Egypt. J. Anim. Prod., 16, No. 1, pp. 41 - 50 (1976)

Effect of Light Stimulus on Pekin Ducks in the Subtropics. I — on Egg Production

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This work was carried out to study the effect of light stimulus (natural, gradual and abrupt) on egg production of Pekin duck in the subtropics.

The results obtained could be summarised as follows :

1. All the light-treated ducks laid more eggs than the control.

2. Lighting regimes used here do not lengthen the laying season more than the control. However, the major effect is due to the increased rate of laying.

3. The ducks performed moulting during the winter pause.This result seems to be a specific phenomenon for ducks.

4. The increase in daily atmospheric temperature and decrease in relative humidity could be considered a sound cause in minimizing the response in rate of laying and shortening the second laying season either for lighted or control groups.

5. In the second laying season, the control ducks laid lower number of eggs than any other lighted group.

6. The largest number of eggs was produced by ducks subjected during the first laying season to abrupt illumination (14 hr/ day) without night feeding and thense recieved the same treatment during the second laying season.

7. The partial correlation of egg number on minimum and maxmum temperature and humidity per cent were highly significant in the presence of artificial light and not significant in natural daylight.

8. During the mild weather of the first laying season the increased humidity seems to play unfavourable role on egg number in both the natural and artificial lighted groups. The high temperature showed a decrease in egg number in hot weather of the second laying season.

Gradual increases in daily light more increase in egg production in layers than abrupt increase (Fanguaf, 1959, Mcclary, 1960 and Morris, 1962). However, literature on the effect of light stimulus on laying erformance of ducks is scanty.

Supplying the chickens with food beside additional light increases egg production than light alone (Dakan, 1934). Recently, Zakaria (1970) indicated that gradual light coincided with offering food at the time of illumination was better for egg production in hens than using constant light.

Several environmental and genetic factors are involved in inducing egg production phenomenon. The climatic factors in subrtopical countries exhibit clear seasonal variation trends in egg production due to variation in surrounding atmospheric temperature, humidity and daylength (Mostageer, 1958, and Kamar, 1962).

This work is carried out to study the effect of light stimulus (natural, gradual and abrupt) on egg production of Pakin ducks in she subtropics.

Material and Methods

General management

250 unsexed growing ducklings, hatched on March 1971, were kept in houses provided with waterers and hoppers under normal climatic conditions. The growing ducklings were fed well balanced growing ration from hatch to 6 months of age, then a balanced chicken-laying ration till the end of the experiments. The mach was given *ad* libitum.

Experimental

Experiment 1

69 females and 32 males were selected from the original 250 unsexed 6 month-old growers. The birds were divided randomly into five groups : A, B, C, D, and control. At the commencement of sexual maturity provided with trapnests, each group was housed in a separate house. Group A was subjected to 14 hr natural and gradual daylength with night feeding, group B was treated as group a without night feeding, group C was subjected to 14 hr natural and adrput light increase in daylength with night feeding, group D was treated as group C without night feeding the control group was subjected to natural daylight only without night feeding. The first laying season began on September 18, 1971 until all the birds ceased laying. which lasted for 13 weeks. At that time the birds started moulting at the beginning of the fall and winter.

Experiment 2

After the end of the winter pause (118 days) by the commencement of laying, 24 ducks and 8 drakes from group D were divided into two groups D_1 and D_2. Similar number of the control group was divided into two groups : $control_1$ and $control_2$. The four divided groups were placed in four separate houses. $Control_1$ and D_1 were subjeceted to 14 hr abrupt daylength for all the 8 weeks. $Control_2$ was subjected to natural daylength only for 8 weeks while the birds of D_2 were subjected to natural daylength for the 1 st 4 weeks and 14 hr abrupt davlength for the 2*nd* 4 weeks. The second laying season began on April 15, 1972 and continued for 8 weeks when laying ceased and the long summer pause occurred.

Light techniques

1) The gradual increase in daylength by artificial illumination was insured by adding the artificial light in the evening on the basis of 18 min of increaments weekly to attain 14 hr of both natural and arificial light,

2) The abrupt increase in daylenght was insured by adding the artificial light from the beginning till the end of the experiment.

Data collection

Egg production

Egg production was studied for the two consectutive laying periods for surviving birds in each treatment on daily individual recording basis. Average egg number at weekly intervals were calculated.

Interrelationship of egg number on atmospheric conditions

Partial correlation and regression of egg number on climatic conditions were calculated. Daily maximum, minimum and mean atmospherie temperature °C, relative humidity and duration of day light hr were recorded for the statistical analysis. The average weekly temperature, relative humidity and duration of day light were illustrated in Fig. 1 and 2.

