The effect of live weight, male to female ratio and breeder age on reproduction performance in Japanese quails *(Coturnix coturnix japonica)*

A. Ipek[#], **U. Sahan and B. Yilmaz**
Department of Animal Science, Faculty of Agriculture, University of Uludag, 16059, Gorukle, Bursa, Turkey

Abstract

This study was carried out to determine the effect of live weight, male to female ratio and breeder age on egg weight and the hatching characteristics in Japanese quails (*Coturnix coturnix japonica*). Female quails at the age of six weeks, were weighed individually and separated into three weight groups depending on their live weights. The groups were classified as light (170-200 g), medium (201-230 g) and heavy (> 230 g). The male quails to be mated with these groups were selected from the individuals with mean live weight of 200-220 g. Groups were placed in the pens at male : female ratios of 1:1, 1:2, 1:3, 1:4 and 1:5. Egg weight was significantly lower in the light group compared with the eggs obtained from the females with medium and heavy live weight. Egg weight increased in accordance with increasing breeder age. Live weight, male to female ratio and breeder age had a significant effect on fertility and hatchability. Fertility increased with an increase in live weight. The highest fertility was found in the group with male to female ratios of 1:2 and 1:3. Fertility at the ages of 11-14 and 15-18 weeks was higher than those of 7-10 and 19-22 weeks of age.

Keywords: Japanese quail, live weight, male to female ratio, hatchability, breeder age
[#]Corresponding author. E-mail: bilgehan@uludag.edu.tr

Introduction

The main purpose of poultry breeder farms is to produce an optimum number of fertile eggs. Both male and female individuals are important for achieving reproductive success (Altan & Oğuz, 1993). Fertility and hatchability are affected by a number of factors (Harris *et al.,* 1984; Mayes & Takeballi, 1984). Changes in many biological features due to the ageing of individual birds or flocks should be expected, as is true for all living organisms (Yannkapoulas *et al.,* 1991). One of the notable differences observed in the egg due to ageing is the increase in egg weight (North & Bell, 1991). A high level of genetic correlation exists between the live weight and egg weight of female breeders (Strong *et al.,* 1978; Marks, 1983). Heavy birds produce heavier eggs than lighter birds (Strong *et al.,* 1978; Marks, 1983; Leeson *et al.,* 1991*).* Egg weight is critical to the hatchability (Altan *et al.,* 1995), incubation period (Hodgetts, 1988), chick weight (Shanawany, 1987), chick mortality during the first days (Skewes *et al.,* 1988) and performance during later stages in life (Morris *et al.,* 1968; Al-Murrani, 1978). Altan *et al*. (1998) reported that egg weight in a quail line selected for live weight was affected by the size of ova produced in the ovaries of females and an increase in albumen secretion, although no differences were observed in shell and albumen quality and egg production. One of the main factors affecting fertility is male to female ratio. It is generally acknowledged that fertility decreases with increasing female to male ratio (Koçak & Özkan, 2000).

In this study the three important factors (e.g. live weight, male to female ratio and age) for hatchability results were examined in Japanese quail.

Materials and Methods

A total of 537 quails that were raised in pens for six weeks, was used. Upon reaching six weeks of age, female quails were weighed individually and separated into three groups according to their live weights. The groups were classified as light (171-200 g), medium (201-230 g) and heavy (> 230 g). Male quails with a live weight between 200-220 g were selected and placed with the different female groups. Breeder quails classified according to weight groups were placed into pens with dimensions of 0.5 x 0.5 x 0.17 m with 1:1, 1:2, 1:3, 1:4

and 1:5 male to female ratios. For each of the three weight groups, 18 male-18 female, 12 male-24 female, 9 male-27 female, 7 male-28 female and 6 male-30 female quails were housed in five separate pens.

Respectively, 14 and 16 hours of illumination were applied during the growth and laying periods. All treatment groups were fed a broiler starter diet containing 230 g CP/kg and 12.8 MJ ME/kg during the growth period. A layer diet containing 180 g CP/kg and 11.3 MJ ME/kg was used from the sixth week onwards. The composition and feeding value of the diets, as shown in Table 1, were analysed using the Weende method (Akyıldız, 1984).

