EFFECT OF CAGES TYPE AND MATING MANAGEMENT ON FERTILITY AND HATCHABILITY OF JAPANESE QUAIL

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Abstract

This study was designed to evaluate the effects of different mating ratios; (1:1, 1:2, 1:3, 1:4 and 1:5 male to females, respectively) and cages types:(individual and colony) on the fertility and hatchability rate of Japanese quail from 16-32 weeks of age. A total number of 260 sexed Japanese quails (65 males &195 females) at 16 weeks of age were used. All birds were randomly divided into two experimental groups according to two cage types (individually & colony cages); 160 birds for colony cage and 100 birds for individually cage. Each group was divided into five treatments of mating ratios (1:1, 1:2, 1:3, 1:4 and 1:5 male to females, respectively), each treatment of individual cages divided into five replicates, while the colony cages was one replicate for each. The results showed that fertility rate and hatchability rate for eggs produced from quails which reared in individual cages was significantly higher (P≤0.05) than those in colony cages. Also, the mating ratios of (1:1, 1:2 and 1:3 male to females) had higher (P≤0.05) fertility and hatchability rates as compared with those of (1:4 and 1:5 male to females).However, data indicated that cages type and different mating ratios had no significant effect on chick weight at hatch (absolute & percentage).From these results, it could be concluded that individual cages had better fertility and hatchability rate as compared with those which reared in colony cages. Also, the mating ratios of (1:1, 1:2 and 1:3 male to females, respectively) are considered the best for rearing adult Japanese quail to obtain the high fertility and hatchability rates compared with others (1:4 and 1:5 male to females, respectively).

Key words: Mating ratio, fertility, hatchability, Japanese quail, cage type

INTRODUCTION

Japanese quail is considered one of the important alternative resources of animal protein, because it have many advantages such as fast growth, early sexual maturity, short incubation period, small size and high egg production, low feed andrequirements and its housing costs, less floor spaces compared with the different species of poultry [13]; [18]. Also quails are widely distributed in many countries of the world [22]; [20] and [7]. Cage type (Individual cage vs. colony cage) and mating ratio are considered two of the most important factors affecting performance of quails, specially fertility and hatchability. It is important to find out the optimum mating ratio of Japanese quails for suitable productive and reproductive performance. Optimum sex ratio for quails is 1M:2F ([24]. Also, [9] investigated that 1M: 2F and 1M: 3F ratios could be suitable ratios for high reproductive performance in Japanese quails depending on the conditions of operations. [2] showed that the mating ratio (1M:1F) had highest (79%) fertility rate in Japanese quails, followed by 74.7% and 70% in (1M:2F), (1M:3F) and (1M:4F), respectively. [5] reported that the highest fertility rate in Japanese quails was obtained from the groups of (1M:1F) and (1M:2F) mating ratios as compared to groups of (1M: 4F) and (1M:5F) mating ratio. [10] showed that fertility was higher in sex ratio of 1M: 2F (79.17%) than in 1M:3F (75.17%) for Japanese quails. They added that hatchability percentage of fertile eggs set was significantly higher (P<0.001) at sex ratio 1:3 (70.12%) than those at 1:2 (64.75%) for Japanese quails.[2] showed that the highest hatchability

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rate in Japanese quails was recorded 78 % of 1M: 1F mating ratio, followed by 67, 63 and 62% in 1M: 2F, 1M: 3F and 1M: 4F groups, respectively. They added that mating ratio 1M: 3F had highest chick weight (8.16g) followed by 1M: 1F (7.65 g), 1M: 4F (7.53 g) and 1M: 2F (7.41g) of Japanese quails. [19] found that the hatchability of fertile eggs was higher in the mating ratio of 1M: 3F (71.48%) than 1M: 2F (26.32%) in Japanese quails. Also, cage type and mating ratio studied by [1], [23], [4]. They indicated that mating ratios of 1:2, 1:3, 1:4 and 1:5 male to females, respectively in colony cages gives high productive and reproductive performance. Individual cages for quails is recommended as rearing system in the genetic studies, while the producers prefer colony cages in commercial and economical production. [16] found that the quails which were kept in individual cage, a single male with one to three females is sufficient and reduce fighting among birds, also pair mating in individual cages gives good fertility. [11] indicated that grouping a single 1 male with 2 to 5 females in colony cages will generally give high fertility rate than individual cages in Japanese quails. [15] showed that the cage type (individual or colony cages) had no significant effect on fertility rate of pharaoh quails during the period from 5 to 42 weeks of age. He added that the pharaoh quails which housed in individual cages had lower ($P<0.05$) hatchability of total and fertile eggs than those in colony cages during the period from 5 to 42 weeks of age.On the other hand, [14] found no significant difference in fertility as affected by mating ratios (1M:1F, 1M:2F, 1M: 3F and1M:4F) in Japanese quails during period from 8 to 32 weeks of age. [26] showed that the fertility and hatchability rate for Bobwhite quails was insignificantly affected by cage type (Individual vs. colony) at six months. Yurdakul (2006) found no significance difference in fertility rate of Japanese quails housed in individual and colony cages.

