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Research Article

Effect of the Hatching Month as an Environmental Factor on the Hatching Features of Bronze Turkeys

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Abstract: The aim of this study was to determine the effect of hatching month on the hatching features of Bronze turkeys, and to determine the suitable months for hatching. For this purpose, the hatching records of Bronze turkeys raised in the Bingöl Beekeeping and Turkey Production Station from 1998 to 2003 were used.

Egg fertility and hatchability of both total eggs and of fertile eggs were investigated, and it was found that the effect of hatching month on all 3 variables was statistically significant. The results regarding all 3 variables were lower in June as compared to the other months investigated. For this reason, it was concluded that hatching should not be performed in June, when temperatures increase sharply.

Key Words: Turkey, hatching month, hatching season, egg fertility, hatchability

Bir Çevre Faktörü Olarak Kuluçka Ayının Bronze Hindilerin Kuluçka Özelliklerine Etkisi

Özet: Bu çalışma, Bronze hindilerde kuluçka özellikleri üzerine kuluçka ayının etkisini ve kuluçka için uygun ayları belirlemek amacıyla yapılmıştır. Bu amaçla Bingöl Arıcılık ve Hindi Üretme İstasyonu'nda yetiştirilen Bronze hindilere ait 1998-2003 yıllarındaki kuluçka kayıtları kullanılmıştır.

Araştırmada döllülük oranı, kuluçka randımanı ve çıkış gücü özellikleri incelenmiştir. Araştırma sonucunda her üç özelliğe de kuluçka ayının etkisi istatistiki olarak önemli bulunmuştur. Her üç özelliğe ait sonuçların haziran ayında, incelenen diğer aylara göre düşük olduğu görülmüştür. Bu nedenle sıcakların artmaya başladığı haziran ayında kuluçka işlemi yapılmaması gerektiği sonucuna varılmıştır.

Anahtar Sözcükler: Hindi, kuluçka ayı, kuluçka mevsimi, yumurta döllülüğü, kuluçka kabiliyeti

Introduction

In poultry breeding, one of the main aims of production is to provide an increase in poult production. The production costs of poults can be lowered by increasing egg yield, fertilization capacity, and hatchability. Egg yield in turkeys is lower compared to that in other poultry species. For this reason, the primary way to increase the number of poults is to increase the number of eggs for hatching produced by each mother bird, and these eggs should benefit from the most effective hatching procedure available. In addition to low egg yield, decreases in the egg fertility and hatchability constitute great obstacles for breeding enterprises. Therefore, Turkish breeding programs are searching for ways to determine the factors affecting hatching, and for defining and improving the environmental factors affecting the factors related to hatching (1,2).

Mean egg fertility in Bronze turkeys raised in the Bingöl Beekeeping and Turkey Production Station was 88.8%-89.0%, the hatchability of total eggs was 66.0%-

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68.5%, and the hatchability of fertile eggs was 73.0%-77.1% (3,4).

One of the main factors affecting the hatching features is the effects of seasonal environment change. When the effect of the hatching month on egg fertility and hatchability is investigated, climatic factors, in particular, should be considered (5). Problems may arise because of seasonal changes, usually during the summer, in the regions where the temperature and humidity are high. Furthermore, when the necessary precautions are not taken in hatching houses in regions that are dry and cold in winter, significant decreases in the hatchability may occur (6).

Increases in environmental temperature and an advanced yield period lower the hatchability in poultry. Specifically, high environmental temperature causes a decrease in the reproduction efficiency of male and female turkeys. This decrease is observed during the production of germ cells, release of the egg, fertilization, and reduction in the strength of the fetus to survive (1). High temperature was reported to be the main environmental factor affecting fertilization and hatchability, which in turn, affects both the quantity and quality of hatching (7). It was also reported that differences in the embryonic development in eggs, brought about by relatively high temperatures during summer months, is the main cause of the reduction of the hatchability of fertile eggs (8).

It has been revealed that the hatching month and season have significant effects on egg fertility (1,9-13), hatchability of total eggs (1,10,12-17), and hatchability of fertile eggs (1,11,14,18) in poultry. It was reported that egg fertility and hatchability were usually lower in the summer months, when the temperature rises, compared to the other months and seasons (1,10,12,13,15-18).

The climate was proven to have a direct effect on the various yields of the poultry. Successful turkey breeding primarily requires the determination of the seasonal factors affecting hatchability, and the determination of resistance to diseases and adaptation capacity. With these criteria in mind, the present study aimed to investigate the effect of hatching month on hatching variables in Bronze turkeys, and to determine the appropriate month/months for hatching.

Materials and Methods

Incubation records of Bronze turkeys in the Bingöl Beekeeping and Turkey Production Station kept between the years 1998 and 2003 were used in this study. The distribution of the egg records according to years and months is presented in Table 1. Laying period started at the end of January in 1999 and 2000, and in other years from the end of February, and lasted until May in 1999, and until the end of June in other years.

