year old birds laid the highest number of eggs in 10-egg and more clutches (about 27.7 %; Fig. 4). On the other hand, when analysing 1 to 9-egg clutches, it should be noted that the experimental pheasants laid most eggs in 2- and 3-egg clutches. However, the two-year old females were characterised by a slightly smaller number of eggs laid in 1-, 3- and 4-egg clutches and higher in 2-, 6-, 8- and 9-egg clutches. Both one- and two-year old hens were characterised by the highest proportion of one-day intervals between laid eggs (about 70 %; Fig. 5).

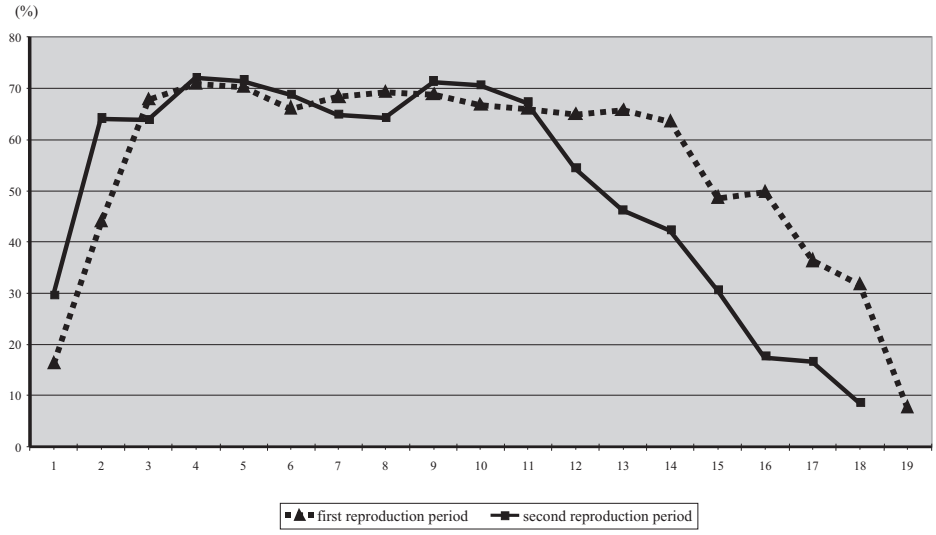

Fig. 2. Pheasants' laying rate (%) in two reproduction periods.

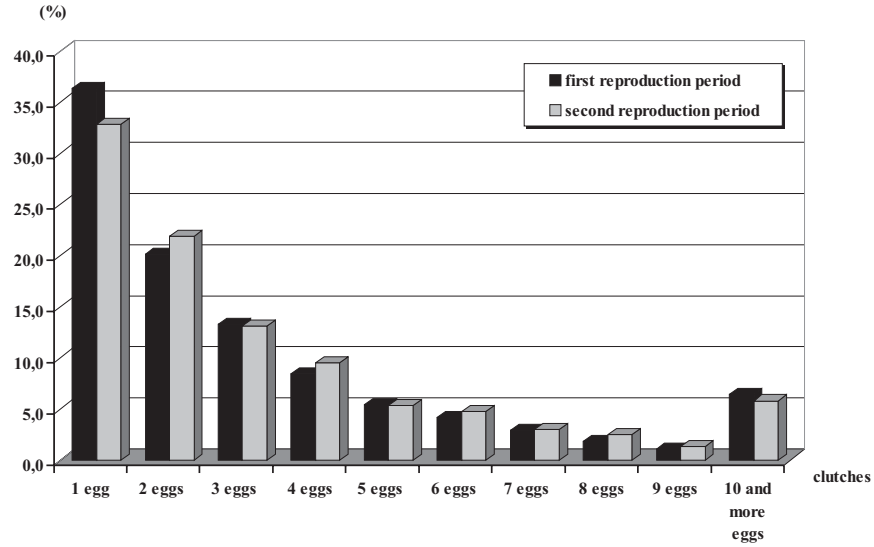

Fig. 3. Percentage of different egg clutches in two reproduction periods of pheasants.

