Original Research

Study of Production Performance of Layers in Different Types of Cages with Different Stocking Densities

G. A. Mangnale*, D. N. Desai, A. S. Ranade[1] and P. E. Avari

Department of Poultry Science, Bombay Veterinary College, Parel, Mumbai – 400 012, Maharashtra, INDIA

[1]Krantisinha Nana Patil College of Veterinary Science, Shirval, Satara, Maharashtra, INDIA

***Corresponding author:** drmangnale.govind@gmail.com

Rec. Date:	Aug 19, 2018 17:12
Accept Date:	Nov 14, 2018 01:05
DOI	10.5455/ijlr.20180819051250

Abstract

The production performance of layers reared in different types of cages with different stocking densities was evaluated on 320 layers of BV300 strain for 20 weeks. The birds were divided in eight groups with four replicates of ten birds. Groups A, B and C were housed in California cages with floor space of 450, 465 and 750 cm^2 per bird; groups D, E and F were housed in battery cages with floor space of 465, 450 and 750 cm^2 per bird; groups G and H were housed in enhanced cages with floor space of 750 and 450 cm^2 per bird, respectively. In California cages, the birds allotted with floor space of 750 cm^2 per bird recorded significantly better production performance. In battery cages, the birds provided with floor space of 450 cm^2 per bird recorded better production performance where as in enhanced cages, the birds reared with floor space of 750 cm^2 per bird recorded significantly better production performance. In California and enhanced cages, the broken eggs were lower where lesser floor space was offered to the birds. *In battery and enhanced cages, the birds reared with floor space of 450 and 750 cm^2 per bird recorded higher net profit. It was concluded that, with respect to the performance of layers in the different cages studied in the experiment, the enhanced cage system with floor space of 750 cm^2 per bird was found to be better.*

Key words: Cage System, Layers, Stocking Densities

How to cite: Mangnale, G., Desai, D., Ranade, A., & Avari, P. (2019). Study of Production Performance of Layers in Different Types of Cages with Different Stocking Densities. International Journal of Livestock Research, 9(2), 190-196. doi: 10.5455/ijlr.20180819051250

Introduction

Housing system is an important aspect of layer industry as the housing condition of laying hens has been one of the major factors affecting production performance. Traditionally battery and California cages have been used for commercial layers for egg production. Cage system is being increasingly used in commercial poultry production programs in view of shortage of land. The egg producers have increasingly used high

stocking densities for hens at laying period as a means to decrease housing and equipment costs per bird. Whereas the excessive reduction in the available cage area per bird, as well as feeder and drinker space per bird, may have direct or indirect negative effects on growth and later performance. Different husbandry systems are available in laying hen rearing such as free-range, organic, cage and furnished cage. In India the welfare issues and concept of cage free layer production has started surfacing in last few years.

Although the cage system of housing in our country has proved extremely beneficial for growth of layer sector, the pressure from animal activists, welfare groups and the society are demanding cage free egg production. The cage system of rearing in India has really proved to be boon in increasing egg production in country taking India at number three in position in the world in egg production. In spite of that, the per capita availability of eggs in the country is rather low and hence egg production has to increase many folds. One must remember that the affordability of egg for common person over the years has ensured the nutritional security of the people in the country. Thus, the noble cause which layer industry is serving will be defeated. Therefore, the option of trying different types of cages for maintaining layer birds is worth considering. The space provided per bird in each type of cage is a major concern raised by the society. Hence, it also worth recording production performance of the birds in different types of cages with different floor spaces, provided to the birds. Therefore, a trial was designed using three types of cages namely California cages, battery cages and enhanced cages by providing different floor space to the birds.

Material and Methods

The trial was conducted on 320 White Leghorn layers of BV300 strain for period of 20 weeks. The trial was started at 35 weeks of age of the birds and lasted till 55 weeks of age. The birds were divided randomly in eight groups. Each group was further divided into 4 replicates of 10 birds and each group received one of the following treatments.

Group A - Floor space of 450 cm^2 per bird in California cages.
Group B - Floor space of 465 cm^2 per bird California cages.
Group C - Floor space of 750 cm^2 per bird in California cages.
Group D - Floor space of 465 cm^2 per bird in Battery cages.
Group E - Floor space of 450 cm^2 per bird in Battery cages.
Group F - Floor space of 750 cm^2 per bird in Battery cages.
Group G - Floor space of 750 cm^2 per bird in Enhanced cages.
Group H - Floor space of 450 cm^2 per bird in Enhanced cages

Parameters Studied

Percent egg production, hen house and hen day egg production, number of broken eggs, daily feed consumption per bird, feed conversion ratio, mortality, H/L ratio was estimated at the start & end of the trial and Economics of egg production was calculated at the end of trial.