Animals were raised in an intensive system, in base-supported poultry houses. Maintenance-raising conditions in the enterprise, such as feeding, watering, cleaning, and vaccination, were performed uniformly and regularly in the years the data were collected. Free mating was used in the flock, and the ratio of males to females was 1/10. No systematic selection was applied to the flocks and they were renewed at the end of the laying period.

Table 1. The numbers of eggs set to hatch according to years and months.

MONTHS YEARS	February	March	April	May	June	Total
1998	-	12,346	11,735	10,116	9298	43,495
1999	28,331	25,384	18,288	14,840	-	86,843
2000	21,478	27,008	26,178	27,531	12,570	114,765
2001	-	29,937	31,114	33,585	14,706	109,342
2002	-	34,140	32,617	23,114	17,094	106,965
2003	-	43,784	14,327	25,064	10,504	93,679
Total	49,809	172,599	134,259	134,250	64,172	555,089

The eggs were collected every morning and stored for 7 days; they were put into incubation at 1-week intervals using fully automatic incubation machines. Temperature and humidity in the incubators were 36.67-37.8 °C and 84%-86%, respectively, and in the hatchers they were 35.6-36.67 °C, and 90%-92%, respectively. Hatching usually started on day 27 and was completed by the end of day 28. The processes utilized, fumigation, storage conditions, and machine conditions, were uniform for every hatching period.

Mean temperatures (°C) in the years and months the incubation records were kept, and mean relative humidity (%) values for Bingöl province were acquired from the General Directorate of the State Meteorology Affairs, and are shown in Table 2.

The variables investigated in the study were determined as follows (19):

Egg fertility (%) = (Number of fertile eggs/Total number of eggs incubated) x 100,

Hatchability of total eggs (%) = (Number of chicks hatched/Total number of eggs incubated) x 100; Machine Yield (hatchability of fertile eggs) (%) = (Number of chicks hatched/Number of fertile eggs) x 100.

In the statistical evaluations, a Kruskal-Wallis test was used to observe any differences between years and between months, and analysis of variance and Duncan tests were used to determine the years and months accounting for the difference. Furthermore, multivariate analysis was utilized to observe if the year x month interaction was significant (20).

Results

Egg fertility

The mean values, standard errors, and statistical evaluation results according to years and months for egg fertility are listed in Tables 3 and 4.

Mean egg fertility was 88.12%, and this value was 88.41%, 88.25%, 88.43%, 89.65%, and 85.05 % for all years, for February, March, April, May, and June, respectively. Based on variance analysis, the effect of year and month, and the year x month interaction had high statistical significance ($P < 0.01$ and $P < 0.001$).

Table 2. The average temperature (°C) and relative humidity (%) values relating to years and months of received data in Bingöl.

MONTHS YEARS		January	February	March	April	May	June
1998	T	- 3.6	- 2.8	3.9	11.9	15.7	23.3
	RH	72.1	57.3	66.5	58.0	62.7	42.7
1999	T	1.2	2.0	5.5	11.8	18.1	22.7
	RH	63.4	63.7	57.3	52.7	40.6	39.0
2000	T	- 1.5	- 2.6	1.3	12.6	17.1	23.1
	RH	72.4	72.8	64.7	62.2	52.1	40.1
2001	T	- 0.4	1.9	9.6	13.2	14.9	23.8
	RH	67.1	67.8	64.6	60.3	60.4	39.9
2002	T	- 4.5	1.4	6.5	10.0	17.5	23.4
	RH	71.8	68.2	69.0	69.4	50.9	49.0
2003	T	0.1	- 1.7	1.1	10.3	19.2	23.0
	RH	76.9	79.9	72.2	65.0	59.3	48.2

T: Temperature RH : Relative Humidity

Table 3. The statistical analysis results related to egg fertility in investigated months and years.

YEARS	MONTHS												
	February		March		April		May		June		P	TOTAL	
	Mean(%)	S.E.	Mean(%)	S.E.	Mean(%)	S.E.	Mean(%)	S.E.	Mean(%)	S.E.		Mean(%)	S.E.
1998	-		87.12^{ab}	1.94	89.54^{ab}	0.98	91.32^{b}	0.42	85.37^{a}	1.47	0.036*	88.16^{ab}	0.84
1999	91.09	0.39	91.30	0.30	91.10	0.09	90.55	0.26	-	-	0.385^{NS}	91.03^{b}	0.15
2000	81.71^{a}	2.72	83.59^{ab}	1.57	89.57^{bc}	0.76	90.75^{c}	0.60	89.76^{bc}	4.39	0.026*	87.73^{ab}	1.12
2001	-		91.31^{b}	1.06	90.67^{b}	0.62	86.94^{ab}	0.77	82.45^{a}	3.73	0.010*	88.12^{ab}	1.09
2002	-		88.87^{b}	1.09	89.37^{b}	0.55	88.38^{b}	0.70	83.01^{a}	2.71	0.026*	87.60^{ab}	0.88
2003	-		86.77^{b}	1.23	71.75^{a}	12.28	90.34^{b}	1.19	85.12^{b}	1.24	0.043*	85.30^{a}	2.31
P												0.000***	
TOTAL	88.41^{ab}	1.85	88.25^{ab}	0.69	88.43^{ab}	1.37	89.65^{b}	0.41	85.05^{a}	1.27	0.001**	88.12	0.47

