Available online at www.garmian.edu.krd

Passer Journal of Basic and Applied Sciences

Passer 7 (Issue 1) (2025) 499-505

Original Article

A Generational Comparison of Some Quantitative Traits in Three Japanese Quail Lines

Questan Ali Ameen*[1]

[1]*Department of Animal Science, College of Agricultural Engineering Sciences, University of Sulaimani, Sulaymaniyah 46001, Iraq.*

Received 5 February 2025; revised 22 April 2025;
accepted 10 May 2025; available online 25 June 2025

DOI: 10.24271/PSR.2025.504462.1933

ABSTRACT

This study was to evaluate the performance of three Japanese quail lines over four generations concerning body weight at sexual maturity (45 days), 90 days, and 120 days, as well as egg production. Fifty-four one-day-old chicks from each quail line were raised and assigned to experimental groups, with a sex ratio of one male to two females. The birds were provided with starter feed up to 30 days and production feed from 30 to 120 days. The body weights were recorded at three stages (sexual maturity, 90 days, and 120 days), and egg production was assessed at 90 and 120 days. The results indicated that at sexual maturity, Body weight did not differ significantly across the three lines ($p \leq 0.05$). However, at 90 and 120 days, the Brown line had significantly higher body weights compared to the Gray and White lines ($p \leq 0.05$). Across generations, body weight decreased progressively, with the highest values recorded in Generation 0 and the lowest in Generation 3, likely due to cumulative genetic selection effects. Egg production also varied significantly among lines, with the Brown line consistently outperforming the White and Gray lines at both 90 and 120 days ($p \leq 0.05$). Generation 0 demonstrated the highest egg production, which declined progressively through Generation 3. A significant positive correlation was found between body weight at sexual maturity and subsequent body weights at 90 and 120 days, indicating that early weight measurements can serve as reliable predictors of long-term growth performance.

Keywords: Generation, Japanese quail, Line, Quantitative traits.

1 Introduction

One of the most productive poultry species established is Japanese quail [1] due to their large production of meat and eggs [2]. The poultry industry focuses on enhancing produce genetically lines for high egg and meat production [3]. Economic qualities are the focus of breeding initiatives in the chicken industry [4], to enhancing early egg production or the body weight of quails due to a set age throughout both short-term and long-term selection initiatives [5]. Programs for selection, a crucial instrument for gaining genetic advantage in quail, have been used to improve body weight and egg production characteristics [6-7]. Selection is one important tool to change gene frequency, resulting in genetic trait changes across generations [8]. The Japanese quail is sexually dimorphic, meaning that females are larger than males and take longer to reach sexual maturity than males, in contrast to other poultry species [9]. Higher body weight selection has been shown to have a major impact on egg quality parameters and early sexual maturity adequate promotes production [10]. Consequently, larger birds lay more eggs and that better hatchability is associated with higher egg quality [11]. The genetic makeup of each generation's parents may have an impact on economic qualities for subsequent generations [12].

The study aimed to evaluate the performance and compare group outcomes. of three Japanese quail lines for four generations on body weight in Japanese quails at 90, 120 days and at age of sexual maturity, as well as and egg production.

* Corresponding author

E-mail address Kwestan.amin@univsul.edu.iq (Instructor).

Peer-reviewed under the responsibility of the University of Garmian.

2 Material and methods

The study was carried out in the poultry research Field of the Animal Production Department at the College of Agriculture, University of Kirkuk; during 25/2-1/7/2022, 54 one-day-old hatched three Japanese quail lines (Brown, White, and Gray) were reared for each line. The selected birds were divided into eighteen families for each treatment with a sex ratio of one male for every two females. Starter and production feeds were used. Starter feed was used from one-day old to 30 days old, while production feed was used from 30 days old to 120 days old (Table1).

Table 1: Composition of Feeds and Chemical Analysis.

