# The Response of Two Commercial Laying Hen Strains to Various Cage Densities

FAROUK G. HORANI[1]


## ABSTRACT

The effects of housing two commercial laying hen strains (Hisex Brown and Hisex White) under various cage densities were studied in two experiments. In the first experiment, 27, 24 and 30 Hisex Brown hens were allotted to three cage densities of 666, 500 and 400 $cm^2$/bird, respectively, for a sixteen-week experimental period. In the second experiment, 27, 24, 30 and 36 Hisex White hens were allotted to four cage densities of 666, 500, 400 and 333 $cm^2$/bird, respectively, for a similar period. Results showed that feed consumption increased significantly ($P < 0.01$) as the cage density decreased, or as the area/bird increased. Feed efficiency was not significantly affected by cage density in both experiments. The effect of cage density on the hen-day production of Hisex Brown hens, but not Hisex White hens, was significant ($P < 0.05$). However, hen-housed egg production of both strains was not significantly ($P < 0.05$) affected by cage density. Mortality was low among all groups of hens during the experimental period. Therefore, it can be concluded that the high cage densities tested were not detrimental to egg production or liveability of the two strains used during their first phase of egg production.


## INTRODUCTION

In a previous paper (8), the author reviewed the results of several investigations of caging hens under various cage densities. Hens of a commercial strain of SCWL were provided with 310 $cm^2$ of cage floor space/bird, and were found to produce less eggs, consume more feed and utilize feed less efficiently than hens with 413 or 619 $cm^2$ of cage floor space/bird. However, the responses of laying hen strains to various cage densities were found to be variable (1, 2, 6, 9, 11 and 14). Rose and Sell (11) reported reduced egg production for only one of two strains when birds were caged with 620 $cm^2$/bird. Fowler and Quisenberry (6) reported that at 310 $cm^2$/bird the heavier strain laid at a higher rate and was more efficient than the lighter strain. According to Adams and Jackson (1) differences in hen-housed production among the experimental strains were highly significant. However, hen-day production showed no significant strain differences. This indicated that the responses of the strains to various cage densities were similar when the effect of mortality was removed. Wilson *et al.* (14) reported strain differences when various cage regimes were compared. H & N strain was reported to be better adapted to high cage densities than the Hyline strain. However, hen-day production was significantly ($P < 0.01$) reduced when hens were provided with less than 390 $cm^2$ of cage floor space per bird. It should be mentioned here that dead birds were immediately replaced during their experiment.

[1]*University of Al-Fateh, Faculty of Agriculture, Animal Production Department, Tripoli, S.P.L.A.J.*

In most of the previously reviewed studies, birds that died during experiments were not replaced. This permitted the cage density to decrease whenever hens died. In order to keep the cage floor space/bird constant throughout the experiment, dead birds should be replaced. Consequently, corrections of the egg production records are then deemed essential.

The following experiments were designed to study the effects of various cage densities on the performance of two commercial laying hen strains—a medium type strain (Hisex Brown) and a light type strain (Hisex White) that were both imported from Holland.[1]

## MATERIALS AND METHODS

The following experiments were conducted on two commercial strains of laying hens that were about six months old and kept in cages at a closed, fan-ventilated house at the Poultry Research Station of this University. All hens were fed a commercial layer ration *ad libitum*; and were given 17 hours of artificial light daily. Feed consumption and egg production records were kept during the 16-week experiment. Dead birds were immediately replaced by hens that were kept for this purpose. This was necessary in order to keep the cage density of each group constant throughout the experimental period. Therefore, % hen-housed egg production was calculated in such a way that the eggs produced by the replacement birds were not considered. Data were subjected to analysis of variance (13) and to Duncan's multiple range test (4) wherever applicable.

### Experiment 1.

Eighty-one (81) laying hens of a commercial strain (Hisex Brown) were randomly divided into three groups and were placed 3, 4 or 5 birds per cage. Thus three cage densities of 666, 500 and 400 $cm^2$/bird were created. Each group within each cage density was subdivided into three replicates. Each replicate within each cage density (666, 500 or 400 $cm^2$/bird) contained 9, 8 or 10 birds, respectively.