Therefore, the present study aimed to investigate the effect of cage type and different mating ratios on fertility and hatchability rate for Japanese quail.

MATERIAL AND METHOD

This study was carried out at the Experimental Poultry Farm Animal production Department, Faculty of Agriculture, AL-Azhar University, Assiut Branch, Egypt.

Experimental Design: A 260, Japanese quails (65 males and 195 females), aged 16 weeks were used in this experiment. All birds were healthy and clinical, wing banded and individually weighed. The experiment extended 16 weeks. This experiment was designed to determine the effect of five mating ratios (1:1, 1:2, 1:3, 1:4 and 1:5 male to females) of Japanese quails breeders in both individually and colony cages on productive and reproductive performance during the period from May to September 2014. At 16 weeks of age, all birds were randomly divided into two experimental groups according to two cage types (individually & colony cages); 160 birds for colony cage and 100 birds for individually cage. Each group was divided into five subgroups of mating ratios (1:1, 1:2, 1:3, 1:4 and 1:5 male to females), with five replicates for individually cage and one replicate for colony cage, Table 1.

Table 1 The number of birds per treatment

Cage type	Mating ratio	Number of birds per replicate		Replicate number
		Male	Female	
Individually cage	1:1	1	1	5
	1:2	1	2	5
	1:3	1	3	5
	1:4	1	4	5
	1:5	1	5	5
Colony cage	1:1	8	8	1
	1:2	8	16	1
	1:3	8	24	1
	1:4	8	32	1
	1:5	8	40	1

Birds' management: Birds were housed under the natural prevailing environmental conditions in open house, and were exposed to natural ventilation. Feed was available allover experimental period; all birds in each replicate had the same feeder space regardless of cage type or mating ratio. Also, fresh water was available allover experimental period; the normal waterers were used in all groups. Birds were subjected to photoperiod regime of 16L: 8D during the whole experiment period with light intensity of 20 lux.

Temperature humidity index: The average of temperature humidity index (THI) was calculated according to the formula of Maria *et al.* (2002) as follow: THI=dbºC-((0.31-0.31RH) (dbºC-14.4)), where: db°C= dry bulb temperature in Celsius and Rh = RH% / 100, Table 2.

Table 2 The average of ambient temperature (ºC), relative humidity (RH) and temperature humidity index (THI) inside and outside the house

Week	Period	Season	Exterior			Interior			THI Ext-In (units)
			AT (ºC)	RH (%)	THI (units)	AT (ºC)	RH (%)	THI (units)	
1	1	Spring	38.14	58.21	35.09	33.42	60.92	31.12	3.96
2			38.71	50	34.89	34.14	51.78	31.171	3.72
3			38.28	54.42	34.92	33.71	56.85	31.13	3.78
4			40.42	52.42	36.55	35.42	55.71	32.53	4.02
5	2	Summer	39	56.28	35.634	35.71	58.35	32.94	2.68
6			42.42	55.14	38.50	36.85	58.85	33.98	4.51
7			39.85	58	36.55	35.71	60	33.07	3.47
8			42.85	54.85	38.89	37.71	58.42	34.72	4.16
9	3		40.28	56.85	36.80	35.71	58.78	32.96	3.84
10			43.71	51.57	39.31	38.57	55.21	35.22	4.09
11			42.57	51.14	38.28	37.71	54.14	34.40	3.87
12			40.42	50.71	36.46	35.57	53	32.49	3.96
13	4		41.28	54.85	37.49	35.42	56.71	32.60	4.89
14			39.14	55.14	35.69	34.57	57	31.88	3.81
15			37.42	50.28	33.873	34.71	52	31.69	2.18
16			39.28	54.85	35.80	34.42	57.07	31.76	4.03

AT (ºC) = Ambient temperature, RH (%) = Relative temperature and THI (units) = Temperature humidity index

Experimental diet: The composition and calculation of the ration which used in this experiment calculated according to [17], and presented in table 3.