Feed Material	Starter Feed (%)	Production Feed (%)
Yellow corn	56.1	55.6
Soybean (48% crude protein)	37.0	27.0
Protein concentrate	5.0	5.0
Vegetable oil (sunflower)	0.2	1.3
Wheat	0.0	5.0
Limestone	1.4	5.6
Dicalcium phosphate	0.0	0.2
Salt	0.3	0.3
Total	100	100
Chemical Analysis	Production Feed	Starter Feed
Protein (%)	20.02	24.16
Metabolizable energy (kcal/kg feed)	2900.4	2906.2
Fiber (%)	2.56	2.82
Fat (%)	4.06	2.95
Methionine (%)	0.43	0.49
Lysine (%)	1.14	1.42
Calcium (%)	2.44	0.81
Phosphorus (%)	0.39	0.37
Arginine** (%)	1.29	1.62

The live body of the birds was weighed at sexual maturity (45days), at the age of 90 and 120 days. The birds were weighed in the morning before feeding them, using an electronic scale with a sensitivity of 0.1 g. Egg production was measured for the first period (90 days) by recording the number of eggs from the day of laying the first egg until day 90, then the second period (120 days) was measured from day 91 until day 120. The fertility rate was calculated after the hatching process was completed. The unhatched eggs were broken and the number of unfertilized eggs and the number of dead embryos were calculated. Calculate shape index according to the following equation [13]:

Shape index= diameter ×100/length

Data were analyzed using the general linear model method in XLSTAT (2019), with group comparisons performed using Duncan's test [14].

3 Result and discussion

3.1 Body weight

Table (2) shoes the results of the body weights (mean ± SE) of three Japanese quail lines (Brown, White, and Gray) at three different ages, sexual maturity, 90 days, and 120 days. At sexual maturity there were no significant difference between the three lines ($p > 0.05$), but at age 90 Days, the Brown line significantly at Days, the had greater body weight (202.419 ± 3.09 g) compared to the Gray line (195.119 ± 2.52 g) and White line (197.471 ± 2.36 g). At 120 days The Brown and White lines showed no significant differences. (201.935 ± 3.07 g), (200.882 ± 3.19 g), respectively. However, there was a significant difference with the Gray line (192.179 ± 2.54 g) at significant level ($p \leq 0.05$). [15] explained that line groups had effect in body weight of Japanese quail at different stage of age. The Brown line have superior in body weight across all stages similar result [16,17] but the Gray line have lowest body weight, however, the White line showed moderate growth, with a trend towards convergence with the Brown line at later stages similar with [10]

The results demonstrate that genetic line significantly influences body weight in Japanese quail, with the Brown line consistently outperforming the Gray and White lines, The White line shows potential for improved growth performance, particularly at later stages, while the Gray line remains the least efficient in terms of body weight gain.

Table 2: The impact of line groups on body weight at sexual maturity and at (90 – 120 days.

Strain	Bird weight at sexual Maturity45 days (g)	Body weight at 90 days (g)	Body weight at 120 days (g)
Brown	195.226 ±1.816a	202.419 ±3.09 b	201.935± 3.07b
White	192.985 ± 2.09a	197.471 ±2.36ab	200.882 ±3.19b
Gray	192.493 ±1.94a	195.119 ±2.52a	192.179 ±2.54a

Different letters in the same column indicate significant differences between the lines at a significance level of ($p \leq 0.05$).

Table 3 results, shows body weights (mean ± SE) at three different periods (sexual maturity, 90 days and 120 days of the four selected generations. Body weight at sexual maturity in different generations (0, 1, 2, and 3) showed significant differences at significant level $p \leq 0.05$ among (0, 1, 2, and 3) being 203.47, 192.620, 194.267 and 175.611 gm respectively. The body weight at sexual maturity decreased by 5.33% of G0 to G1, but from G1 to G2, the result showed 0.86% increase and 9.61% decrease for G2 to G3 from Generation 2 to 3: 9.61% decrease. Body weight at 90 days in different generations revealed significant at level $p \leq 0.05$

Differences among (G0, G1, G2, G3) being 211.40, 196.58, 197.42 and 177.36 gm respectively. Change of percentage in body weight at 90 days across generations from G0 to G1 was a reduction of 7.01%, whereas for G 1 to G2 was increased by 0.43% and that from G2 to G3 being 10.16% redaction. Body weight at age 120 days showed a significant at level $p \leq 0.05$ difference between (G0, G1, G2, and G3) being 210.53, 199.42, 195.88 and 177.08 gm respectively. Change of percentage in body weight at 120 days across generations from G0 to G1 revealed a decreased of5.28percentage, while that from G 1 to G2, being 15.89% and that from G2 to G3 was 9.60%. According to the study by [16] there were statistical differences in weekly body weight between different periods and. The body weight decreases across generation of a potential cumulative effect of genetic selection leading to reduced growth performance.

Table 3: Illustrates the impact of generation in body weight at sexual Maturity, (90 – 120) days.