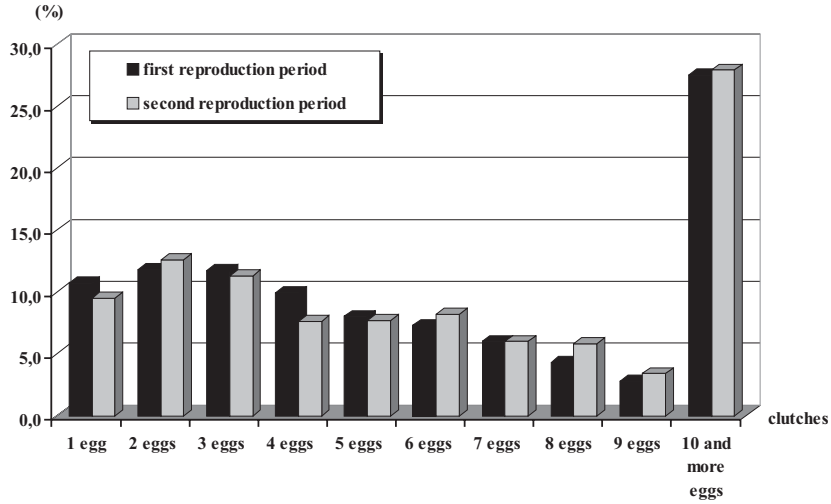

Fig. 4. Percentage of eggs laid in different clutches in two reproduction periods of pheasants.

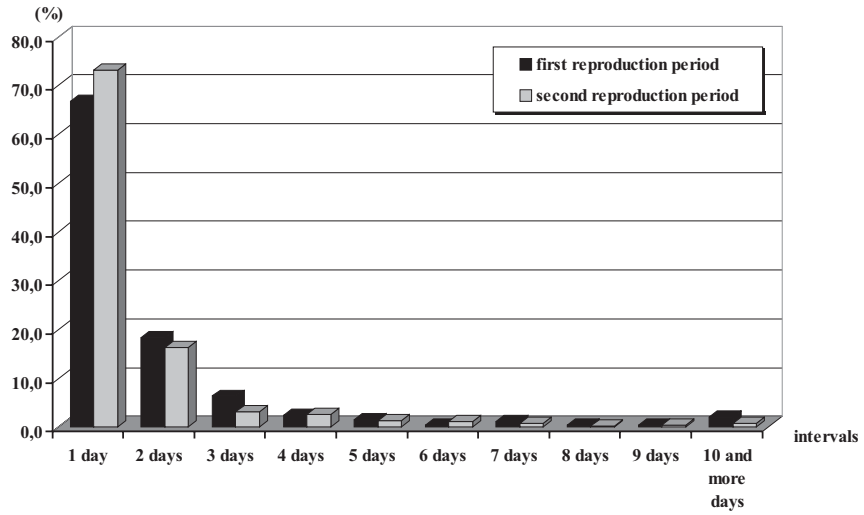

Fig. 5. Percentage of different intervals beetwen clutches in two reproduction periods of pheasants.

Slightly more of these intervals and fewer 2- and 3-day intervals were recorded in the second period of reproduction.

A significantly positive correlation (Table 2) was found between the number of eggs and the length of the reproductive period and traits characterising the laying rhythm (r_p= from 0.505 to 0.826). A significantly negative correlation was only found between the mean length of the interval between egg clutches and the number of laid eggs. A positive correlation ($P \leq 0.05$) was recorded between the length of the reproductive period and the majority of characters of the laying rhythm (r_p= from 0.222 to 0.796). However, a negative correlation was found between this character and the weight of eggs in the 8th week of reproduction. Furthermore, statistically significant negative correlations (r_p= from -0.287 to -0.350) were observed between the number of egg clutches and the number of eggs in clutches, the length of intervals between clutches and the weight of eggs. On the other hand, the number of egg clutches was positively dependent ($P \leq 0.05$) on the number of intervals between them. The hens were characterised by a negative correlation between the number of eggs in clutches and the number of intervals, length of intervals and the longest interval between clutches and this character was positively correlated with the highest number of eggs in clutches and egg weight (r_p= from 0.236 to 0.823).