Table 1 Composition and feeding value of the diets

Diet Composition	Broiler starter diet	Layer diet
Dry matter, g/kg	1000.0	1000.0
Organic matters, g/kg	934.9	912.5
Crude protein, g/kg	230.0	180.0
Ether extract, g/kg	71.5	51.3
Crude fibre, g/kg	88.7	124.0
Crude ash, g/kg	65.1	87.5
Nitrogen free extract, g/kg	544.7	469.7
ME, MJ/kg	12.8	11.3

Egg production and mortality were recorded daily. Dead birds were replaced with birds of similar sex, age and live weight to maintain male to female ratios during the experimental period. Eggs obtained from the experimental groups were weighed before being loaded into trays.

Eggs were collected from the pens at breeder ages of 7-10, 11-14, 15-18 and 19-22 weeks and put into incubators. All hatchable eggs were incubated and fertility was determined by microscopically examining the embryonic development of all the eggs that did not hatch. Fertility, hatchability of fertile eggs, hatchability of total eggs and early and late-term embryonic mortalities were determined. Mid-term embryo mortalities were observed very rarely in the study. Therefore, these mortalities were given as late-term embryo mortalities. The trial was a randomised-block factorial design. The Minitab (1991) program was used for the evaluation of statistical analyses, and the Duncan's multiple range test was used in the determination of differences between groups.

Results and Discussion

The effects of live weight, male to female ratio and breeder age on egg weight, fertility and hatchability in Japanese quails are given in Table 2.

Egg weight increased significantly with an increase in live weight. These results are in accordance with the research results of İnal *et al.* (1996) and Yalçın *et al.* (1996). Calculated egg weights were similar to the mean egg weights reported in a number of studies on Japanese quails (Nagarajan *et al.*, 1991; Vilchez *et al.,* 1991; Testik *et al.,* 1993). Breeder age is one of the most important factors to have an effect on the quality of eggs obtained as well as the number and quality of chicks hatched from fertile eggs. One of the marked changes observed in eggs with increased breeder age is the increase in egg weight, not only in chickens (North & Bell, 1990), but also in Japanese quail (Altan *et al.,* 1998). It has been reported that the mean egg weight in Japanese quails was 10 g, and generally exhibited an increase up to five months of breeder age (Nagarajan *et al*., 1991; Altınel *et al.,* 1996; Nazlıgül *et al.,* 2001). In this study, egg weight increased significantly with increasing breeder age ($P < 0.01$). Fertility proved to be significantly higher with increasing breeder age ($P < 0.01$). These results were similar to the results of the research carried out by Narahari *et al.* (1988). Türkmut *et al.* (1999), reported in their study, relating the effects of the selection made for live weight on the reproduction performance

of Japanese quails, that the fertility rates increased in the advanced generations of selection. The effect of male to female ratios in the experimental groups on fertility was found to be significant. Experimental results indicated that the best fertility rates were obtained in the groups that had 1M : 2F and 1M : 3F ratios. However, fertility rates declined in 1M : 1F and 1M : 5F groups. Research results were similar to the fertility rates obtained by Narahari *et al.* (1988), as a result of breeding with different male : female ratios. Uluocak & Okan (1993) emphasized that they obtained the lowest fertility rates from the mating groups of 1M : 1F in their investigation of the effects of mating at different male to female ratios. This is contradictory to reports stating that the highest fertility rates was obtained in 1M : 1F group (Woodard *et al.,* 1973; Altan & Oğuz, 1993). The effect of breeder age on fertility rates was found to be significant ($P < 0.01$). When the fertility data were evaluated in relation to breeder age, fertility rates at the ages of 11-14 and 15-18 weeks were higher than those of 7-10 and 19-22 weeks of age. Altan & Oğuz (1993) reported that the fertility rates of quails at the beginning of the laying period were lower compared to the later periods. Woodard *et al*. (1973) pointed out that hatchability of fertile eggs and fertility in quails declined with ageing.