Generation	Bird weight at sexual Maturity (g) 45 days	Bird weight at 90 days (g)	Bird weight at 120 days (g)
0	203.47±2.11 c	211.40± 2.87c	210.53 ±2.59c
1	192.62 ±1.34 b	196.58 ±2.09b	199.42± 3.40b
2	194.26±1.54b	197.42 ±2.49b	195.88± 2.57b
3	175.61±2.38 a	177.36 ±2.96a	177.08± 3.62a

Different letters in the same column indicate significant differences between the lines at a significance level of ($p \leq 0.05$).

Figure (1,2 and 3) shows the effect of interaction between three lines (Brown, White, and Gray) and four generations (0, 1, 2 and 3) of body weight on Japanese quail lines at three-growth stages sexual maturity, 90 days, and 120 days. Statistical analysis indicates significant differences across lines and generations. At sexual maturity, the brown line had the highest weight in all generations, being (208.62, 176.93g) in G0 to G3, but the White and Gray lines had lower weight redaction to 171.56 g in G3.

At 90 days, the Brown line have highest body weight in all generations, that (221.29 and 179.20 g in G1 to G3 but the White and Gray lines did not have significant difference between them. At 120 days the brown line had significant difference of body weights (219.29 and 179.60 g) in G0 to G3 but the Gray line had the lowest body weights in all generations, with 173.25 g in G3.

The observed differences in body weight across generations and lines may be attributed to genetic variations, selective breeding, and environmental influences. The decline in body weight from G0 to G3 in all lines, particularly in the Brown line, suggests a possible response to genetic dilution or environmental adaptation over generations [10]. Additionally, the White and Gray lines demonstrated more stability in weight, which aligns with findings by indicating that some quail lines maintain consistent growth patterns despite generational changes [18].

The superior growth performance of the Brown line could be associated with its genetic predisposition for higher body weight, as reported in studies on quail growth and selection [19,20]. The lower weight observed in the Gray line suggests that it may have a slower growth rate or different metabolic efficiency, which is consistent with earlier reports that growth rate variations exist among quail strains [21].

The Brown line had highest body weight due to inherent genetic advantages Gray and White resulted in a decrease in body weight across generation because of the possible cumulative effects of genetic selection and environmental stressors [22].

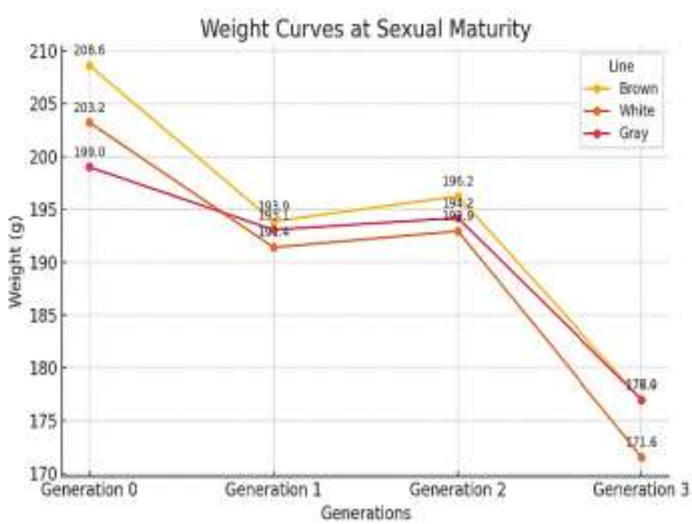

Figure 1: Illustrate interaction between line and generation in body weight at sexual maturity (45 days).

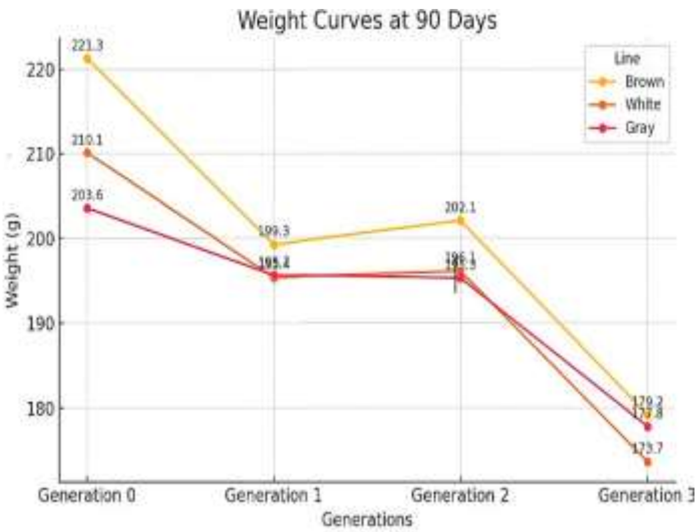

Figure 2: Illustrate interaction between line and generation in body weight at 90 days.