 DOI 10.5455/ijlr.20180819051250

Statistical Analysis

The data were subjected to statistical analysis for all the parameters as per Snedecor and Cochran (1994), considering the treatments as the only variable and using Completely Randomized Design.

Results and Discussion

Percent Egg Production

It is noted that in California cages, the percent egg production did not show significant difference when the floor space per bird was increased from 450 to 465 cm^2 per bird. However, when the floor space per bird was further increased to 750 cm^2 per bird, the birds recorded marginally higher percent egg production than the birds with floor space of 450 cm^2 per bird (group A). However, the differences were statistically non-significant. Further, the percent egg production recorded was significantly higher by the birds reared on floor space of 750 cm^2 per bird (group C) than the birds reared on floor space of 465 cm^2 per bird (group B). In battery cages, the differences in the percent egg production recorded by birds reared with stocking densities of 465 cm^2 per bird (group D) and 450 cm^2 per bird (group E) were statistically non-significant. However, the birds reared with floor space of 750 cm^2 per bird (group F) recorded significantly lower percent egg production than the groups D and E.

In enhanced cages, the birds reared with the stocking density of 750 cm^2 per bird recorded significantly higher percent egg production than the bird reared with stocking density of 450 cm^2 per bird. Fulvia *et al.* (2014) observed that in furnished cages, hens reared with floor space of 751 cm^2 per bird had lower percentage of egg production (84.91 vs 88.90%, ($P<0.01$)) than the group reared with floor space of 749 cm^2 per bird. Anderson *et al.* (2004) reported reduced egg production from 82.3% to 77.4% due to reduction in cage stocking from 482 cm^2 to 361 cm^2 per hen. The result of these two studies corroborate with the findings of the current trial with respect to enhanced cages. Craig *et al.* (1986) reported the reduction in egg production due to decreased cage space. The result of this study corroborates with the finding of current trial for California and enhanced cages. Sarica (2008) recorded that in battery cages, increased space allowance significantly enhanced egg production. Hens kept either at 667 cm^2 or 1000 cm^2 cage densities produced the same amount of eggs while those kept at 500 cm^2 space allowance decreased egg production. These finding do not corroborate with the present study with respect to battery cage group.

Hen Day Egg Production

It is noted that among the groups reared in California cages, birds from group B reared with floor space of 465 cm2 per bird recorded higher hen day egg production than the birds from the groups A and C with floor space 450 and 750 cm^2 per bird. In battery cages, the birds from group D reared on floor space 465 cm2 per bird recorded highest hen day egg production than the birds from group E and F that had floor space of 450

DOI 10.5455/ijlr.20180819051250

and 750 cm^2 per bird. In enhanced cages, it was observed that as the floor space was decreased to 450 cm2 per bird from 750 cm^2 per bird, the hen day egg production was also reduced.

Anderson *et al.* (2004) observed that the when the floor space per bird increases the birds show decreased hen-day egg production. The result of this study corroborates with the finding of current trial for Battery cages. Onbasilar and Aksoy (2005) reported hen-day egg production as 94.1%, 89.3% and 78.5% at the respective stocking densities of 968, 656 and 393.8 cm^2 per hen with statistical significance ($P < 0.05$). This result corroborates with the findings with California and enhanced cages in current trial.

Hen House Egg Production

It is noted that among the groups reared in California cages, as the floor space allotted to the bird was increased from 450, 465 and 750 cm^2 per bird the hen house egg production increased. In battery cages it was observed that birds from group E reared on floor space 450 cm^2 per bird recorded higher hen house egg production than the birds from group D that had floor space of 465 cm^2 per bird. However, when the floor space was increased to 750 cm^2 per bird (group F) hen house egg production was reduced as compared to the group E and D. In enhanced cages, it was observed that when the floor space was decreased to 450 cm^2 per bird from 750 cm^2 per bird the hen housed egg production was also reduced. In the literature reviewed it was seen that most of the scientist recorded the finding related to percent egg production and hen day egg production and the parameter of Hen house production was not considered.

Number of Broken Eggs

It is noted that in California cages, the number of broken eggs from the bird from group A and B, reared on floor space of 450 to 465 cm^2 per bird were statistically non-significant. However, the bird reared on floor space of 750 cm^2 per bird, recorded significantly higher number of broken eggs than the birds from groups A and B. In battery cages, the differences in the number of broken eggs recorded by the birds reared with stocking densities of 465 cm^2 per bird (group D) 450 cm^2 per bird (group E) and 750 cm^2 per bird (group F) were statistically non-significant. Similarly, in enhanced cages, also the differences in the broken egg number of group reared on 750 cm^2 per bird (group G) and 450 cm^2 per bird (group H) were statistically non-significant. Hence, in general it may be concluded that in the present trial, the number of broken eggs were less where lesser floor space was offered to the birds. Carey *et al.* (1995) observed that the broken eggs decreased significantly when the higher floor space provided to the birds. These finding do not corroborate with the present study with respect to California and enhanced cages group.

