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SHORT COMMUNICATION

Modulation of Stocking Densities in California Cages to Enhance the Production and Welfare of Commercial Laying Hens

Pinky Roy[1]*, Mukund M. Kadam[1], Archana R. Patil[1], Jaydip J. Rokade[2], Subrat Kumar Bhanja[2], Darshana Bhaisare[1] and Siddharth B. Pawar[1]

[1]Department of Poultry Science, Nagpur Veterinary College, MAFSU, Nagpur, Maharashtra, INDIA
[2]Central Avian Research Institute, Izatnagar, Bareilly, U.P., INDIA

**Corresponding author: P Roy; E-mail: ingewarpin@gmail.com*

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ABSTRACT

The present investigation was carried out to investigate the optimum stocking density in conventional California cages depending on the production performance and welfare of commercial white leghorn hens. To achieve the objectives of the designed experiment total 270 commercial white leghorn layer strain of BV 300 were maintained into four stocking densities that is 60 sq. inch (T1), 75 sq. inch (T2), 85 sq. inch (T3) and 100 sq. inch per bird for 20 weeks period, with 18 replicates in each treatment. At the end of the experimental period the birds reared in 85 sq. inch and 100 sq. inches had significantly ($P<0.001$) higher percentage of hen day egg production, better feed conversion ratio, minimum cost of production per egg & higher egg weight ($P<0.05$) compared to the birds reared in 60 and 75 sq. inches group. Physiological indicators of welfare i.e. H/L ratio and Corticosterone was significantly better in birds reared at stocking density 85 sq. inch when compared to 60 sq. inches group. Laying hens maintained in California cages at stocking density of 85 and 100 sq. inch per bird recorded the best production and welfare parameters. Therefore, considering best utilization of the space with due weightage to welfare, the commercial layer birds reared at stocking density 85 to 100 sq inch per bird performed well.

HIGHLIGHTS

- Optimum Stocking Density of layers in cages.
- Production performance at different Stocking Density.
- Welfare indicators at different Stocking density.

Keywords: California cages, commercial layers, production, stocking density, welfare

Cage ban for laying hens is getting very critical from commercial production point of view for the poultry farmers and the topic has been gaining a strong foothold in the recent years. Welfare activist from India have claimed that rearing of layers in cages has been considered to have a negative impact on the welfare of bird because of restriction of physical environment.

Animal Welfare Board of India advised to GOI and State Government [D.O.No.6(3)310/2017-LC(LS), dated 3rd July 2017] to prohibit the use of battery cages for egg production. In response, Ministry of Agriculture and Farmers welfare, Government of India under G.S.R. 335(E) indicated that the floor space per bird shall not be less than 550 sq. cm and each cage. Hence, in Indian context California cage space standards must be tested with regards to production and welfare of the commercial laying hens as reports and data is scanty and most of the time we are dependent on European reports.

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The experiment was conducted in Poultry Research and Training Center, Department of Poultry Science, Nagpur Veterinary College, MAFSU, Maharashtra. The biological experiment was conducted for a period of 20 weeks from 28th to 47th week of bird's age under standard managemental practices with four experimental treatments T1 (60 sq. inch per bird), T2 (75 sq. inch per bird), T3 (85 sq. inch per bird) and T4 (100 sq. inch per bird) with each treatment having 18 replicates and numbers of birds accommodated in each cage box were 5, 4, 3 and 3 respectively as per space designed.

Egg production, feed offered were noted daily and weekly egg weight, feed intake recorded and feed conversion ratio (per dozen egg) was calculated. The cost of production per egg in terms of recurring expenditure was calculated at the end of the experimental period. The welfare of the birds was measured through Heterophil: Lymphocyte ratio and Corticosterone level during the start and end of the experiment by randomly selecting eight birds per treatment. Heterophil: lymphocyte ratio was calculated as the method described by Gonzales *et al.* (2003). Corticosterone has been analyzed by ELISA kit (Eiahcor 96-Invitrogen-Thermo Fisher Scientific).

