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Araştırma Makalesi

Determination of Heritability and Genotypic-Phenotypic Correlations According to Yield Traits in Japanese Quails

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ABSTARCT

The animal material of the study consisted of quails of similar live weight selected from a randomly mated 14-week-old flock. Selected 29 male and 29 female quails were placed in individual cages with a ratio of 1-1 male females. The chicks obtained from this flock were fed ad libitum with 24% crude protein and 2900 kcal/kg metabolic energy from hatching to the sixth week of the experiment. The sexes of those who completed their development up to three weeks in growth cages by marking were determined and placed in special cages one by one according to their genders. In the study, 86 quails belonging to each family, including 3 siblings, were used. At the end of the trial, the survivability decreased to 75.58%. When considered as the sum of Male+Female, it is seen that the average of the starting weight is 8.776 g, the final weight measurement is 176.16 g and the average weight is 86.47 g. While this average weight is 85.06 g in females, it increases to 87.43 in males. Considering the average heritability, it was clearly separated from the others with a heritability value of 0.586 and this was found to be statistically significant (P<0.05). While the heritability for males was 0.428, it was found to be 0.269 for the total herd. It is seen that the genetic variation for Male, Female and Male+Female was significantly higher in the first generation but decreased with the second generation. It is seen that genetic variation is significantly higher in the first generation for Male, Female and Male+Female, but decreases with the second generation . When we look at the additive genetic change, it is seen that there is a similar change. As seen in this study, it is necessary to pay attention to the changes in breeding activities, especially in the weeks when the genotypic correlations are high.

Anahtar kelimeler: Quail, Heritability, Genetic correlations, Yield

Japon Bıldırcınlarında Verim Özelliklerine Göre Kalıtım Derecesi ile Genotipik ve Fenotipik Korelasyonların Belirlenmesi

ÖZ

Çalışmanın hayvan materyalini rastgele çiftleştirilen 14 haftalık sürüden seçilen benzer canlı ağırlıktaki bıldırcınlar oluşturmuştur. Seçilen 29 erkek 29 dişi bıldırcın bireysel kafeslere 1-1 erkek dişi oranı ile yerleştirilmişlerdir. Bu sürüden elde edilen civcivler çıkımdan deneme sonu olan altıncı haftaya kadar %24 ham protein ve 2900 kcal/ kg metabolik enerji içeren yemle ad libitum olarak beslenmişlerdir. İşaretlenerek büyüme kafeslerinde üç haftaya kadar gelişmelerini tamamlayanların cinsiyetleri belirlenmiş ve cinsiyetlerine göre özel kafeslere tek tek konulmuşlardır. Çalışmada her aileye ait 3 öz kardeş olmak üzere 86 bıldırcın kullanılmıştır. Deneme sonunda yaşama gücü %75,58'e kadar düşmüştür. Erkek+Dişi toplamı olarak bakıldığında çıkış ağırlığının ortalamasının 8,776 g, son ağırlık ölçümünün ise 176,16 g ve ortalama ağırlığın ise 86,47 g olduğu görülmektedir. Bu ortalama ağırlık dişilerde 85,06 g iken erkeklerde 87,43'e çıkmaktadır. Ortalama kalıtım derecelerine bakıldığında Dişilere ait 0,586 kalıtım derecesi değeri ile Erkek ve Erkek+Dişi'lere ait kalıtım derecelerinden belirgin şekilde ayrılmış ve bu istatistiksel olarak önemli bulunmuştur (P<0,05). Erkeklerde kalıtım derecesi 0,428 olurken, sürü toplamında 0,269 olarak belirlenmiştir. Genetik değişimin Erkek, Dişi ve Erkek+Dişi için ilk generasyonda belirgin şekilde yüksek olduğu ancak ikinci generasyonla birlikte düşüş gösterdiği görülmektedir. Genetik değişimin Erkek, Dişi ve Erkek+Dişi için ilk generasyonda belirgin şekilde yüksek olduğu ancak ikinci generasyonla birlikte düşüş gösterdiği görülmektedir. Eklemeli genetik değişime bakıldığında ise benzer değişimin olduğu görülmektedir. Yapılan bu çalışmada da görüldüğü üzere ıslah faaliyetlerinde özellikle genotipik korelasyonların yüksek çıktığı haftalardaki değişimlere dikkat edilmesi gerekmektedir.