Daily Feed Consumption per Bird

It is noted that when all three types of cages *viz.* California, battery and enhanced were considered separately and compared for different stocking densities the differences in daily feed consumption per bird were

DOI 10.5455/ijlr.20180819051250

statistically non-significant. However, in California cages the daily feed consumption per bird was marginally reduced with decreasing stocking densities. In battery cages the daily feed consumption per bird did not show any specific pattern with increase or decrease in the stocking densities. However, in enhanced cages the daily feed consumption was marginally increased with increase in stocking density. Lee and Moss (1995) recorded significantly lower feed consumption with increasing stocking density. These results corroborate with present findings. However, Kang *et al.* (2016) observed that feed intake was lower ($P < 0.01$) for higher density than other three stock densities. These findings do not corroborate with the findings of present study.

Feed Conversion Ratio

It is noted that in California cages and battery cages the different stocking densities did not have significant effect on the feed conversion ratio of the birds However, in enhanced cage, the feed conversion ratio of bird provided with lesser floor space (group H) recorded significantly poorer feed conversion ratio as compared to the birds provided with 750 cm^2 floor space. Nahashon *et al.* (2006) observed that FCR was poor in birds reared in cages at 1394 cm^2/birds than those stocked at 697 and 465 cm^2 per bird. This finding do not corroborate with observation of current study. Sahin (2007) observed there were significant effects of cage density on feed conversion ratio increased cage density level resulted in better in FCR.

Mortality

The mortality in all the groups were within the limit indicating that the different types of cages with different stocking densities does not have any effect on the health of birds. This is an important observation with view of bird welfare in different cages. Pavan *et al.* (2005) recorded that mortality was not affected in ISA Brown hens kept in cages having 563, 450 and 375 cm2 space allowance per hen. This finding similar to the observation of the current study.

H/L Ratio

The average H/L ratio estimated for the birds from different groups at the start of the trial was 1.25. The average H/L ratio percent of the birds from different groups from A to H of ends of trial were 0.9, 2.75, 1.55, 1.81, 1.4, 0.92, 2.01 and 1.15 respectively. It is noted that the H/L ratio of birds reared in different stocking densities and different type of cage were non-conclusive. Kang *et al.* (2016) recorded that H/L ratio were greater ($P < 0.01$) for 10 birds/m^2 than in stocking density of 6 or 7 birds/m^2.

Economics of Egg Production

The economics of production was worked out considering the prevailing prices of inputs in the market. The cost of rearing of the layers for 20 weeks, feed, medication, vaccination and overheads and the returns

DOI 10.5455/ijlr.20180819051250

generated from sale of the eggs were considered while calculating the profit. The average sale price of the eggs produced by the birds from different groups was considered Rs. 4.25 per egg. The net profit per egg for the groups A, B, C, D, E, F, G, and H were Rs. 0.33, 0.43, 0.46, 0.22, 0.26, 0.10, 0.65 and 0.20, respectively. It has been observed that the net profit obtained per egg by the birds reared in California cage system and enhanced cage system was more when more space was allotted to the birds. However, providing more space to the birds in battery cages was not useful in getting more net profit per egg. Thus, it may be concluded that except California cages, the recommended floor space beneficial for obtaining more net profit per egg. Further, it is to be stated that while working out the economics of production, only working capital has been considered for this trial during the entire period of 20 weeks. The cost of cages, equipment's, efficiency of space utilization, labour involved all have not been accounted for. As the cost of battery cages is more than the California cages and the cost of enhanced cages, is further higher, in reality at farm conditions those factors will have it be considered. After considering all these costs, the observations and results with respect to economic parameters may drastically change.

Overall Performance

It was noted that in California cages, the birds from group C allotted with floor space of 750 cm^2 per bird recorded marginally better performance with respect to percent egg production, feed consumption, feed conversion ratio, hen housed production and higher profit per egg.