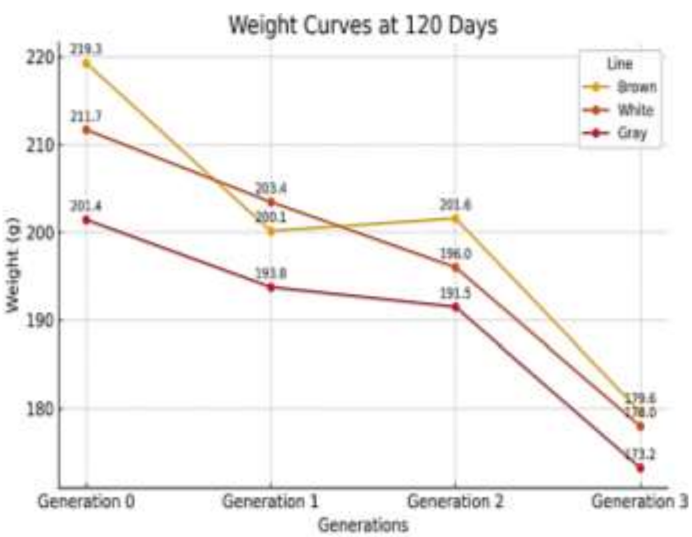

Figure 3: Illustrate interaction between line and generation in body weight at 120 days.

The correlation coefficients between body weight at sexual maturity and at 90a with 120 Days are presented in (Table 4). There were significant ($p<0.05$) positive correlations between body weight at sexual maturity and at 90 and Days ($r = 0.352$ and 0.387), respectively. there was highly significant ($p<0.01$) correlation between body weight at 90 and body weight at 120 days. This result indicates that body weights at earlier age, particularly at 120 days, are better predictors of weight at sexual maturity. These insights are valuable for optimizing breeding strategies and improving growth performance predictions. Further studies incorporating additional factors, such as nutrition and genetic profiles, could enhance predictive accuracy. [23-24] calculated the genetic correlations between W2 and W6 to be 0.76 and 0.73, respectively. Compared to previously published genetic correlations, the study's estimated genetic correlation between W2 and W6 was lower for males (0.57 ± 0.11) and greater for females (0.81 ± 0.15). The prevalent belief that Japanese quails may be selected based on early body weight is supported by the study by [25] the genetic connections between live weights at early and later stages.

3.2 Egg Production

Among the three different ages, the egg shape index showed no significant differences observed between lines (table, 5). At sexual maturity, 90-120 days, the values were (80.25, 80.73 and 80. %), (79.21, 79.14 and %79.37) and (79.50,78.20 and 79.42) for (Brown. White and Gray), respectively. These results indicate that uniformity between lines produce eggs of similar shapes. The result showed significant differences between lines in egg production at 90 days (29.92, 28.69 and 26.16) eggs Brown, Gray and White line respectively. At age120 days have similar results the brown lines have better egg production compare to the other lines that (21.62, 21.74 and 17.83) eggs (Brown, Gray and White line respectively.

These results indicate uniformity in egg shape across lines, suggesting that genetic and environmental factors did not significantly influence egg shape variation. Similar findings were reported by Narushin and Romanov [26], who noted that the egg shape index remains relatively stable across different poultry breeds.

Table 4: Correlation between body weights at sexual Maturity (g), body weight at (90 -120) days.

Bird weight	**Bird weight at sexual Maturity (g)**	**Bird weight at 90 days (g)**	**Bird weight at 120 days (g)**
Bird weight at sexual Maturity (g)	1		
Bird weight at 90 days (g)	0.352 *	1	
Bird weight at 120 days (g)	0.387 *	0.616 **	1

These findings suggest that the Brown line may have superior reproductive performance compared to the White and Gray lines. Previous studies have reported that egg production traits in quail can vary based on genetic selection, breed, and environmental conditions [27,28]. The higher production in the Brown line may be attributed to genetic factors linked to better adaptability and reproductive efficiency.

