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Effects of environment on layer performance

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Abstract

Ten layer farms (eight from Manikganj and two from Gazipur) were selected to evaluate the effect of the different environmental condition on layer performance. Temperature (°C) and relative humidity (%) were recorded and concentrations of carbon dioxide (CO_2, ppm) and ammonia (NH_3, ppm) were determined. Productive performance of flock was evaluated by measuring egg production, feed consumption, egg weight and egg shell thickness. The tolerable temperature for the layer was 15-27°C. High temperature (above 27°C) affects feed consumption, egg weight and egg shell thickness while relative humidity has less impact on egg production, egg weight and feed consumption. Feed consumption and egg weight were decreased markedly when CO_2 and NH_3 concentration were more than 3000 and 37 ppm, but not on egg shell thickness. Postmortem examination indicated that 51, 24, 11, 9 and 5% birds were died due to bacterial, viral, non-infectious, protozoal and fungal infection respectively. Improper environments reduced the chickens' defenses, making them more vulnerable to diseases.

Keywords: Temperature, Humidity, CO_2, NH_3, Layer performance

Introduction

Poultry plays an important role in human nutrition, employment and income generation. Poultry is by far the largest livestock group and has been estimated to be about 252.3 million consisting of chickens, ducks and pigeons (BBS 2009). Poultry constitute 30% of animal protein and will increase to 40% before 2015 (IFPRI 2000).

In poultry housing environment may affect the performance of birds as well as its well being. Aerial ammonia in poultry houses is usually found to be the most abundant air contaminant. Ammonia concentration varies depending upon several factors including temperature, humidity, animal density and ventilation rate. Chickens exposed to ammonia showed reduced feed consumption, feed efficiency, live weight gain, carcass condemnation, and egg production (Charles and Payne, 1966; Quarles and Kling, 1974 and Reece and Lott, 1983). Again, infectious and non-infectious diseases is one of the major constrains in poultry rearing. Farmers face a wide range of diseases, which reduced the production of the birds. During last few years several emerging diseases like infectious bursal disease, aflatoxicosis, avian influenza, chicken anemia virus and egg drop syndrome and some unknown cause threatened the industry and cause huge damage to the farmers. Viruses, which affect the mucus membranes of the respiratory and reproductive tract, such as Newcastle disease and infectious bronchitis, not only cause a decrease in egg production, but also cause the shell to become abnormally thin and pale (Beyer, 2005 and Butcher and Miles, 2003). Therefore, the present study was conducted to evaluate the effect of environmental condition on the performance of layer.

Materials and Methods

Ten layer farms (eight from Manikganj and two from Gazipur district) were selected. The flock was 20-70 weeks of age and the strains were Hyline white and Isa Brown. This study was conducted for 3 months. The birds were reared in cage system and fed commercial layer feeds. The layer farms were mainly dependent on natural day light. The extra required light was provided by using a 60 W bulb. Birds were kept in well-dried litter and good hygienic condition. Routine vaccination was practiced with anthelmintics and other probiotics as preventive measure.

Productive performance of the flock was evaluated by measuring egg production, feed consumption and egg shell thickness. Average weight of egg was taken by weighing 30 eggs per week by random sampling. The infectious and non-infectious diseases occurred during study period were evaluated.

Housing temperature (°C) and relative humidity (%) were recorded. Concentrations of carbon dioxide (CO_2, ppm) and ammonia (NH_3, ppm) were determined by utilizing Multiple Gases Detection Instrument (Rosemount Analytical Inc, USA). The levels of the gases were determined in each particular day when the temperature is around 15- 27 °C and the relative humidity is 60-70%. This was done to identify the effect of those gases when the other parameters are normal.

Post-mortem examinations of dead birds were performed. Liver, spleen and intestine samples were collected in separate sterile containers for the isolation and identification of causal agents using bacteriological examination.

Statistical analysis

Results were expressed as Mean ± Standard Error (S.E.). All the data were analyzed under one way analysis of variance with least significant differences at $p<0.05$.

Results and Discussion

Effects of temperature and humidity

Above 27°C feed consumption gradually decreases. Oarad *et al*., (1981) stated that higher temperature reduce the productive performance of layer hens. At 35°C there is a remarkable decrease of feed consumption. Moreover, high temperature is related to egg shell thickness. In high temperature the shell thickness is decreased while Sloan and Harms (1984) reported that there is no effect of low temperature on egg shell thickness. Merat and Bordas (1982) found that body weight did not differ significantly but feed consumption was lower at the higher temperature. A negative correlation between daily feed consumption and temperature in poultry was detected. As the temperature of poultry house increased, feed consumption reduced. In addition to, feed conversion ratio also decreased. The reverse trend was observed in lower temperature (Fig. 1).