The effect of live weight on the hatchability of fertile eggs and hatchability of total eggs was significant ($P < 0.01$). Lower hatchability of fertile eggs was observed in the group with low live weight compared with the eggs obtained from the quails in the medium and heavy weight groups, while no statistical difference was noted between the eggs obtained from medium and heavy weight quails with respect to hatchability of fertile eggs. However, hatchability of total eggs increased with increasing live weight. These results are similar to the results of the studies in which a higher hatchability of total eggs was recorded in the heavy line compared with the light line (Darden & Marks, 1988; Marks, 1991).

Table 2 The effects of live weight, male to female ratio and breeder age on egg weight, fertility and hatchability in Japanese quails (mean ± standard error of the mean)

Traits	Egg weight (g)	Fertility (%)	Hatchability of fertile eggs (%)	Hatchability of total eggs (%)	Early term embryo mortalities (%)	Late term embryo mortalities (%)
Live weight	**	**	**	**	**	**
Light	10.32±0.18^{b}	87.73±2.02^{c}	87.20±2.12^{b}	76.50±1.67^{c}	6.32±0.55^{a}	8.36±0.78^{a}
Medium	11.48±0.22^{a}	90.93±2.28^{b}	91.16±2.60^{a}	82.90±2.04^{b}	4.02±0.36^{b}	5.67±0.51^{b}
Heavy	11.59±0.29^{a}	93.63±2.59^{a}	91.03±2.48^{a}	85.23±2.11^{a}	4.38±0.31^{b}	5.47±0.49^{b}
Male : Female	NS	**	NS	**	NS	NS
1:1	11.07±0.14	87.00±1.87^{c}	89.72±1.83	78.05±1.61^{c}	4.91±0.45	6.55±0.65
1:2	11.21±0.16	94.44±2.12^{a}	89.64±1.77	84.66±1.85^{a}	4.85±0.42	6.69±0.63
1:3	11.08±0.14	94.77±2.14^{a}	89.91±1.91	85.22±1.87^{a}	4.89±0.42	6.32±0.59
1:4	11.18±0.15	90.88±1.98^{b}	89.73±1.84	81.55±1.74^{b}	4.90±0.44	6.54±0.61
1:5	11.12±0.15	86.72±1.84^{c}	90.19±1.96	78.22±1.63^{c}	4.90±0.44	6.97±0.72
Breeder age (week)	**	**	**	**	**	**
7-10	9.22±0.17^{d}	89.24±1.98^{b}	89.64±1.54^{b}	80.00±2.13^{b}	5.19±0.48^{b}	6.36±0.55^{b}
11-14	10.98±0.21^{c}	92.84±2.18^{a}	91.43±1.62^{a}	84.88±2.87^{a}	4.26±0.33^{c}	5.11±0.46^{c}
15-18	11.97±0.20^{b}	92.08±2.10^{a}	91.12±1.59^{a}	83.91±2.72^{a}	4.28±0.35^{c}	5.46±0.50^{c}
19-22	12.35±0.25^{a}	88.88±1.79^{b}	87.05±1.43^{c}	77.37±1.86^{c}	5.89±0.52^{a}	8.98±0.84^{a}

^{a,b,c} Column means within parameter with common superscripts do not differ (** $P < 0.01$)
NS - not significant

The effect of male : female ratios on the hatchability of fertile eggs was found non-significant, whereas the effect of this ratio on the hatchability of total eggs was significant. Begin & Maclaury (1974) stated that differences occurred in the hatchability of fertile eggs in quails with an increase in age of breeder females, hatchability being inversely proportional with age. Woodard *et al*. (1973) reported that hatchability of fertile eggs declined with increasing age in quails.

Conclusions

Considering all these results and evaluations, live weight, male : female ratio and breeder age were determined to be crucial on reproduction characteristics in quails. Positive advances will be obtained in the egg weight, fertility ratio, and hatchability of fertile eggs when breeder farm managers use birds with high live weight as breeders when forming breeder flocks. It was evident that 1M : 2F and 1M : 3F ratios could be suitable ratios, depending on the conditions of operations. Optimum breeder renewal age, fertility and hatchability results should be determined via economical analysis in breeder managements.

References

Akyıldız, R., 1984. Yemler Bilgisi Laboratuar Kılavuzu (Turkish of: *Laboratory guide of Feeds and Feed Technology*). Ank. Univ. Zir. Fak. Yay. 895, Uygulama Kılavuzu ANKARA. pp. 213-236.