S.E.: Standard error NS: nonsignificant * P < 0.05 ** P <0.01 *** P < 0.001
a,b,c: The differences between the means of groups carrying different letters in the same line are statistically significant (P < 0.05).

Table 4. The interaction of year x month relating to egg fertility.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1328.268^{a}	24	55.345	4.763	0.000
Intercept	591,735.244	1	591,735.244	509,28.276	0.000
Year Group	388.249	5	77.650	6.683	0.000
Month	227.409	4	56.852	4.893	0.001
Year x Month	856.499	15	57.100	4.914	0.000
Error	871.424	75	11.619		
Total	778,728.875	100			
Corrected Total	2199.693	99			

a. R Squared = 0.604 (Adjusted R Squared = 0.477)

Hatchability of total eggs

Mean values and standard errors of the hatchability of total eggs according to the years and months, and variance analysis results are given in Tables 5 and 6.

Mean hatchability of total eggs was 56.61%, and this rate was 59.72%, 55.22%, 60.50%, 58.11%, and 49.99% in February, March, April, May, and June, respectively. The effect of year on hatchability of total eggs was statistically significant (P < 0.001), the effect of month was significant (P < 0.05), and the effect of year x month interaction was very significant (P < 0.01).

Hatchability of fertile eggs

Mean values and standard errors of the hatchability of fertile eggs according to the years and months investigated, and variance analysis results are given in Tables 7 and 8.

Mean hatchability of fertile eggs was 64.15%, and this rate was 66.86%, 62.27%, 68.67%, 64.80% and 58.92% in February, March, April, May, and June, respectively. The effect of year on this variable was quite significant (P < 0.01), the effect of month was significant (P < 0.05), and the effect of year x month interaction was highly significant (P < 0.001).

Table 5. The statistical analysis results related to hatchability of total eggs in investigated months and years.

YEARS	MONTHS										P	TOTAL	
	February		March		April		May		June				
	Mean(%)	S.E.	Mean(%)	S.E.	Mean(%)	S.E.	Mean(%)	S.E.	Mean(%)	S.E.		Mean(%)	S.E.
1998	-		57.63^{b}	6.34	67.95^{b}	0.99	62.69^{b}	1.19	45.55^{a}	4.09	0.007**	57.69^{b}	2.78
1999	68.44^{bc}	3.50	73.58^{c}	0.68	60.76^{ab}	2.74	57.38^{a}	4.72	-	-	0.010*	65.70^{c}	2.09
2000	37.91^{a}	4.18	51.43^{ab}	6.05	60.90^{b}	1.55	56.13^{ab}	4.64	47.00^{ab}	8.36	0.041*	52.60^{ab}	2.70
2001	-		59.34	2.82	56.24	3.48	54.88	2.95	50.89	7.68	0.592^{NS}	55.59^{b}	1.93
2002	-		49.31^{a}	4.96	59.87^{b}	1.37	63.01^{b}	0.64	59.05^{b}	2.31	0.033*	57.45^{b}	1.89
2003	-		40.56	6.19	54.36	4.67	55.85	2.71	46.14	7.27	0.212^{NS}	48.25^{a}	3.22
P												0.000***	
TOTAL	59.72^{b}	6.19	55.22^{ab}	2.77	60.50^{b}	1.20	58.11^{b}	1.39	49.99^{a}	2.55	0.012*	56.61	1.10

S.E.: Standard error NS : nonsignificant * P < 0.05 ** P < 0.01 *** P < 0.001

a,b,c : The differences between the means of groups carrying different letters in the same line are statistically significant (P < 0.05).