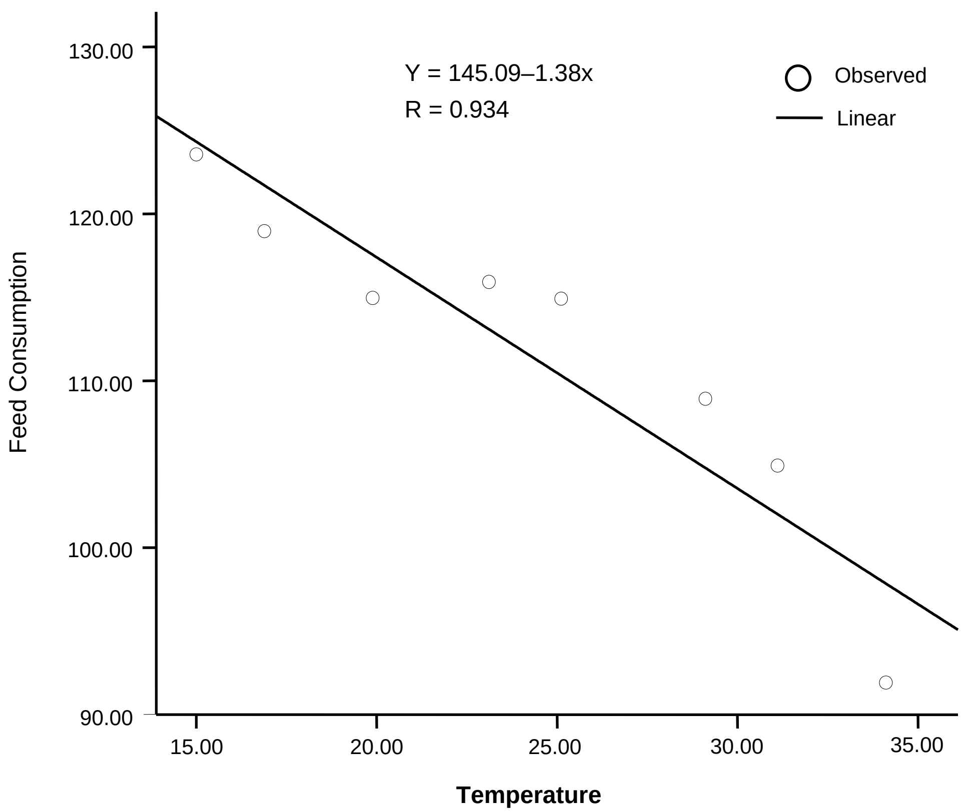

Fig. 1. Negative correlation of temperature and feed consumption

Table 1. Effects of temperature on layer performance

Temperature (°C)	Egg production (%)	Egg weight (g)	Shell thickness (mm)	Feed consumption/hen/day (g)
16	75.1±1.82	57±0.89	0.34±0.11	122±0.41
18	76.83± 0.35	56±1.91	0.34±0.01	118±0.25
21	78.18±2.70	56±1.94	0.33±0.01	114±0.97
24	75.18±1.92	58±1.89	0.33±0.003	114±0.52
26	78.4±1.0	58±1.75	0.34±0.004	113±0.30
30	80.67±1.75	58±2.26	0.34±0.018	107±0.44
32	78.33±0.7	55±2.81	0.32±0.03	103±0.27
35	76.15±0.55	55±1.86	0.30±0.01	90±0.35
SED	0.62	0.51	0.04	3.54
Level of significance	*	NS	NS	*

* indicates significant at 0.05% level; NS = Non-significant

From Table 2 it is marked that egg production increased when relative humidity was 60-70% and feed consumption and egg weight gradually decreased with high relative humidity (above 70%). But shell thickness did not vary for relative humidity.

Table 2. Effects of humidity on layer performance

Relative Humidity (%)	Egg production (%)	Egg weight (g)	Shell thickness (mm)	Feed consumption/hen/day (g)
78	76.05±0.11	55± 0.14	0.34±0.007	118±1.1
76	75.27±0.14	55±1.51	0.33±0.008	119±0.43
72	76.98±0.34	56±0.28	0.34±0.01	119±0.21
68	76.1±0.07	57±0.18	0.34±0.01	121±0.53
64	77±1.07	58±0.24	0.37±0.02	121±0.63
60	77.1±0.45	58±0.39	0.34±0.01	120±1.19
58	76.33±0.14	57±0.22	0.33±0.03	121±1.12
54	76.15±0.24	58±0.25	0.33±0.01	120±0.64
SED	0.86	0.45	0.001	0.40
Level of significance	*	NS	NS	NS

* indicates significant at 0.05% level; NS = Non-significant

Effects of different gasses

The CO_2 level in the experimental farm was not more than 3000 ppm and NH_3 level was not more than 37 ppm (Table 3). It is evident that 3000 ppm CO_2 and 37 ppm NH_3 level effect egg production. Feed consumption and egg weight were decreased markedly but not on egg shell thickness. Moreover, feed consumption, egg weight and egg production were affected when NH_3 level was above 25 ppm. The practical tolerable level of CO_2 is below 10,000 ppm and tolerable level of NH_3 is below 25 ppm. However the higher level of CO_2 is injurious to the birds. Higher level causes significant loss in feed consumption, egg production and serious respiratory trouble. Deaton *et al*. (1982) reported that 200 ppm ammonia for 17 days causes a significant reduction in percent egg production, body weight and feed intake.