Al-Murrani, W.K, 1978. Maternal effects on embryonic and post embryonic growth in poultry. Br. Poult. Sci. 19, 277-281.

Altan, Ö. & Oğuz, İ., 1993. Bıldırcınlarda *(Coturnix coturnix japonica)* yaşın ve erkek:dişi oranının kuluçka özellikleri ve döllü süre üzerine etkileri (Turkish of: *Effect of mating rations and parental age on fertility, hatchability, duration and recovery of fertility in Japanese quail (*Coturnix coturnix japonica*)*). E. U. Zir. Fak. Derg. 30(1-2), 57-64.

Altan, Ö., Oğuz, İ. & Settar, P., 1995. Japon bıldırcınlarında yumurta ağırlığı ile özgül ağırlığının kuluçka özelliklerine etkileri (Turkish of: *Effect of egg weight and specific gravity on hatchability and chick weight in Japanese quails*). Tr. J. Agric. Forest. 19, 219-222.

Altan, Ö., Oğuz, İ. & Akbaş, Y., 1998. Japon bıldırcınlarında *(Coturnix coturnix japonica)* canlı ağırlık yönünde yapılan seleksiyonun ve yaşın yumurta özelliklerine etkileri (Turkish of: *Effects of selection for high body weight and age of hen on egg characteristics in Japanese quail (*Coturnix coturnix japonica*)*. Tr. J. Vet. Anim. Sci. 22, 467-473.

Altınel, A., Güneş, H., Kırmızıbayrak, T., Çörekçi, Ş.B. & Bilal, T., 1996. Japon bıldırcınlarında *(Coturnix coturnix japonica*) yumurta kalitesi ve özellikleri üzerinde araştırmalar (Turkish of: *The studies on egg quality characteristics of Japanese quails (*Coturnix coturnix japonica*)*. İ. U. Vet. Fak. Derg. 22(1), 203-213.

Begin, J.J. & Maclaury, D.W., 1974. Age of breeder versus hatchability of fertile eggs in coturnix quail. Poult. Sci. 53, 1614-1616.

Darden, J.R. & Marks, H.L., 1988 Divergent selection for growth in Japanese quail under split and complete nutritional environments, 1. Genetic and correlated responses to selection. Poult. Sci. 67, 519-529.

Harris, J.R., Benson, J.A. & Sellers, R.S., 1984. The influence of day length, body weight and age on the reproductive ability of broiler breeder cockerels. Poult. Sci. 63, 1705-1710.

Hodgetts, B., 1988. Hatch time and chick quality. Hatch Handouts. ADAS.

İnal, Ş., Dere, S., Kırıkçı, K. & Tepeli, C., 1996. Japon bıldırcınlarında *(Coturnix coturnix japonica)* canlı ağırlığa göre yapılan seleksiyonun yumurta verimi, yumurta ağırlığı, fertilite, kuluçka randımanı ve yaşama gücüne etkileri (Turkish of: *Effects of selection for body weight of Japanese quail (*Coturnix coturnix japonica*) on egg production, egg weight, fertility, hatchability and survivability)*. Vet. Bil. Derg. 12(2), 13-22.

Koçak, Ç. & Özkan, S., 2000. Bıldırcın, Sülün ve Keklik Yetiştiriciliği (Turkish of: *Quail, pheasant and partridge breeding)*. E. Ü. Z. F. Yayın. No.:538

Leeson, S., Coston, L. & Summers, J.D., 1991. Significance of physiological age of leghorn pullets in terms of subsequent reproductive characteristics and economic analysis. Poult. Sci. 70, 37-43.

Marks, H.L., 1983. Genetics of growth and meat production in other galliformes. In: Poultry breeding and genetics. Ed. Crawford, R.D., Elsevier, Part 4, Amsterdam. pp. 677-690.

Marks, H.L., 1991. Divergent selection for growth in Japanese quail under split and complete nutritional environments 4. genetic and correlated responses from generations 12-20. Poult. Sci. 70, 453-462.

Mayes, F.J. & Takeballi, M.A., 1984. Storage of the eggs of the fowl *(Gallus domesticus)* before incubation: A Review. World's Poult. Sci. 40, 131-140.