The first egg age recorded in various lines is extremely similar to the 47–53-day range reported by previous researchers [29].

Table 5: Effect of line (Brown, White, and Gray) at age of Sexual Maturity, Egg Shape Index (%), Egg production in 90 and 120 days.

Line	Age of Sexual Maturity (45) days	Egg Shape Index (%)	Egg production 90 days	Egg Shape Index (%)	Egg production 120 days	Egg Shape Index (%)
Brown	51.84± 0.72 a	80.25± 0.44 a	29.92±1.52 b	79.21±0.29 a	21.620±1.29 b	79.503±0.32 b
White	52.20± 0.56 a	80.73± 0.58 a	26.16±1.45 a	79.14±0.28 a	17.833±1.26 a	78.202± 0.30 a
Gray	51.37± 0.45 a	80.25± 0.36 a	28.69±1.53 b	79.023±0.37 a	21.736±1.21 b	79.428 ±0.31 b

Different letters in the same column indicate significant differences between the lines at a significance level of ($p \leq 0.05$).

The results in table (6) represented no significant level $p \leq 0.05$ differences at the age of sexual maturity, 90-120 days egg shape index across generations however, egg production showed a significant difference across generations. Generation 0 had the highest productivity over 90 days (36.46 eggs) and 120 days (25.88 eggs), while Generation 3 recorded the lowest values (17.22 and 6.83) eggs, respectively. This decrease in egg production may indicate potential genetic, adversely affecting productivity. The highly significant level $p \leq 0.05$ The observed difference in body weight between the selected lines aligns with findings from previous studies [28].

Table 6: Effect of generation on Age of Sexual Maturity, 90-120 days of Egg Shape Index (%) and Egg production.

Generation	Age of Sexual Maturity (45 days)	Egg Shape Index (%)	Egg production 90 days	Egg Shape Index (%)	Egg production 120 days	Egg Shape Index (%)
0	51.40±0.56 a	80.34±0.47 a	36.46±1.14 c	78.92± 0.32 a	25.88±1.04 c	78.78±0.33 a
1	51.76± 0.58 a	77.96± 0.5 a	27.44± 1.59 b	78.99± 0.35 a	22.17± 1.08 b	78.79± 0.38 a
2	50.97± 0.58 a	82.35±0.5 a	26.15± 1.58 b	79.24±0.39 a	21.34±1.40 b	79.22± 0.36 a
3	53.80 ±0.98 a	80.56±0.64 a	17.22± 1.29 a	79.45± 0.39 a	6.83±0.86 a	79.27±0.40 a

Different letters in the same column indicate significant differences between the lines at a significance level of ($p \leq 0.05$).

The interaction between line groups and generation was not significant at level $p \leq 0.05$difference for egg shape index at age of sexual maturity (45, 90 and 120 days) as shown in Figure (4,5 and 6). The interaction between line groups and generation showed significant level $p \leq 0.05$difference in egg production. While Brown lines in generation 0 had high egg production in all generation 90 days 36.66 eggs, the egg production became decrease generation after generation at all ages showed the lowest production in all generation the brown have superiority to other after brown white and gray respectively. The interaction reveals that lines differ in how they respond to generational changes. While all lines show declining productivity, the Gray line appears less affected compared to Brown and White, indicating potential genetic or adaptive advantages.

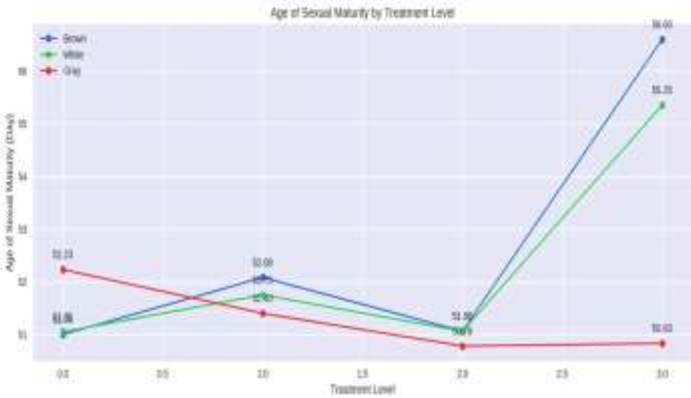

Figure 4: The interaction between line (Brown, White and Gray) and generation at age sexual maturity.