Key words: Bıldırcın, Kalıtım Derecesi, Genetik Korelasyonlar, Verim.

INTRODUCTION

Humans strive to be able to eat healthily and appropriately. A balanced diet is also one of the basic conditions for a healthy life. It is recommended to take both animal and vegetable proteins. Although there is a great imbalance today, it is known that this needs to be corrected. As the world population grows, its demand is expected to increase. The rate of increase should increase in direct proportion to the rate of meeting the demand. It is known that there are relations between the social and cultural development of people and their diet (Canbaz & Özsöz, 2020). This feature, which is important in shaping people's lives, should be carefully planned and production planning should be carried out in the most appropriate way for public health (Kutbay et al., 2017).

The most important problem of animal husbandry today is seen as productivity (ZMO, 2018). The greatest added value in the agricultural field is obtained from animal husbandry. Meat, milk and other animal products not only contribute to the economy by providing raw materials, but also make significant contributions to the industry that produces feed production, pharmaceuticals and agricultural tools and equipment. However, in order for this contribution to be sustainable, production must be properly planned and continuity must be ensured (Ranzijn et al., 1988). In this regard, it is necessary to carry out studies to increase productivity by giving the necessary importance to animal husbandry. In order to increase productivity, it is necessary to monitor livestock activities, to eliminate factors that reduce productivity, and to support the production of high-yielding animals, especially without damaging local gene resources.

Productivity is important in animal husbandry as it is important in all fields. It has become important to use high-yielding genotypes in breeding in terms of yield and yield characteristics (Şeker et al., 2013). In this study, it was carried out to determine the genotypic and phenotypic characteristics of some yield characteristics of Japanese quails. Japanese quails are particularly suitable for breeding studies (Wilson et al., 1961). Due to the short intergenerational time, genetic studies can be performed in a shorter time and more successfully. However, phenotypic and genotypic characteristics may vary according to the character examined (Altan et al., 1998). Whether the observed change is large or small depends on the amount and duration of the effect of genotypic conditions, especially the environment (Leeson et al., 1991). For this reason, Japanese quail is preferred in poultry genetic studies. Estimation of genotypic and phenotypic parameters during growth and development periods can increase the success of the studies to be done. Singh (2009) stated in their study for live weight that the heritability ranged between 0.26 and 2.38. Özsoy and Orhan (2011) also reported similar results. However, some studies have reported that heritability is between 0.40 and 0.60 (Akbaş et al., 2004; Shokoohmand et al., 2007). It is possible to link the difference between breeding conditions and genetic differences (Toelle et al., 1991). Vali et al (2005), on the other hand, stated that the presence and height of correlations were determined by other environmental conditions, especially nutrition. Karadavut and Taşkın (2014) in their study to determine the degree of heritability in quails stated that the heritability could be determined by different models and the heritability changed depending on the growth and development periods. It is especially important to determine the genotypic and phenotypic parameters to be used in breeding studies (Narinç et al., 2010). Determination of phenotypic and genotypic parameters is considered important in terms of breeding and improving animals (Oğuz and Türkmut, 1999; Karadavut et al., 2014). In this study, Japanese quails of different body weights and sexes (*Coturnix coturnix japonica*) is aimed to estimate the genotypic-phenotypic parameters related to body weights.

MATERIAL AND METHOD

This study was carried out between March and November in 2021 in a private enterprise engaged in quail breeding in Bingöl Province. The material of the study was composed of quails of similar live weight obtained from a randomly mated 14-week-old flock. Selected 29 male and 29 female quails were placed in individual cages with a ratio of 1-1 male females. Two weeks of adaptation and waiting period were applied to the quails, and then the eggs obtained from these matings were marked. Until the eggs were put into the incubator, they were kept in a room with an ambient temperature of 16-18 ^{0} C and a relative humidity of 75-80%.