Table 3. Effects of CO_2 and NH_3 gasses on layer performance

CO_2 (PPM)	NH_3 (PPM)	Egg production (%)	Egg weight (g)	Feed consumption/hen/day (g)
500	22	78.45	57	119
3000	37	72	58	107
750	20.5	77.6	58	121
1240	23	76.1	58	120
1091	27	74	58	117
998	32	72.15	57	116
980	30	73.95	58	116
2488	24	74	58	118
2560	12	73.7	57	118
2989	8	73.2	58	118
1286	15	78	57	120
1199	18	78.8	57	122
895	25	77	58	120
920	13	77.6	58	122
1000	14	76.3	58	121
983	33	73.6	59	117
897	37	73.25	59	116

Effect of floor space

Egg production, feed consumption or egg weight of flock was not associated with variation of floor space (Table 4). However, the higher density did not directly influence mortality of layer birds; it made them susceptible to diseases as diseases may transfer highly rapidly in dense population. Campo *et al*. (2005) and Estevez (2007) reported that high population density per square meter caused fear (stressful reaction) and threatens the benefit of birds. In addition, increased population density of broiler reduces the body weight, worse the food conversion and increase mortality (Skomorucha *et al*., 2004, 2009)

Disease prevalence

Table 4. Effects of floor space on layer performance

Allotted space (cm^2)	Mortality (%)	Egg production (%)	Ave. egg weight (g)	Feed consumption/hen/day (g)
450	3.9	77.9	60.31	121.9
525	3.3	76.4	60.59	122.3
600	0.75	76.7	60.73	121.9
750	1.75	77.25	60.645	121.15

Total number of birds of the selected farms were 38000 (Farm-1 to Farm-10). Among these, 3089 were died due to different disease or managemental faults. The percentage of the dead birds due to different reasons is listed in Fig. 2. Mortality of laying birds in Bangladesh occurs every year due to outbreaks of several diseases. Newcastle disease was the earlier economically important infectious disease for native and commercial poultry (Islam, 1998), where as infectious bursal disease was first reported in 1992 with high morbidity. Among bacterial diseases salmonellosis in poultry shows about 20% mortality and reduce egg production and hatchability for up to 20-30% (Fehervari, 1994 and Haque *et al*., 1997).

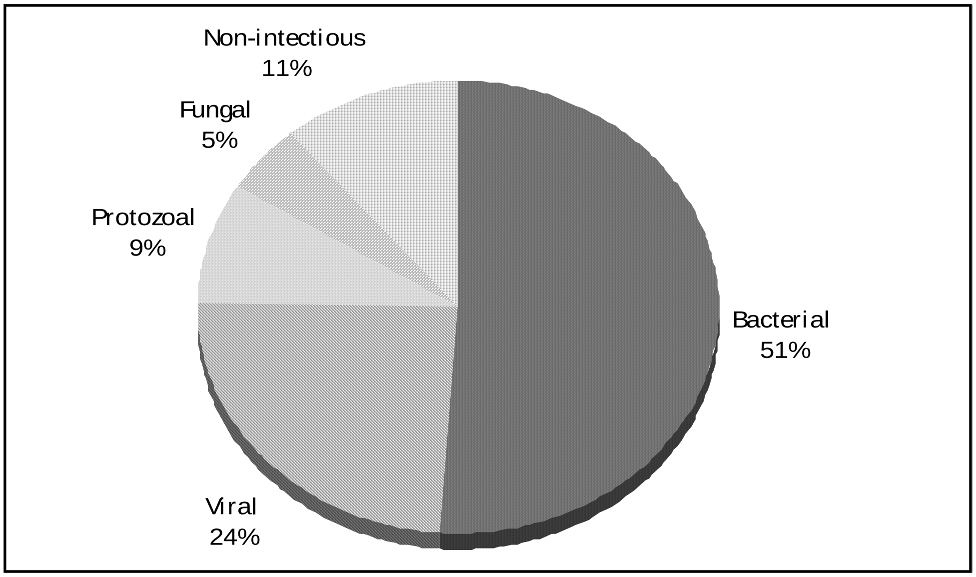

Fig. 2. Mortality percentage of birds due to diseases

Conclusion

Laying birds should be kept in a good environment conditions with a good care. In poultry house if environmental temperature is allowed to exceed normal ranges, then egg production, egg size, and growth will be negatively affected. These factors along with others affect the birds' metabolism which in turn is responsible for the output of eggs, meat, and body heat to maintain normal physiological processes and functions. Environmental stressors such as hot temperatures, high air humidity, etc., may affect the bird in an additive manner if these stressors are imposed concurrently. These stressors can negatively affect hen's growth performance, feed intake and efficiency, and physiological status.

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