Statistical analysis

The statistical analysis was performed after Snedecor (1956) for analysis of variance and partial correlation and regression.

Result and Discussion

Egg number

The first laying season for all the ducks including the control lasted for 13 weeks (Table 1 and Fig. 1).

The difference between the groups in egg number was statistically highly significant (Table 1). The least significant difference between treatments for total egg number per duck at 1% level was 8.48 and at 5% level was 6.38 eggs.

Lighting regimes used here do not lengthen the laying season more than the control. However, the major effect is due to the increased rate of laying. Although the abrupt lighting has a favourable effect on egg laying, however, the mechanisms of egg laying coordinating with the endocrines involved in this phenomenon, respond to a greater extent when this light is gradually added to normal daylength. In normal fluctuations in daylength, birds lay more eggs when daylength is increasing even that daylight is short. Meanwhile, when daylight is decreasing, egg laying decreases even that daylight is long.

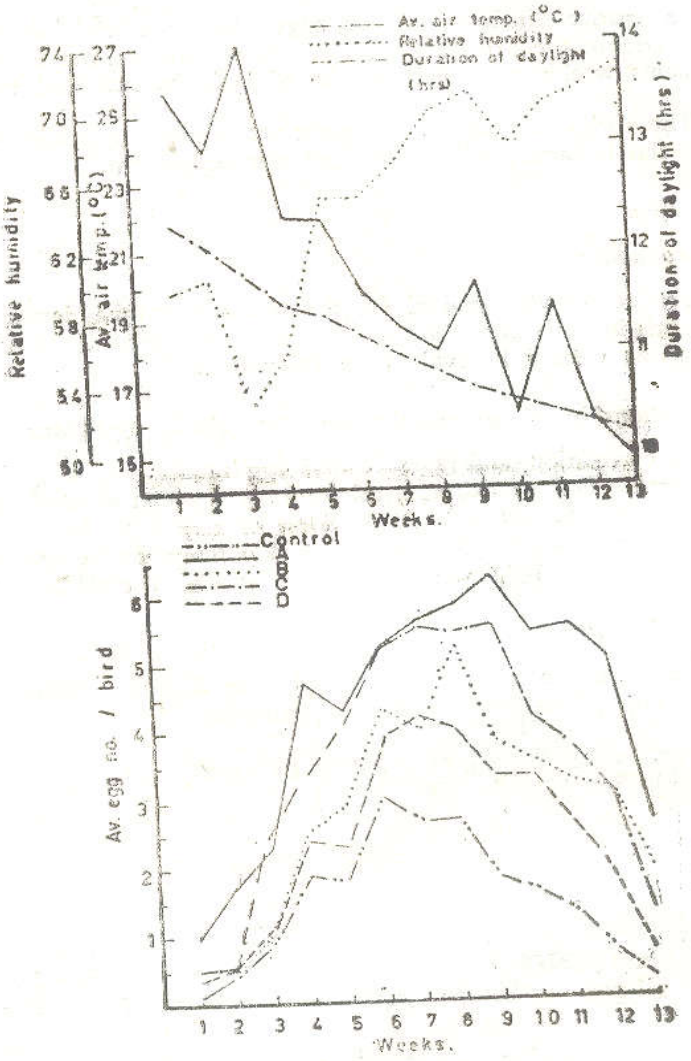

Fig. 1. Weekly egg number and climatic conditions in the first laying season.