A temperature of 37.7ºC and a relative humidity of 55% was applied in the incubator, and a relative humidity of 37.2ºC and 75% in the take-off machine. The hatching times of the chicks were carefully recorded. The fry were kept in an environment at 32-33ºC for the first two weeks after hatching. After this period, the temperature was gradually reduced and after 3 weeks it was lowered to 25-26 ºC. While lighting was provided for 23 hours on the first day, this period was later reduced to 16 hours. The chicks were fed ad libitum with a feed containing 24% crude protein and 2900 kcal/kg metabolic energy until the sixth week, which is the end of the experiment (NRC, 1994). The chicks were weighed weekly on a precision balance of 0.01 g from hatching and their live weights were determined. The sexes of those who completed their development in growth cages for up to three weeks were determined and placed in special cages one by one according to their gender. In the study, 86 quails, 3 animals belonging to each family, were used. The period when the animals, which were constantly monitored in the cages, started to lay their eggs, were recorded as the age of sexual maturity. During this period, their weights were also weighed and their sexual maturity weights were taken.

Heritability and genotypic and phenotypic correlations were determined in the study. Separate estimates were made for males, females, and the herd total. The mathematical model used to estimate the parameters can be shown as:

$Y_{ijkl} = \mu + a_i + b_j + c_k + (bc)_{jk} + e_{ijkl}$

Here;

Y_{ijkl} : i. paternal j. out in the period, k-sexed l. animal value,

μ : mean,

$ai :_i$. paternal influence,

$bj :_j$. period effect,

c_k : k. gender effect,

$(bc)_{jk}$: gender x period interaction,

e_{ijkl} : i. paternal j. out in the period, k-sexed l. It shows the amount of error affecting the animal.

In order to calculate heritability and genetic correlations, paternal variance was calculated from the variance analysis table obtained at the end of the analysis of variance according to the models mentioned above.

heritability;

$h^2 = 4\sigma^2_S / (\sigma^2_{iÇ+}\sigma^2_S)$

equation . The standard error of heritability is;

$S_h{}^2 = 4(1-r)[1+(n-1)r] / \sqrt{(1/2)n(n-1)(b-1)}$

equality (Düzgünes , 1963).

Here, n is the number of individuals in the half-sibling family, *b is the* number of fathers, and r is the correlation coefficient.

Genetic correlations are;

$$r_G = Cov(A)_{xy} / \sqrt{\sigma^2 A(x) + \sigma^2 A(y)}$$

calculated from the relationship. Here; $Cov(A)_{xy}$: Genetic covariance between x and y traits, $\sigma^2_{A(x)}$ and $\sigma^2_{A(y)}$: represent additive genetic variances of x and y traits, respectively (Düzgüneş and Akman, 1985).

The standard errors of genetic correlations are also;

$$Sr_G = (1-r)[1+(n_0-1)r] / \sqrt{1/2n_0(n_0-1)(k-1)} ,$$

It was calculated with the help of the equation (Tüzemen et al., 2006). In addition, genetic changes were calculated according to Türedi (1986). In the study, the LSMLMW (Harvey, 1987) and the necessary inter-paternal and intra-paternal variance elements were used to determine the heritability by using the GLM procedure in the SAS statistical package program (Searle et al., 1980).

RESULTS AND DISCUSSION

In the study, primarily the survivability was determined. Hatchery is calculated as the proportion of the offspring that survive the first six weeks. In this, the situation of the hatched chicks in the first 6 weeks was examined and given in Table 1. When the chart is examined, it is seen that the number of deaths decreases as the puppies grow. Actually, this is to be expected. Because puppies are greatly affected by environmental conditions at first. Even small changes can cause the death of the offspring. The size of the problems such as ambient temperature, humidity and not being able to gain nutritional habits or not being able to drink enough water can cause an increase in mortality rates (Sarıca, 1998). Balcıoğlu et al. (2005) emphasized the effect of the environment in their study to determine genetic parameters for live weight gain in Japanese quails. Karadavut et al. (2014) stated that the environment has a great impact on growth and development. As time progressed, mortality rates began to decrease with the strengthening of the offspring and the increase in their adaptation to environmental conditions. After the six-week period, the survivability decreased to 75.58%. Accordingly, ¼ of the offspring died in the first six weeks.

Table 1. the situation of the hatched chicks in the first 6 weeks

	Examined Features	
Age (Week)	Number of Puppies (Number)	Vitality (%)
0	86	-
1	79	91.86
2	73	84.88
3	70	81.40
4	68	79.07
5	66	76.74
6	65	75.58

In the study, descriptive statistics of live weight for quail breeding seasons were determined and given in Table 2. When considered as the sum of Male+Female, it is seen that the average of the starting weight is 8.776 g, the final weight measurement is 176.16 g and the average weight is 86.47 g. While this average weight is 85.06 g in females, it increases to 87.43 in males. It is seen that the average weight of the females is the lowest, the males are the highest, and it is in the middle in Male+Female.