Table 6. The interaction of year x month relating to hatchability of total eggs.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6818.290^{a}	24	284.095	4.113	0.000
Intercept	239,410.996	1	239,410.996	3465.948	0.000
Year Group	2237.261	5	447.452	6.478	0.000
Month	948.451	4	237.113	3.433	0.012
Year x Month	3137.678	15	209.179	3.028	0.001
Error	5180.639	75	69.075		
Total	332,471.121	100			
Corrected Total	11,998.929	99			

a. R Squared = 0.568 (Adjusted R Squared = 0.430)

Discussion

Mean egg fertility found in the present study (88.12%) is in accordance with the data from 2 other studies of Bronze turkeys held under the same operating conditions (3,4). The effect of hatching month on egg fertility was found to be statistically very significant (P < 0.01). This result is supported by various research findings (1,9-13). The highest egg fertility observed was in the eggs hatched in May, and the lowest rate was in the eggs hatched in June. When all the years were analyzed, the values for February, March, and April were found to be similar to each other. The results appeared to be significantly lower in June, compared to the other months, especially between 2001 and 2002 (Table 3). When Table 2 is analyzed, the temperature appears to be higher in June 2001 and 2002, compared to the other years. Similarly, Kaygısız (1), Das and Ali (13), and Chowdhury et al. (16) have reported that the egg fertility decreased in summer months when the temperature rises.

Table 7. The statistical analysis results related to hatchability of fertile eggs in investigated months and years.

YEARS	MONTHS										P	TOTAL	
	February		March		April		May		June				
	Mean(%)	S.E.	Mean(%)	S.E.	Mean(%)	S.E.	Mean(%)	S.E.	Mean(%)	S.E.		Mean(%)	S.E.
1998	-		66.04^{b}	6.69	75.90^{b}	0.96	68.63^{b}	1.12	53.13^{a}	3.98	0.008**	65.17^{bc}	2.79
1999	75.08^{bc}	3.53	80.60^{c}	0.89	66.71^{ab}	3.06	63.36^{a}	5.20	-	-	0.010*	72.15^{c}	2.24
2000	46.28	3.57	61.39	6.71	68.02	1.99	61.78	4.87	53.23	10.81	0.275^{NS}	59.93^{ab}	2.91
2001	-		64.98	2.94	61.96	3.43	63.16	3.52	61.22	7.13	0.929^{NS}	62.95^{ab}	1.86
2002	-		55.34^{a}	5.13	67.03^{b}	1.84	71.29^{b}	0.67	71.10^{b}	0.69	0.007**	65.64^{bc}	2.13
2003	-		46.38^{a}	6.46	76.90^{b}	6.65	61.77^{ab}	2.50	54.10^{a}	7.76	0.048*	57.00^{a}	4.07
P												0.002**	
TOTAL	66.86^{ab}	5.90	62.27^{ab}	2.88	68.67^{b}	1.42	64.80^{ab}	1.51	58.92^{a}	2.95	0.013*	64.15	1.16

S.E.: Standard error NS: nonsignificant * $P < 0.05$ ** $P < 0.01$
a,b,c: The differences between the means of groups carrying different letters in the same line are statistically significant ($P < 0.05$).

Table 8. The interaction of year x month relating to hatchability of fertile eggs.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7356.057^{a}	24	306.502	3.902	0.000
Intercept	313,550.880	1	313,550.880	3991.468	0.000
Year Group	1656.172	5	331.234	4.217	0.002
Month	1073.541	4	268.385	3.417	0.013
Year x Month	4312.891	15	287.526	3.660	0.000
Error	5891.645	75	78.555		
Total	424,780.244	100			
Corrected Total	13,247.702	99			

a. R Squared = 0.555 (Adjusted R Squared = 0.413)

The mean hatchability of total eggs measured in the present study was lower than in 2 previous studies (3,4). When the years were analyzed separately, the hatchability of total eggs was lowest in February 2000, in March 2002, and 2003. However, when the years were considered in general, the hatchability of total eggs was lower in June when compared to the other months. This result is supported by research findings where hatchability was reported to decrease in the months when the temperature rises (1,13,15-17).

Mean hatchability of fertile eggs in the present study (64.15%) is slightly lower compared to the findings of 2 other studies of Bronze turkeys conducted with the same operating conditions (3,4). Although there is concordance with the literature in terms of egg fertility, the fact that the values acquired regarding the hatchability was lower than those in the literature may be due to unexpected negative conditions in the hatching conditions. In fact, due to the earthquake that took place in the province of Bingöl in 2003, where the incubation records were taken from, hatching results were negatively affected in February, March, and April.

Among the years analyzed, except for 2002, hatchability of fertile eggs was generally lower in June.

On the other hand, the highest hatchability of fertile eggs was observed in April. The finding that the effect of hatching month on the hatchability of fertile eggs was found to be statistically significant is supported by various investigative findings (1,11,14,15,18). Kaygısız (1), Singh et al. (15), and Sreenivasaiah and Joshi (18) have also reported that the hatchability of fertile eggs was lower in summer months when the temperature rises in comparison to the other months.

In the present study, the effect of the hatching month on egg fertility and hatchability was significant, and the results regarding these variables were observed to be similar to each other in the months of February, March, April, and May; however, they decreased in June. These findings led to the conclusion that in Bingöl province June is not an appropriate month for hatching, as was the case for the other summer months.

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