Table 2

Coefficients of phenotype correlation between reproductive traits and laying rhythm in pheasants

Trait	Traits – coefficients of correlation							
	2	3	4	5	6	7	8	9[1)]
1. No of eggs	0.826*	0.658*	0.505*	0.621*	0.649*	-0.479*	-0.171	-0.031
2. Length of the reproductive period (days)		0.796*	0.215*	0.345*	0.773*	-0.112	0.222*	-0.243*
3. No of egg clutches			-0.297*	-0.119	0.938*	-0.287*	0.100	-0.350*
4. No of eggs in clutches				0.823*	-0.230*	-0.236*	-0.309*	0.236*
5. The largest number of eggs in clutches					-0.067	-0.173	-0.201*	0.153
6. No of intervals						-0.270*	0.075	-0.482*
7. Length of interval (days)							0.351*	-0.024
8. The longest interval (days)								-0.155

1) Egg weight in 8th week of laying.
* – significant at $P \leq 0.05$.

The highest number of eggs in clutches and the number of intervals between clutches were negatively correlated ($P \leq 0.05$) with, respectively, the longest interval between clutches and the length of intervals as well as with the weight of eggs. A significantly positive correlation was demonstrated between the length of intervals and the longest interval between clutches.

Discussion

No precise information was found in the literature concerning the age of pheasant hens at the first laying which, in the analysed flock, occurred in week 40. MARSHALLY *et al*. (1983) demonstrated that it was possible to considerably advance the laying of the first egg in pheasant hens employing an appropriate lighting program. In our experiments, hens started laying in April, which is in agreement with studies carried out by LABISKY and JACKSON (1969) in which the first egg (in one- and two-year old hens) was also laid in this month. On the other hand, WISE (1995) and GIBES *et al*. (1974) recorded the beginning of the laying season in pheasants already in the third decade of March. In our studies, in the group of one-year old birds, the last egg was laid on the 8th of August, while in trials carried out by LABISKY & JACKSON (1969) – already in July. On the other hand, the above-mentioned authors reported the laying of the last egg in August, similarly as in this study.

The first reproductive period lasted 19 and the second 18 weeks. A longer laying season (27 weeks) was reported by MARSHALY *et al*. (1983), but these researchers employed a lighting program during their experiments. In addition, in our studies, the first laying period was significantly longer (by 21 days) than the second. Also LABISKY and JACKSON (1969) reported a longer (by 23 days) first reproductive period. The peak of egg production, both in the first and the second periods of reproduction, was recorded in the 4th week of laying. TSERVENI-GOUSI and YANNAKOPOULOS (1990) reported the peak of laying in pheasants one week earlier, while WOODARD and SNYDER (1978) reported it in week 5 and the egg production in their trial was 8 % higher than that found in this study. On the other hand, GIBES *et al*. (1974) reported the highest egg production in pheasants only in the 7th week of laying. In the present study, hens laid more eggs during the first than the second laying period. Similar results were reported by SMITH *et al*. (1968) and GIBES and WASILEWSKI (1976). On the other hand, LABISKY and JACKSON (1969) reported that two-year old pheasants laid 19 eggs more than one-year old hens. In the present trial, heavier eggs were laid by hens during the second reproductive period. On the other hand, LABISKY and JACKSON (1969) recorded a similar weight of eggs laid by one- and two-year old pheasant hens during the entire period of reproduction, although they were about 2 g lighter than in this investigation.