Minitab, 1991. Minitab Reference Manual Minitab Inc.State Coll. PA 16801, USA.

Morris, R.H., Hessel, D.F. & Bishop, R.J., 1968. The relationship between hatching egg weight and subsequent performance of broiler chickens. Br. Poult. Sci. 5, 305-315.

Nagarajan, S., Narahari, D., Jayaprasad, I.A. & Thyagarajan, D., 1991. Influence of stocking density and layer age on production traits and egg quality in Japanese quail. Br. Poult. Sci. 32, 243-248.

Narahari, D., Abdulmujeer, K., Thangavel, A., Ramamurty, N., Viswanathan, S., Mohan, B., Murugananadan, B. & Sundararusu, V., 1988. Traits ınfluencing the hatching performance of Japanese quail eggs. Br. Poult. Sci. 29, 101-112.

Nazlıgül, A., Türkyılmaz, K. & Bardakçıoğlu, H.E., 2001. Japon bıldırcınlarında *(Coturnix coturnix japonica)* bazı verim ve yumurta kalite özellikleri üzerinde bir araştırma (Turkish of: *A study on some production traits and egg quality characteristics of Japanese quail (*Coturnix coturnix japonica*))*. Tr. J. Vet. Anim. Sci. 25, 1007-1013.

North, M.O. & Bell, D.D., 1990. Commercial chicken production manual. An Avi Book, 4th ed. New York.

Shanawany, M.M., 1987. Hatching weight in relation to egg weight in domestic birds. World's Poult. Sci. 43, 107-115.

Skewes, P.A., Wilson, H.R. & Mather, F.B., 1988. Correlations among egg weight, chick weight and yolk sac weight in Bobwhite quail *(Calinus virginianus).* Florida Sci. 51, 159-162.

Strong, C.F., Nestor Jr., K.E. & Bacon, W.L., 1978. Inheritance of egg production, egg weight, body weight and certain plasma constituents in coturnix. Poult. Sci. 57, 1-9.

Testik, A., Uluocak, N. & Sarıca, M., 1993. Değişik genotiplerdeki japon bıldırcınlarının *(Coturnix coturnix japonica*) bazı verim özellikleri (Turkish of: *Studies on some production traits of Japanese quail (*Coturnix coturnix japonica*) of different genotypes).* Tr. J. Vet. Anim. Sci. 17, 167-173.

Türkmut, L., Altan, Ö., Oğuz, İ. & Yalçın, S., 1999. Japon bıldırcınlarında canlı ağırlık için yapılan seleksiyonun üreme performansı üzerine etkileri (Turkish of: *Effects of selection for four week body weight on reproductive performance in Japanese quail).* Tr. J. Vet. Anim. Sci. 23, 229-234.

Uluocak, A.N. & Okan, F., 1993. Bıldırcınlarda değişik erkek–dişi oranlarının kuluçka sonuçlarına etkisi (Turkish of: *The effect of different sex ratios on the hatching performance of Japanese quail).* J. Agric. Fac. Cukurova Univ. 8(3), 167-174.

Vilchez, C., Touchburn, S.P., Chavez, E.R. & Chan, C.W., 1991. Effect of feeding palmitic, oleic and linoleic acids to japanese quail hens *(Coturnix coturnix japonica)* 1.reproductive performance and tissue fatty acids. Poult. Sci. 70, 2484-2493.

Woodard, A.E., Abplanalp, H., Wilson, W.O. & Vahra, P., 1973. Japanese quail husbandry in the laboratory. Department of Avian Sci. University of California, Davis, C.A, 95616.

Yalçın, S., Akbaş, Y., Ötleş, S. & Oğuz, İ., 1996. Effect of maternal body weight of quail (C*oturnix coturnix japonica*) on progeny performance. E. Ü. Zir. Fak. Derg. 33(2-3), 9-16.

Yannakapoulas, A.L., O'Sullivan, N.P., Dunnungton, E.A. & Siegel, P.B., 1991. Relationship among age of dam, egg components, embryo lipid transfer and hatchability of broiler breeder eggs. Poult. Sci. 70, 2180-2185.