### Experiment 2.

One hundred and seventeen (117) laying hens of another commercial strain (Hisex White) were used in this experiment. The hens were randomly divided into four groups and were placed 3, 4, 5 or 4 birds per cage, thus creating four cage densities (666, 500, 400 and 333 $cm^2$/bird, respectively). Obviously, the last cage density was created by using cages of smaller size than those used in the other groups. There were three replicates of 9, 8, 10 or 12 birds each within each cage density of 666, 500, 400 or 333 $cm^2$/bird, respectively.

## RESULTS AND DISCUSSION

The effects of cage density on hen-day feed consumption (HDF) and on feed efficiency (FE) of both strains are presented in Tables 1 and 2. There was a significant ($P < 0.01$) effect of cage density on HDF of the Hisex Brown or Hisex White hens. There was no significant ($P < 0.05$) effect on FE in both experiments. However, FE of Hisex Brown hens in Experiment 2 was significantly affected at $P < 0.10$. In general, HDF of Hisex Brown hens was increased (106, 107 and 112 g) as the cage density decreased, or as the area/bird increased (400, 500 and 666 $cm^2$/bird, respectively).

[1]*Euribrid B.V., P.O. Box 30, 5830 AA Boxmeer, Holland.*

Table 1 Effect of Cage Density on Hen-Day Feed Consumption (HDF) and Feed Efficiency (FE) of Hisex Brown Hens—Experiment 1.

| Replicate | Cage Density 400 $cm^2$/hen HDF | FE | 500 $cm^2$/hen HDF | FE | 666 $cm^2$/hen HDF | FE |
|---|---|---|---|---|---|---|
| 1 | 106 | 1.50[2] | 106 | 1.67 | 111 | 1.55 |
| 2 | 105 | 1.63 | 108 | 1.56 | 112 | 1.49 |
| 3 | 107 | 1.53 | 107 | 1.66 | 112 | 1.49 |
| Average ± S.D.[1] | 106 ± 1.0$^a$ | 1.55 ± 0.07 | 107 ± 1.0$^a$ | 1.63 ± 0.06 | 112 ± 0.06$^b$ | 1.51 ± 0.03 |

[1]Means without a common letter are significantly different ($P < 0.01$).
[2]FE is expressed as kg feed/dozen eggs.

Similarly, HDF of Hisex White hens increased (102, 103, 105 and 108 g) as the area/bird also increased (333, 400, 500 and 666 $cm^2$/bird, respectively). These results are contrary to those reported by Dorminey and Arscott (3), Horani (8) and Wilson *et al.* (14), but in agreement with those reported by Jensen and Chang (9) and Jensen *et al.* (10). This discrepancy in results reported by various researchers is not yet fully explained.

However, the following hypothesis can be postulated. On the one hand, the increase in feed consumption in high cage densities might be caused by such factors as increased physical activity and competition among birds for eating. On the other hand, the decrease in feed consumption could be caused by stress factors that would lead to reductions in body size and egg production. Often, the picture is complicated by an interaction of all these factors whereby feed consumption would then be indicative of the predominating factors.

Sample measurements of the hens' bodyweights at the start and at the end of the experiment indicated that when hens had $\leqslant 500\ cm^2$ of cage floor space per bird, there was an appreciable reduction in body size. However, careful experimentation is needed in this area in order to determine the magnitude as well as the validity of such a reduction.

It is apparent from Tables 1 and 2 that Hisex Brown hens consumed more feed than Hisex White hens. This was expected because of the differences in body size between the two strains. Hisex Brown hens had an average bodyweight of about 2.1 kg in comparison to 1.6 kg for the Hisex White hens. Thus, the energy required for maintenance would be higher for the Hisex Brown hens, and therefore feed consumption would be expected to be higher too.