The studied traits: At 20th week of age, eggs were collected and stored 7 days at 15-18ºC and 70-75% **RH** before incubation. The incubation was performed by using automatic Paterzime. Fertility and hatchability percentages were calculated as follow:

Fertility (%) = (Fertile eggs number/ Total set eggs number) *100

Hatchability (%)= (Number of hatched chicks/ Total fertile eggs number)*100

Statistical analysis: The achieved Data were subjected to a two-ways analysis of variance with treatment group effect by using the GLM procedure of **[21]** according to the following model:

Yijk = μ + Ci + Mj + CMij + eijk

Where, **Yijk** = an observation; **μ** = general mean; **Ci** = fixed effect of ith Cage types, **i** = 1 & 2 (individual or colony); **Mj** = fixed effect of jth mating ratios, **i** = 1, 2, 3, 4 and 5 (1:1, 1:2, 1:3, 1:4 and 1:5 M:F); **CMij** = interaction effect of ith Cage types and jth mating ratios, **eijk** = error of the model, which included all the other effects not specified in the mixed model. Differences among experimental groups were separated by Duncan's multiple range test [6]. The rate values of fertility and hatchability were transformed to Arcsin values before analysis.

Table 3 Composition of experiment diet

Ingredients	Layer (%)	Calculated Analysis**	%
Yellow corn (8.8%)	54.50	Crude Protein (%)	22.5
Soybean meal (44%)	31	ME (KCal/ Kg diet)	2710
Concentrate*	8	Calcium (%)	2.77
Salt	0.50	Available phosphorus (%)	0.87
Dicalcium phosphate	1.50		
Limestone	4.50		
Total	100		

* The layer concentrate contains: Crude protein 51.00% - Lysine 3.30%- Crude fiber 2.00% - Calcium 8.00%- Crude fat 6.40 % -Available phosphorus 3.00% - Methionine 1.67%- Salt 3.19- Methionine+ Cystine 2.25% - Metabolizable energy 2400 kcal/ diet. ** Calculated according to NRC,1994

RESULTS AND DISCUSSIONS

Effect of cage type: Data in Table 4 shows that fertility and hatchability rate for eggs produced from quails which reared in individual cages was significantly (P≤0.05) higher than those in colony cages by about 2% and 4.4%, respectively. However, cage type had no significant effect on chick weight at hatch (absolute & percentage). The reduction of fertility and hatchability rates in colony cages may be attributed to stress, cannibalism and the high aggressive activity among males compared with individually cages [16]. These results in agreement with those of [16], who found that the higher fertility rate for Japanese quails was recorded in the individual cage 87.43% than that 84.26% of the colony cages. However, [11] indicated that grouping 1 male with 2 to 5 females in colony cages will generally give high fertility rate than individual cages in Japanese quails. [15] showed that the pharaoh quails which housed in individual cages had lower (P<0.05) hatchability of total and fertile eggs than those in colony cages during the period from 5 to 42 weeks of age. On the other hand, [26] showed that the fertility and hatchability rate for Bobwhite quails was insignificantly affected by cage type at six months.

Effect of mating ratio: Data in Table 4 shows that mating ratios of (1:1, 1:2 and 1:3 male to females) had higher (P≤0.05) fertility and hatchability rates by about 38 and 29%, respectively as compared with those of (1:4 and 1:5 male to females). However, mating ratios had no significant effect on chick weight at hatch (absolute & percentage). The improvement in fertility rate at lower mating ratios could be attributed to that females in these groups received more mounting than those in other groups [10], increase females may be due to stress of males, also males at lower sex ratio can successfully mate and service a harem [12]. Fertility can affect hatchability during the process of incubation and hatching; hatchability is reduced with reduction in fertility [8].These results in agreement with those of [25], who showed that mating ratios of one male to four, five or six females resulted in lower fertility than ratio of one male to three females of bobwhite quails. Abdel Magied (2006) reported that there was a significant steep decline in fertility rate and hatchability (%) of fertile eggs for Japanese quails with increasing number of females per male. Also, [14] found that the mating ratios had a significant effect on hatchability in Japanese quails at different mating ratios amounted 1:1, 1:2, 1:3 and 1:4 male to females were 72.15, 72.03, 63.65 and 59.04%, respectively during the period from 8 up to 32 weeks of age. However, [9] found that the effect of male to females ratios on hatchability of fertile eggs was not significant, for Japanese quails at 7-22weeks of age. [3] showed that the different mating ratios of (1M: 3F, 1M: 4F, 1M: 5F, and 1M: 6F) had no significant effect on fertility and hatchability of Japanese quails at six weeks of age which amounted (92.65, 90.45, 91.21 and 90.71 percent, respectively).