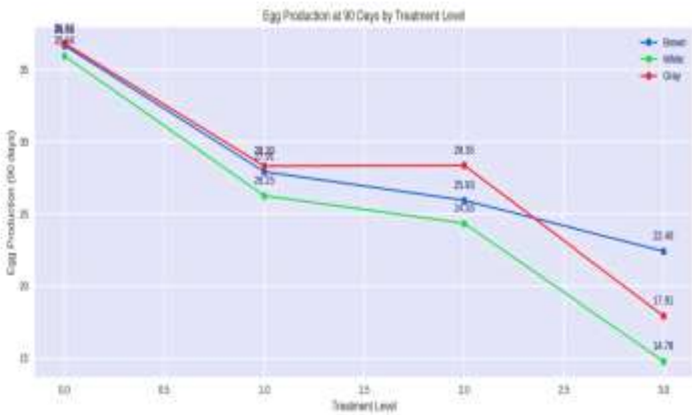

Figure 5: The interaction between line (Brown, White and Gray) and generation at age sexual maturity.

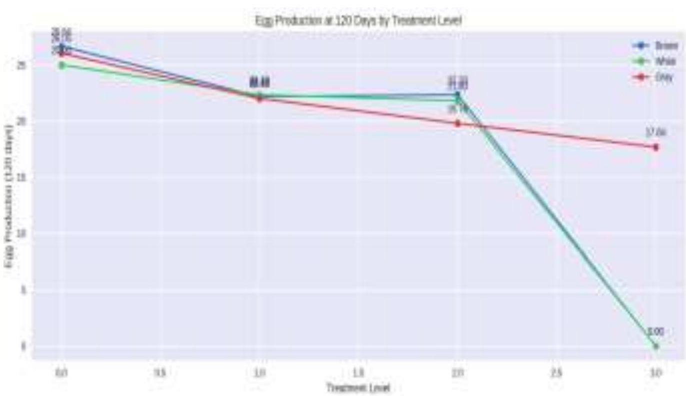

Figure 6: The interaction between line (Brown, White and Gray) and generation at age sexual maturity.

Conclusion

The Brown line had superior body weight and egg production across all ages (sexual maturity, 90 days, and 120 days), but across generation body weight decreased significantly due to cumulative genetic selection effects. Significant positive correlations were observed between body weight at sexual maturity, 90, and 120 days. Early body weights were reliable predictors of long-term growth performance, underscoring the importance of early selection for breeding strategies.

Recommendation

The goal is to create new strains with somewhat high productive performance and more acceptable adaptation from the base population (generation 0) by systematic selection and crossbreeding (between brown and gray lines). The project's breeding and selection plan might need to acquire 2– way, 3 – way.

References

[1] Alsalihi, L. W., Shaker, A. S., Ameen, Q. A., & Ortega Torres, M. J. The effect of line and age on the egg external characteristics of Japanese quail. *Basrah J Vet Res* **21**(S1), 27–34 (2022).

[2] Boni, I., Nurul, H., & Noryati, I. Comparison of meat quality characteristics between young and spent quails. Int *Food Res* J **17**(3), 661–667 (2010).

[3] Taskin, A., Karadavut, U., Tunca, R. I., Genc, S., & Cayan, H. Effect of selection for body weight in Japanese quails (*Coturnix coturnix japonica*) on some production traits. *Ind J Anim. Res* **51** (2), 358-364 (2017).

[4] Jatoi, A. S., Sahota, A. W., Akram, M., Javed, K., Jaspal, M. H., & Hussain, J., Effect of different body weight categories on the productive performance of four close-bred flocks of Japanese quails (*Coturnix coturnix japonica*). *J A & Plant Sci* **23**(1), 7-13 (2013)

[5] Narinc, D., & Aksoy, T. Effects of mass selection based on phenotype and early feed restriction on performance and carcass characteristics in Japanese quails. Kafkas Univ *Vet Fak Derg* **18**(3), 425-430 (2012).

[6] Durmus, D., & Davis, W. Object color naturalness and attractiveness with spectrally optimized illumination. *Opt Express* **25**(11), 12839–12850 (2017).

[7] Hussain, J., Javed, K., Akram, M., Ahmad, H. A., Mahmud, A., & Mehmood, S. Egg quality traits at different ages as affected by selection for higher three-week body weight in three generations of Japanese quail. *J Anim Plant Sci* **27**(1), 15-19 (2017).