Table 2. Some descriptive statistics for live weights by sex

Gender	Periods (Days)	$X_a \pm S$	Coefficient of Variance (%)
Male+Female	Exit	8.66 ± 0.047	11.17
	7	21.55 ± 0.247	10.05
	14	52.17 ± 0.302	12.76
	21	79.49 ± 0.576	13.29
	28	119.77 ± 0.697	14.17
	35	147.36 ± 0.847	12.08
	42	176.16 ± 0.912	12.19
Average		86.47 ± 0.520	12.24
Male	Exit	8.76 ± 0.036	8.93
	7	21.44 ± 0.171	10.08
	14	54.92 ± 0.398	13.77
	21	81.03 ± 0.447	14.45
	28	116.79 ± 0.612	12.28
	35	147.92 ± 0.855	15.62
	42	181.17 ± 0.971	15.22
		87.43 ± 0.498	12.90
Female	Exit	8.26 ± 0.055	10.55
	7	21.79 ± 0.097	9.28
	14	51.12 ± 0.188	9.16
	21	86.51 ± 0.377	13.72
	28	111.13 ± 0.512	15.63
	35	144.11 ± 0.778	12.29
	42	172.64 ± 0.916	10.88
		85.08 ± 0.417	11.64

The standard deviation value was determined as 0.520 in Male+Female, it was 0.498 in males and 0.417 in females. High variation in Male+Female is an expected result. Because the differences in male and female weights are obvious. Considering the coefficient of variation, the highest value was observed in men with 12.90%. This rate was 11.64% in females and 12.24 in Male+Female. It is seen that the coefficient of variation is generally not very high in all variables and is within acceptable limits. In Male+Female, a rapid increase was observed starting from 8.66 and the final weight was determined as 176.16 g. While the male emergence weight was 8.76 g, the last measurement increased to 181.17 g. In females, it increased from 8.26 to 172.64 g. The increase was higher in males than females. The reason for this can be considered as the physiological development of men faster. Celik et al. (2014) stated in their study that teeth grow faster than males and have higher live weight in the cage system, while the opposite is seen in free roaming. Marks (1991), on the other hand, stated that the effects of environmental factors on animals will be determinant in studies for growth and development, and he said that this should be paid attention to in the selection to be made. On the other hand, Tozluca (1993) stated that the effect of nutritional conditions on live weight is high and men are in a better situation in this regard. Although there was a difference between males and females in terms of live weight gain in the study, this was not statistically significant. Accordingly, we can say that there is no difference in live weight increase according to gender. In this study, trying to keep the environmental conditions constant as much as possible and not allowing sudden changes may have been effective.

Heritability degrees were also examined in the study. The results obtained are given in Table 3. While heritability was found to be slightly higher in females, it was observed to be the least in the total herd. Considering the average heritability, it was clearly separated from the others with a heritability value of 0.586 and this was found to be statistically significant ($P<0.05$). While the heritability for males was 0.428, it was found to be 0.269 for the total herd. Keskin and Tozluca (2001) in their study, heritability results are similar to our study. The reason for the higher heritability for the females was considered to be that females are physiologically different from males and that they need to strengthen their bodies for reproduction (Özkan and Kesici, 2000). In the study of Yolcu et al. (2006) have obtained similar results in their study, which shows that the differentiation of females in this regard according to males and the total herd has increased significantly. Knowing the heritability is essential to determine the performance of animals. In this, it gives a measure of how effective and important the additive genetic value is. Heritability is very important for determining the additive genetic effects of progeny (Çağlayan and İnal, 2006).

Table 3. Heritability and standard errors of live weights during growth periods

Period	**Female**	**Male**	**Male+Female**
	$h^2 \pm S_h$	**$h^2 \pm S_h$**	**$h^2 \pm S_h$**
Exit	0.588±0.219	0.502±0.177	0.499±0.193
7 days	0.441±0.226	0.334±0.196	0.371±0.218
14th day	0.592±0.277	0.356±0.120	0.304±0.155
day 21	0.675±0.301	0.504±0.227	0.290±0.116
28th day	0.717±0.298	0.588±0.239	0.328±0.141
35th day	0.566±0.197	0.315±0.119	0.289±0.132
day 42	0.495±0.268	0.428±0.249	0.269±0.121
Average	**0.582±0.193 A**	**0.434±0.208 B**	**0.336±0.167 C**

The actual genetic changes (GD) and additive genetic change levels (EGD) determined in the study were determined and are given in Table 4. When the chart is examined, it is seen that the genetic change for Male, Female and Male+Female was significantly higher in the first generation, but decreased with the second generation. When we look at the additive genetic change, it is seen that there is a similar change. It was determined that the observed difference was statistically significant. It has been observed that the effect of additive genetic effects increases as the generation progresses. Positive genetic effects are accepted as positive in terms of desired traits.