Table 1: Overall performance of the birds from different groups

Parameter	Gr. A	Gr. B	Gr. C	Gr. D	Gr. E	Gr. F	Gr. G	Gr. H
Percent egg production	93.08^{bcd}	91.99^{cde}	94.25^{ab}	93.43^{bc}	94.39^{ab}	91.54^{de}	95.89^{a}	90.45^{e}
Hen House egg production	122.23	128.78	131.56	128.5	130.2	123.98	134.42	120.82
Hen day egg production	122.23	132.93	131.36	134.08	130.2	129.08	134.42	128.15
Broken eggs(No.)	8^{c}	14^{bc}	36^{a}	6^{c}	2^{c}	5^{c}	34^{a}	26^{ab}
Feed consumption per bird/day (gm)	111.03^{a}	110.06^{ab}	108.18^{abc}	106.44^{c}	107.17^{bc}	107.07^{bc}	108.88^{abc}	110.57^{a}
Feed conversion ratio	1.42^{abc}	1.43^{ab}	1.38^{bcd}	1.37^{cd}	1.36^{d}	1.40^{bcd}	1.36^{d}	1.46^{a}
Mortality (%)	0	2.5	0	2.5	0	2.5	0	5
Net profit per egg (Rs.)	0.33	0.43	0.46	0.22	0.26	0.1	0.65	0.2

However, the birds from group C recorded higher number of broken eggs, less number of total eggs produced and hen day egg production as compared to birds from group B provided with the floor space of 465 cm^2 per bird followed by birds from group A, respectively, in California cage. In battery cages, group E providing floor space of 450 cm^2 per bird recorded marginally better performance with respect to total egg production, percent egg production, feed conversion ratio, hen house production and higher profit per egg as compared to the other two group in battery cage, groups D and F. Less number of broken eggs and

 DOI 10.5455/ijlr.20180819051250

hen day egg production was recorded by the birds from group C than the birds from group D was and F with floor space of 465 and 450 cm^2 per bird. In enhanced cages, the bird from group G allotted floor space of 750 cm^2 per bird recorded significantly better performance with respect to total egg production, percent egg production, feed consumption, feed conversion ratio, hen house production and hen day production and higher profit per egg than, birds from group H. However, the birds from group G recorded higher number of broken eggs as compared to the birds from group H with the floor space of 450 cm^2 per bird.

Conclusion

It was concluded that with low stocking density the production performance of layers was found to be better in California and Enhanced cages at the floor space of 750 cm^2 per bird. However, the incidence of broken eggs was more in the both type of cages. It has also been concluded that for the birds reared in battery cages, when the floor space was increased than the recommended allowance, the production performance was found to have been decreased. Further it was concluded that, with respect to the performance of layers in the different cages studied in the experiment, the enhanced cage system was found to be better.

References

1. Anderson, K. E., J. B. Tharrington, P. A. Curtis and F.T. Jones (2004). Shell characteristics of eggs from historic strains of single comb white leghorn chickens and the relationship of egg shape to shell strength. *Int. J. Poult. Sci.,* 3(1): 17-19.
2. Carey, J. B., F. L. Kuo, and Anderson (1995) Effects of cage population on the productive performance of layers. *Poult. Sci*, 74 (4): 633-637.
3. Craig, J. V., J. A. Craig and J. Vargas (1986). Corticoster-oids and other indicators of hens well-being in four laying-house environments. *Poult. Sci.* 65: 856–863.
4. Fulvia B. I., Francesco and P. Giovanni (2014). Effect of group size on performance and egg quality of laying hens during 20 to 36 weeks of age, *Italian J. Ani. Sci*., 13: 3148.
5. Kang, H. K., S. B. Park, S. H. Kim, and C. H. Kim (2016). Effects of stock density on the laying performance, blood parameter, corticosterone, litter quality, gas emission and bone mineral density of laying hens in floor pens. *Poult. Sci*., 95 (12): 2764-2770.
6. Lee, K. and C. W. Moss (1995). Effects of population density on layer performance. *Poult. Sci.,* 74(11): 1754-1760.
7. Nahashon, S. N., N. A. Adefope, A. Amenyenu and Wright (2006). Laying performance of pearl gray guinea fowl hens as affected by caging density. *Poult. Sci.,* 85(9): 1682-1689.
8. Onbasilar, E. E. and F. T. Aksoy (2005). Stress parameters and immune response of layers under different cage floor and density conditions. *Livestock Prod. Sci.,* 95(3): 255-263.
9. Pavan, A. C., E. A. Garcia, C. Mori, C. C. Pizzolante and A. Piccinin (2005). Effect of cage stocking density on performance of laying hens during the growing and laying periods, R. Bras. Zootec., 34 (4): 1320-1328.
10. Sahin, S., M. Macit, N. Esenbuga and H. Karaca (2007). Effect of cage density on performance and egg quality traits of layer, *J. Appl. Ani. Res*. 31: 37-39.
11. Sarica, M., S. Boga and U. S. Yamak (2008). The effects of space allowance on egg yield, egg quality and plumage condition of laying hens in battery cages. *Czech J. Ani. Sci.,* 53 (8): 346-353.
12. Snedecor, G. W. and W. G. Cochran (1994) Statistical Methods. New Delhi: Oxford and IBM, Publications, 265.

DOI 10.5455/ijlr.20180819051250