It was demonstrated that the one-year old birds were characterised by a higher mean number of egg clutches in comparison with the two-year old hens. LABISKY and JACKSON (1969) reported a smaller number of egg clutches by 3.9 in the first reproductive period than in our studies, although in the second period of reproduction this difference dropped to only 1.1. In addition, the above-mentioned researchers reported, respectively, 4.8 and 6.8 eggs per clutch during the first and second laying period, whereas in our trial, an average of 3.6 eggs per clutch were laid in both reproductive periods. BLAKE and RINGER (1987) reported that the ahemeral light-dark cycle (14L:12D) resulted in longer egg clutches in pheasants (average 8.5 eggs per clutch). On the other hand, the mean number of eggs in a clutch found in broiler breeders by GUMUŁKA and KAPKOWSKA (1996) amounted to about 3. ROBINSON *et al*. (1990) and GUMUŁKA and KAPKOWSKA (1996) reported the occurrence of one very long clutch during which the number of laid eggs exceeded 50 in some laying hens during the laying peak. In our studies, the longest clutch comprised 37 and 42 eggs in the first and second reproductive periods, respectively. The results concerning the number of eggs laid during the longest clutches as well as the number of intervals between them were significantly higher than those reported by LABISKY and JACKSON (1969). KAPKOWSKA *et al*. (1993) as well as LILLPERS and WILHELMSON (1993) demonstrated that the decline in laying of broiler breeders associated with age was the result of, among others, the decrease in the number of eggs laid in a clutch and the lengthening of intervals between clutches. However, our studies as well as studies carried out by LABISKY and JACKSON (1969) failed to identify any regularity regarding the number and length of egg clutches and the intervals between them in the case of pheasants. The considerable variability observed between layers with regard to the examined characters could have resulted from the lack of selection in the pheasant flock analysed in this investigation.

The frequency of occurrence of egg clutches in the experimental pheasants was similar to that reported by SZADO *et al*. (1995) in geese. The most numerous were the 1-egg clutches (over 30 %), whereas the number of 2-egg clutches was about 50 % smaller and as the number of eggs in the clutch increased, its percentage proportion decreased. However, in the case of pheasants, the 10-egg and longer clutches constituted about 5 %,

while in geese their proportion reached about 10 % (SZADO *et al*. 1995). On the other hand, according to KAPKOWSKA *et al*. (1993) and GUMUŁKA and KAPKOWSKA (1996), hens are characterised by the highest proportion of the 2-egg clutches (about 28.0 %) and then 1-, 3-, 4- and 5-egg clutches. 11-egg and longer clutches constituted only 3.2 % of all eggs. The highest number of eggs laid by the examined pheasant hens were in the 10-egg and longer clutches (over 25 %). Similar results (about 32 %) were reported by SZADO *et al*. (1995) in geese. However, in the case of the 1-9-egg clutches, geese laid the highest number of eggs in 6-egg clutches, whereas pheasants – in 2-eggs clutches. The laying rhythm in pheasants, as that reported by GUMUŁKA and KAPKOWSKA (1996) in hens, was characterised by the highest number of 1-day intervals between laid eggs (about 70 %) from among all intervals, whereas 5-day and longer intervals constituted only a small fraction. In the case of geese, SZADO *et al*. (1995) reported the highest proportion of 2-day intervals.

ROSIŃSKI *et al*. (2006) demonstrated a significant positive correlation between the number of eggs and the number of intervals between clutches (r_p= from 0.919 to 0.957) in geese. Statistically positive, albeit smaller, correlations between these characters were shown in this investigation. This was confirmed by the obtained results because pheasants which laid more eggs (the first reproduction period) were characterised by a significantly greater number of intervals between clutches. In their experiments on laying hens, ROBINSON *et al*. (1990) demonstrated a significant correlation between the number of eggs in the longest clutch and the total egg production (r_p= 0.399). Similar results in broiler breeders (r_p= 0.441) were reported by GUMUŁKA and KAPKOWSKA (1996). A significant positive correlation between these characters was also shown in pheasants.

The results of this investigation showed that during the first reproductive period, in comparison with the second, pheasants were characterised by a longer laying period and a greater number of egg clutches and intervals between them. However, similar mean values of the number of eggs in a clutch as well as the length of intervals between egg clutches were found in both of the trial periods. The experimental pheasants laid the highest number of eggs in 10-egg and longer clutches; however, out of all clutches, it was the 1-egg clutches that were the most numerous. The positive correlation between the number of eggs and the number of egg clutches, the highest number of eggs in a clutch and the number of intervals between clutches indicate that the greater the number of clutches and intervals, the more eggs can be expected to be obtained from pheasants. The observed considerable variability between individual birds with regard to the number and length of clutches as well as the intervals between them indicate the possibility of selection taking into account the traits of the laying rhythm. On the other hand, the high value of the reproductive characters of the two-year old pheasants indicates that it is possible to utilize these birds for more than one reproductive period.

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