Table 4. Genetic Changes and Additive Genetic Changes from Study

Genetic Change Detection Method	generation	Female	Male	Male+Female
Genetic Changes (GM)	1	14.91 a	16.27 a	15.44 a
	2	6.03 b	4.87b	4.96b
	3	5.18 b	4.12b	4.07 b
Average		**8.71 A**	**8.42 A**	**8.16 A**
Additive Genetic Changes (EGD)	1	14.91 a	16.27 a	15.44 a
	2	19.47b	20.38 b	19.06 b
	3	24.68 a	24.51 a	25.73 a
Average		**19.69 A**	**20.39 A**	**20.08 A**

The detected genotypic and phenotypic correlations are given in Table 5. When the correlations were examined, in general, all genetic and phenotypic correlations, especially between emergence and other weeks, were negative. The highest estimated genotypic correlation in the study was between the 1st and 2nd weeks, with a value of 0.956 (0.980). This was followed by a correlation between 2 and 4 weeks with a value of 0.912. Considering the phenotypic correlations, it was observed that it was higher at the 5th and 6th weeks compared to the others.

Table 5. Genotypic and Phenotypic Correlations

Weeks	Exit	one	2	3	4	5	6
Exit	**0.026**	-0.871	-0.816	-0.417	-0.945	-0.871	-0.706
one	-0.072	**0.144**	0.965	0.014	0.794	0.614	0.415
2	-0.063	0.314	**0.296**	0.896	0.912	0.829	0.611
3	-0.094	0.239	0.335	**0.419**	0.874	0.876	0.719
4	-0.093	0.227	0.406	0.587	**0.516**	0.919	0.877
5	-0.090	0.159	0.357	0.413	0.565	**0.417**	0.846
6	-0.084	0.113	0.243	0.358	0.527	0.764	**0.433**

Breeding studies are generally not done on a single trait. Working with a large number of features is always an important factor that can ensure successful production. It is desirable that individuals have good genetic characteristics and pass them on to their offspring. However, as the number of characters increases, breeding studies become more difficult. As a result of the relationship with environmental and genotypic effects, phenotypic correlations occur and can shape production. However, in terms of breeding, the main determinant is always genotypic characteristics. In this study, special attention should be paid to the changes in the weeks when the genotypic correlations are high. After the genotypic trait, it will be necessary to look at the phenotypic traits. Resende et al. (2005) stated that in their study for live weight in Japanese quails, genotypic and phenotypic correlations showed significant changes according to weeks and the variation caused this. Toelle et al. (1991) stated that the variation being large or small will affect the genotypic or phenotypic correlation. Similar results were obtained in the study.

CONCLUSION

In this study, phenotypic and genotypic correlations of different weights of quails of different sexes were determined. The main purpose in animal breeding is to increase the yield per animal as much as possible and to provide the highest productivity. Although different studies are carried out to achieve this, the most basic process is the selection process. While making selection processes, firstly phenotypic and then genotypic features are taken into consideration. In fact, genotypic traits are the main determinants of phenotypic traits in selection. In this, it is necessary to look at the magnitude of the heritability. The magnitude of these traits will also directly affect phenotypic and genotypic correlations. Whichever method is used in the studies, the heritability should be known. If this is known, the explanation of phenotypic and genotypic relationships will become more meaningful. The fact that the correlations are positive or negative and at the same time high or low will determine the success of the studies to be done and will also guide them. Successful estimation of phenotypic and genotypic parameters is of great importance. In this study, although there are serious changes according to time, it has been seen that they have more important values in the first weeks. The first weeks are more important in the growth and development periods of animals. Because growth and development are much faster and slower in time. Concentrating on the first developmental periods in the studies to be carried out will increase the success of the studies to be carried out.

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