The effects of cage density on egg production of Hisex Brown hens and Hisex White hens are shown in Tables 3 and 4, respectively. Hen-day production (HDP) of Hisex Brown hens was significantly ($P < 0.05$) reduced when the cage floor space/bird was less than 500 $cm^2$. However, hen-housed production (HHP) was not significantly ($P < 0.05$) affected. HDP values for hens with 400, 500 or 666 $cm^2$/bird were 81.8, 78.8 or 88.8%, respectively, during the 16-week experimental period. These values represented, in fact, the first phase of egg production. If the experiment was continued during the second and third phases of egg production, the results would have been then more conclusive. However, the experiment had to be terminated through unavoidable circumstances.

In Experiment 2, which also represented the first phase of egg production, the effect of cage density on HDP of Hisex White hens was not significant ($P < 0.10$). For example, HDP values for hens with 333, 400, 500 or 666 $cm^2$/bird were 80.8, 79.7, 84.4 or 81.0%, respectively. There were great variations in HDP or HHP values among the

Table 2 Effect of Cage Density on Hen-Day Feed Consumption (HDF) and Feed Efficiency (FE) of Hisex White Hens—Experiment 2.

| | Cage Density 333 cm²/hen | | 400 cm²/hen | | 500 cm²/hen | | 666 cm²/hen | |
|---|---|---|---|---|---|---|---|---|
| Replicate | HDF | FE | HDF | FE | HDF | FE | HDF | FE |
| 1 | 103 | 1.55[2] | 102 | 1.66 | 104 | 1.40 | 108 | 1.78 |
| 2 | 103 | 1.49 | 103 | 1.43 | 106 | 1.54 | 108 | 1.50 |
| 3 | 101 | 1.53 | 104 | 1.59 | 105 | 1.53 | 107 | 1.53 |
| Average $\pm$ S.D.[1] | 102 $\pm$ 1.0[a] | 1.52 $\pm$ 0.03 | 103 $\pm$ 1.0[a] | 1.56 $\pm$ 0.12 | 105 $\pm$ 1.0 | 1.49 $\pm$ 0.08 | 108 $\pm$ 0.06 | 1.60 $\pm$ 0.15 |

[1]Means without a common letter are significantly different ($P < 0.01$).
[2]FE is expressed as kg feed/dozen eggs.

Table 3 Effect of Cage Density on Hen-Day Production (HDP) and Hen-Housed Production (HHP) of Hisex Brown Hens—Experiment 1.

| | Cage Density | | | | | |
|---|---|---|---|---|---|---|
| | 400 cm$^2$/hen | | 500 cm$^2$/hen | | 666 cm$^2$/hen | |
| Replicate | HDP | HHP | HDP | HHP | HDP | HHP |
| 1 | 84.4 | 84.4 | 76.1 | 76.1 | 86.3 | 86.3 |
| 2 | 77.4 | 77.4 | 82.8 | 82.8 | 90.0 | 90.0 |
| 3 | 83.5 | 83.5 | 77.5 | 77.5 | 90.0 | 83.2 |
| Average ± S.D.[1] | 81.8[a] ± 3.8 | 81.8 ± 3.8 | 78.8[a] ± 3.5 | 78.8 ± 3.5 | 88.8[b] ± 2.1 | 86.5 ± 3.4 |

[1]Means without a common letter are significantly different ($P < 0.05$).

Table 4 Effect of Cage Density on Hen-Day Production (HDP) and Hen-Housed Production (HHP) of Hisex White Hens—Experiment 2.

| | Cage Density | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 333 cm$^2$/hen | | 400 cm$^2$/hen | | 500 cm$^2$/hen | | 666 cm$^2$/hen | |
| Replicate | HDP | HHP | HDP | HHP | HDP | HHP | HDP | HHP |
| 1 | 80.1 | 80.1 | 73.9 | 73.9 | 89.0 | 89.0 | 72.5 | 72.5 |
| 2 | 82.9 | 82.8 | 86.3 | 86.3 | 82.4 | 82.4 | 86.5 | 86.5 |
| 3 | 79.4 | 76.0 | 78.8 | 78.8 | 81.9 | 80.3 | 84.0 | 84.0 |
| Average ± S.D. | 80.8 ± 1.9 | 79.6 ± 3.4 | 79.7 ± 6.2 | 79.7 ± 6.2 | 84.4 ± 4.0 | 83.9 ± 4.5 | 81.0 ± 7.5 | 81.0 ± 7.5 |