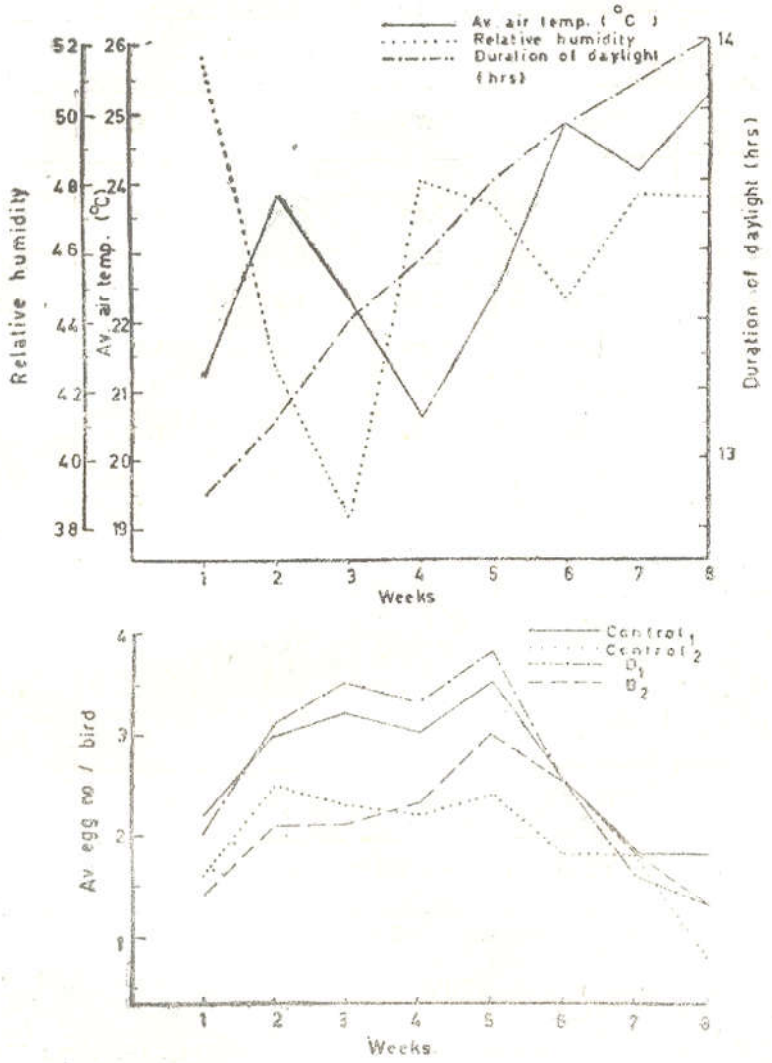

Fig. 2. Weekly egg number and climatic conditions in the second laying season.

TABLE 1. Average weekly and total number of eggs per duck and rate of response of the first laying season. *

Weeks	Treatments				
	Control	A	B	C	D
1	0.11	1.00	0.53	0.50	0.44
2	0.44	1.73	0.47	0.58	0.48
3	0.93	2.30	1.07	2.50	1.07
4	1.89	4.73	2.47	3.42	2.37
5	1.81	4.33	2.87	4.08	2.30
6	2.96	5.20	4.33	5.17	3.85
7	2.59	5.60	4.00	5.50	4·15
8	2.74	5.80	5.20	5.42	4.00
9	1.81	6.20	3.80	5.50	3.30
10	1.55	5.40	3.47	4.08	3.30
11	1.33	5.53	3.20	3.66	2.63
12	0.70	5.00	3.13	3.00	1.81
13	0.26	2.60	1.86	1.33	0.74
Total ** . . .	19.12	55.42	36.40	44.74	30.44
Rate of response ***	100.0	289.9	190.4	234.5	159.2

* Age at sexual maturity averaged from 217.6 to 223.3 days for all the experimental stock after which the experiment began.

** L.S.D. between treatments for total egg number per duck at 1% level was 48.8 and at 5% level was 6.38 egg.

*** Assuming that egg number of the control group = 100 %. F. value : 37.99** Highly significant at 1% level).

Zakaria (1970) working on chickens, came to the same conclusions observed in this work with ducks. He added that the effect of food availability withdrawn rapidly after 7 weeks of treatment. But in the present study the availability of food at the time of illumination was advantageous all over the laying period.

The annual pause began during winter when also the ducks perfromed moulting (Table 2 and Fig. 2). This result seems to be a sepcific phenomenon for ducks. Normally in chickens this pause and moult occurs in fall. Thense ducks began the second laying season for a shorter period that lasted for 8 weeks from the secons half of April until June 9.

TABLE 2. Average weekly and total number of eggs per duck and rate of response of the second laying season.

Weeks	Treatments			
	$Control_2$	D_1	D_2	$Control_1$
1	1.58	2.00	1.42	2.17
2	2.50	3.08	2.08	3·00
3	2.25	3.50	2.08	3.17
4	2.17	3.33	2.25	3.00
5	2.24	3.75	3.00	3.50
6	1.83	2.75	2.50	2.50
7	1.75	1.58	1.75	1.75
8	0.75	1.33	1.33	1.83
Total *	15.25	21.32	16.41	20.92
Rate of response % ***	100.0	139.7	107.6	137.3

* L.S.D. between treatments for total egg number per duck at % level was 7.07 and at 5% level was 5.30 eggs.

** Assuming the total egg number of the control 2 = 100 %.

F. value : 2.90* (significant at 5% level).

Ducks seem to have quite different nature than chickens in their response to light. This is clear when light stimulus is used alone away from any other modification or feeding. It seems that there is an accumulative effect as observed when abrupt lighting for 14 hr was used for a long time in the two seasons. The abrupt light for 14 hr caused the ducks to lay more eggs than any other treatment that had taken a rest period of natural daylength. The light treatments were planned to break refractoriness that was boserved in chickens.