[8] Hill, W. G., & Mackay, T. F. D. S. Falconer and Introduction to quantitative genetics. *Genetics* **167**(4), 1529–1536 (2004).

[9] Kaya, E., & Aktan, S. Japon bıldırcınlarında sürü yaşı ve kuluçkalık yumurta depolama süresi: 1. Koyu ak özellikleri üzerine etkileri. Ziraat Fak Derg **6**(2), 30–38 (2011).

[10] Alkan, S., Karabağ, K., Galiç, A., Karsli, T., & Balcioğlu, M. S. Effects of selection for body weight and egg production on egg quality traits in Japanese quails of different lines. *Kafkas Univ Vet Fak Derg* **16**(2), 239-244. (2010).

[11] Cavero, D., & Schmutz, M. Relationship between egg quality traits and hatchability in pure-line white layer strains. *Agri and F. Sci* **1**–7 (2009).

[12] Sezer, M. Heritability of exterior egg quality traits in Japanese quail. *J Appl Biol Sci* **1**(2), 37–40 (2007).

[13] MacLaury, D. W., Insko Jr, W. M., Begin, J. J., & Johnson, T. H. Shape index versus hatchability of fertile eggs of Japanese quail. *Poult Sci* **52**(2), 558–562 (1973).

[14] Duncan, D. B. New multiple range test. *Biometrics* **11**(1), 1–42 (1955).

[15] Islam, S. S., Faruque, S., Khatun, H., & Islam, M. N. Effects of quail genotypes on hatchability traits, body weight and egg production. *J Bang Acad Sci* **38**(2), 219–422 (2014).

[16] Marks, H. L. Long-term selection for four-week body weight in Japanese quail under different selection environments. *Poult Sci* **75**(10), 1198–1203 (1996).

[17] Narinc, D., Karaman, E., Firat, M. Z., & Aksoy, T. Genetic parameter estimates of growth curve and reproduction traits in Japanese quail. *Poult Sci* **92**(7), 1735–1741 (2013).

[18] Minvielle, F. The future of Japanese quail for research and production. *World Poult Sci J* **60**(4), 500–507 (2004).

[19] Shanawany, M. M. Hatching weight in relation to egg weight in domestic birds. *World Poult Sci* J **43**(2), 107–115 (1987).

[20] Narushin, V. G., & Romanov, M. N. Egg physical characteristics and hatchability. *World Poult Sci* J **58**(3), 297–303 (2002).
[21] Minvielle, F. The future of Japanese quail for research and production. *World Poult Sci J* **60**(4), 500–507 (2004).
[22] Falconer, D. S. Introduction to quantitative genetics (4th ed.). *Longman (*1981).
[23] Rehman, A., Jibran, H., Athar, M., Javed, K., Ghayas, A., & Sohail, A. "Productive performance, egg quality, and hatching traits of Japanese quail lines selectedfor higher body weight and egg number. *Turk J Vet & Anim Sci* **46** (2), 322-335 (2022).
[24] Hussain, J., Akram, M., Sahota, A. W., Javed, K., Ahmed, H. A., & Mehmood, S. S. Selection for higher three-week body weight in Japanese quail: 1. Effect on growth performance. *J Anim Plant Sci* **23**, 1496–1500 (2013).
[25] Brah, G. S., Chaudhary, M. L., & Sandhu, J. S. Genetic analyses of body weight in three lines of Japanese quail. *Ind J Poult Sci* **32**, 242–248 (1997).
[26] Saatci, M., Ap Dewi, I., & Aksoy, A. R. Application of REML procedure to estimate genetic parameters of weekly live weights in Japanese quail. *J Anim Breed Genet* **120**, 23–28 (2003).
[27] Aggrey, S. A., & Cheng, K. M. Animal model analysis of genetic (co)variances for growth traits in Japanese quail. *Poult Sci* **73**, 1822–1828 (1994).
[28] Dzuriatmono, S. T., Widyas, N., Cahyadi, M., Wati, A. K., & Dewanti, R. Egg production of black and brown Japanese quails raised under battery cage system. *IOP Conf Ser Earth Environ Sci* **387**, 012042 (2019).
[29] Vieira Filho, J. A., Garcia, E. A., Molino, A. B., Santos, T. A., Almeida Paz, I. C. L., & Baldo, G. A. A. Productivity of Japanese quails in relation to body weight at the end of the rearing phase. *Acta Sci Anim Sci* **38**(2), 213–217 (2016).