replicates of each cage density. These variations resulted in high standard deviation (SD) values as shown in Table 4. Apparently there were unexpected great variations among individual hens in the same replicate. These variations were later observed when individual egg records of 44 hens were taken. It was observed that 23% of these hens had less than 50% egg production during a four-week post experimental period. It was interesting to know that 25 and 52% of these hens had 50–70% and 70–96% egg production, respectively. The total average of the % egg production of these hens was 63%. Thus, it was noticed that the percentage of the very poor or very good layers were very high. Small groups of these hens that are selected at random are very likely to have an unproportional number of either very poor or very good layers. Evidently, such large variations among the individual hens may bring about replicates of quite different performance.

Mortality was low among both strains during the experimental period. Therefore, HHP values were not much different from HDP values as shown in Tables 3 and 4. Previously, Horani (8), Grover *et al.* (7) and Foss and Carew (5) have reported dramatic decreases in HHP due to high mortality among hens in high cage densities. However, it should be noted that the duration of the two experiments reported herein was relatively short (16 weeks) in comparison to that of the other experiments (5, 7 and 8) which lasted over 32 weeks.

In Experiment 1 and 2 there were no detrimental effects of the high cage densities on HDP or HHP of the two strains tested. Moreover, the results of these experiments showed that there were significant reductions in feed consumption of the two strains at high cage densities. Nowadays, there seems to be a trend toward housing hens at high cage densities. This trend is obviously due to the rising costs of the equipment, buildings and labour used in laying farms. Although the results of Experiments 1 and 2 are limited to the first phase of egg production, it may be more economical to consider housing laying hens at high cage densities in view of the current costs encountered in establishing laying hen farms.

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# تجاوب سلالتين من دجاج البيض مع المساحة المخصصة لكل دجاجه في الأقفاص

فاروق غانم حوراني

## المستخلص

أجريت تجربتان لدراسة تاثير المساحة المخصصة لكل دجاجة في الاقفاص على سلالتين من دجاج البيض ( هايسكس البني وهايسكس الأبيض ) . فقد وزعت في التجربة الاولى ٢٧ ، ٢٤ و ٣٠ دجاجة من سلالة هايسكس البني في اقفاص بحيث كانت المساحات المخصصة لكل دجاجة هي ٦٦٦ ، ٥٠٠و٤٠٠ سم٢ على التوالي وذلك لمدة ستة عشر اسبوعا . وفي التجربة الثانية فقد وزعت ٢٧ ، ٢٤ ، ٣٠ و ٣٦ دجاجة من سلالة هايسكس الأبيض في اقفاص بحيث كانت المساحة المخصصة لكل دجاجة هي ٦٦٦ ، ٥٠٠ ، ٤٠٠ و ٣٣٣ سم٢ وذلك لمدة ستة عشر اسبوعا أيضا . ولقد دلت النتائج على أن استهلاك العلف قد ازداد معنويا ( تحت احتمال ١ ٪ ) كلما زادت المساحة المخصصة للدجاجة في القفص . غير أن الكفاءه الغذائية لم تتأثر معنويا في كلتا التجربتين . لقد كان للمساحة المخصصة للدجاجه في القفص تأثيرا معنويا ( تحت احتمال ٥ ٪ ) على انتاج البيض ( على أساس عدد أيام الدجاج الحي ) بالنسبة لسلالة الهايسكس البني ولكن ليس بالنسبة لسلالة الهايسكس الابيض . ولكن انتاج البيض ( على أساس عدد آيام الدجاج الأساسي ) بالنسبة للسلالتين لم يتأثر معنويا ( تحت احتمال ٥ ٪ ) .

لقد كانت نسبة الوفيات قليلة في التجربتين ولذلك فانه يمكننا القول بأنه عندما كانت المساحة المخصصة للدجاجه قليلة فان انتاج البيض ونسبة الوفيات للسلالتين خلال الفترة الأولى من الانتاج لم يتأثر بشكل سيىء .