Interrelationship of egg number on atmospheric conditions

It was worthwhile to indicate that the partial correlation of egg number on minimum and maximum temperature and humidity per cent were highly significant in the presence of artifical light and not significant in natural daylight. So, attention would be considered to these atmospheric conditions in mild weather, while humidity may be neglected in hot weather throughout the lighting programme to increase the laying capacity (Table 3).

TABLE 3. **Partial correlation of egg number (X_1) on atmospheric minimum temperature (X_2), maximum temperature (X_3) and humidity % (X_4).**

Items	1*st* season		2*nd* season	
	Control	Treatment	Control	Treatment
Number of days . . .	91	91	56	56
Number of ducks/group	27	69	12	24
$r_{12.34}$	0.164	0.406**	0.262	0.691**
$r_{13.24}$	0.178	0.026**	—0.232	—0.601
$r_{14.23}$	—0.039	—0.563	0.016	0.233

* Significant at 5% level.
** Significant at 1% level.

TABLE 4. **Partial regression of egg number (y) on atmospheric minimum temperature (X_1)T, maximum temperature (X_2) and humidity % (X_3).**

Items	1*st* season		2*nd* season	
	Control	Treatments	Control	Treatments
Number of days	91	91	56	56
Number of ducks/group	27	69	12	24
by 1.23	0.317	3.137**	0.132	0.821**
by 2.13	0.268	2.013**	—0.104	—0.793**
by 3.12	—0.094	—0.826**	0.023	0.137

* Significant at 5% level.
** Signiciant at 1% level.

During the mild weather of the first laying season the increase humidity seems to play unfavourable role on egg number of the both the natural and artificial lighted groups. The high temperature showed a decrease in egg number in hot weather of the second laying season. The former unfavourable effects are emphasized by the negative partial correlation of egg number on humidity % in the first laying season and on maximum temperature in the second laying season (Tables 3 and 4).

The values of the partial regression of the egg number on these atmospheric condition may assure their prominent effect on laying capacity when artifical light is considered (Table 4).

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تأثير التنبيه الضوئى على البط البكينى فى المناطق شبه الحارة
١ ـ على انتاج البيض

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أجريت دراسة تأثير التنبيه الضوئى (الطبيعى) التدريجى ، المباشر) باستعمال الاضاءة الصناعية على انتاج البيض فى البط البكينى ، ويمكن تلخيص أهم النتائج المتحصل عليها فى الآتى :ـ

١ ـ وضعت مجاميع البط التى عوملت بالاضاءة الصناعية بصفة عامة بيضا أكثر من مجموعة الكنترول .

٢ ـ استعمال الاضاءة الصناعية لم يؤثر على طول موسم وضع البيض فى المجاميع المعاملة بالاضاءة الصناعية عن مجموعة الكنترول ولكن الزيادة الرئيسية كانت فى معدل وضع البيض .

٣ ـ حدث الاتى فى البط البياض فى فترة الراحة الشتوية ويبدو أن البط يتميز بهذه الظاهرة .

٤ ـ زيادة درجة حرارة الجو اليومية وانخفاض الرطوبة النسبية ممكن أن يكون سببا جوهريا فى تقليل معدل الوضع وقصر طول موسم وضع البيض الثانى سواء للمجاميع المعاملة أو مجموعة الكنترول .

٥ ـ فى موسم الوضع الثانى كانت مجموعة الكنترول أقل فى انتاج البيض عن أى مجموعة معاملة بالاضائة الصناعية .

٦ ـ كان أعلى انتاج من البيض فى موسم الوضع الثانى من مجموعة البط التى عوملت بالاضاءة الصناعية الفجائية (١٤ ساعة اضاءة يومية) بدون تغذية ليلية فى موسم الوضع الأول ثم عوملت نفس المعاملة فى موسم الوضع الثانى .

٧ ـ يرتبط فعل الاضاءة الصناعية مع درجة حرارة الجو والرطوبةالنسبية فى التأثير على انتاج البيض ويدل على ذلك معامل الارتباط الجزئى بين عدد البيض والعوامل الجوية .

٨ ـ أدى ارتفاع الرطوبة النسبية خلال موسم الوضع الأول الى زيادة وضع البيض ويدل على ذلك معامل الارتباط الموجب بين الرطوبة النسبية وعدد البيض فى هذا الموسم .