Effect of interaction: Data in Table 4 shows that the interaction (cage type x mating ratio) had significant (P≤0.05) effect on fertility and hatchability rates for Japanese quails; quails in individually cages had better fertility and hatchability than those in colony cages especially at lower mating ratios (1:1,

1:2, 1:3 male to females, respectively) .This may be due to the effect of stress, cannibalism and aggressive behavior among males in colony cage which led to that females in these groups received lower mounting compared with those in individually cages. But data showed no significant effects of interaction (Cage type x mating ratio) on hatched chick weight (absolute & percentage). These results in agreement with [16], who found that the higher fertility rate for Japanese quails was recorded in the individual cage 87.43% than that 84.26% of the colony cages. They added that the higher percentages of fertility rate in Japanese quails were obtained in (1M:1F) and (1M:2F) mating groups, while the lowest value was observed in (1M:5F) mating ratio. Also, [9] indicated that the best fertility rates in Japanese quails were obtained in the groups that had 1male: 2females and 1male: 3 females ratios. While, the fertility rates declined in 1male:5females groups allover experimental period from 7 to 22weeks of age. On the other hand, [14] found no significant difference in fertility rate between different mating ratio (1M:1F), (1M:2F), (1M:3F), and (1M:4F) in Japanese quails aged from 8 to 32 weeks. Yurdakul (2006) found no significance difference in fertility rate of Japanese quails housed in individual and colony cages.

Table 4 Effect of cage type and mating ratio on fertility, hatchability, and chick weight at hatching

Traits / Treatments	Fertility (%)	Hatchability (%)	Chick weight	
			(g)	(%)
Effect of cage type (CT)				
Colony cage	76.80 b ±1.3	77.94 b±6.3	6.37±0.1	66.95±1.4
Individual cage	78.13 a ±3.0	81.40 a ±2.4	6.39±0.0	67.28±0.6
Effect of mating ratio (MR)				
1:1	88.66 a ±4.0	83.10 a ±6.4	6.52±0.0	65.30±1.6
1:2	89.15a±2.9	84.32 a ±1.8	6.47±0.1	64.07±0.9
1:3	87.66a±3.0	84.61 a ±2.2	6.39±0.1	66.83±1.1
1:4	64.50b±2.5	81.57 a ±5.0	6.24±0.1	65.87±1.5
1:5	64.16b±5.8	64.27 b ±4.5	6.32±0.1	65.43±0.6
Effect of interaction (CT×MR)				
Colony cage*1:1	89.00A±0.0	82.60B±0.1	6.55±1.2	67.76±1.0
Colony cage*1:2	84.00B±0.2	85.71AB±2.1	6.37±0.2	65.33±0.9
Colony cage*1:3	76.00C±0.0	84.73AB±1.1	6.33±1.3	65.77±0.8
Colony cage*1:4	72.00C±1.0	66.66D±0.2	6.36±0.0	64.03±1.1
Colony cage*1:5	60.00E±0.1	60.00E±0.6	6.23±0.7	62.86±1.8
Individual cage*1:1	89.00A±1.9	82.00B±7.5	6.52±0.0	66.81±0.8
Individual cage*1:2	90.66A±2.6	89.24A±4.0	6.49±0.0	66.42±1.3
Individual cage*1:3	84.00B±2.6	86.59AB±2.5	6.40±0.1	66.04±0.5
Individual cage*1:4	63.00DE±1.7	71.56C±1.9	6.21±1.0	62.64±1.1
Individual cage*1:5	65.00D±1.8	65.12D±1.2	6.33±0.1	63.99±1.2
Significance				
Cage type	*	*	NS	NS
mating ratio	**	*	NS	NS
Interaction	**	*	NS	NS

a ,b, c Means with different superscripts in the same column are significantly different (P< 0.05).
CT= Cage type MR= Mating ratio *=Low significant **=High significant ***=Highly significant NS=Not significant

CONCLUSIONS

From this study, it could be concluded that the individually cages system had better for fertility and hatchability rate compared to colony cages. Also, the mating ratios of (1:1, 1:2 and 1:3 male to females, respectively) are considered the best for rearing adult Japanese quail to obtain the high fertility and hatchability rates compared with others (1:4 and 1:5 male to females, respectively). Hence, the author recommend the breeders to use individually cage system at mating ratios of (1:1, 1:2 and 1:3 male to females, respectively) in breeding and selection to high return.

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