Data emerged from the different treatments were analyzed for statistical significance using completely randomized design (CRD) by following standard methods Snedecor and Cochran, 1989. All data were statistically analyzed using SPSS software package (version 13).

Egg Production data showed significantly higher (P<0.001) hen day egg production (HDEP) in T3 and T4 when compared to T1 and T2 (Table 1). Similar findings on effect of stocking density was noticed by Onbasilar and Aksoy (2005), Benyi *et al.* (2006) and Rajendran *et al.* (2013). The best feed conversion ratio was recorded in the birds in T4 with non-significant difference with T3 and T2 but significantly different than T1 (P<0.01) for the 20-week period. Similar findings were observed by Mangnale *et al.* (2019) where significant improvement was observed in FCR as space allowance increased while in contrast Benyi *et al.* (2006) observed poorer feed efficiency as stocking density decreased.

Egg weight (55.88 g) recorded best in the birds of T3 group and lowest in T1 with significant differences (P<0.01). Similar observations were presented by Rajendran *et al.* (2012) and Onbasilar and Aksoy (2005), as space allowance improved egg weight also increased. The cost of production per egg (considering recurring expenses) showed the same trend as like FCR with the highest cost of production in T1 group bird and lowest cost of production per egg in T4 (Table 1). The cost of production per egg was non-significant in the T4, T3 and T2 groups. Mangnale *et al.* (2019) reported higher net profit per egg in birds maintained at more space allowance (or lesser stocking density) in California cages, indicating lower cost of production similar to present experiment.

At the start of the trial, H/L ratio showed significantly better in birds reared at T2 (P<0.01) than rest excepting T3, while corticosterone (ng/ml) was non-significant among the various treatment groups. While towards the end of the trial the H/L ratio of birds from T3 and T4 group were significantly better (P<0.05) than T1 of 60 sq. inch of space. T2 group had lower H/L ratio than T1,

Table 1: Production performance of commercial layers for 20 week period

Treatment	Hen Day Egg Production % (HDEP)	Feed Conversion ratio (FCR)	Cost of Production (₹ /egg)	Egg Weight
T1 (60 sq inch/bird)	83.54 ^{c} ±0.73	1.58 ^{a}±0.01	2.74^{a}±0.02	52.44 ^{b}±0.34
T2 (75 sq. inch/bird)	88.25^{b} ±0.82	1.50 ^{b}±0.01	2.62 ^{b}±0.02	54.48 ^{ab}±0.49
T3 (85 sq. inch/bird)	89.71 ^{ab} ±0.59	1.47 ^{b}±0.01	2.62 ^{b}±0.02	55.88^{a}±0.98
T4 (100 sq. inch/bird)	90.72 ^{a}±1.09	1.46^{b}±0.02	2.59 ^{b}±0.03	54.67^{a}±0.46
N	18	18	18	18
SEM	**0.422**	**0.01**	**0.01**	0.32
P Value	**	**	**	**

Means bearing superscript within a column differ significantly. NS- Non -significant, *P<0.05, **P<0.01.

Table 2: Measurement of Welfare in commercial layers for 20 weeks through Physiological indicators

Treatment	H/L Ratio at Start of Trial	H/L Ratio at End of Trial	Corticosterone (ng/ml) at Start of Trial	Corticosterone (ng/ml) at End of Trial
T1 (60 sq. inch /bird)	$0.55^{a} \pm 0.04$	$0.34^{a} \pm 0.05$	1.03 ± 0.18	$2.21^{a} \pm 0.28$
T2(75 sq. inch /bird)	$0.37^{b} \pm 0.03$	$0.27^{ab} \pm 0.03$	1.18 ± 0.10	$1.08^{ab} \pm 0.16$
T3 (85 sq. inch /bird)	$0.44^{ab} \pm 0.02$	$0.22^{b} \pm 0.01$	0.95 ± 0.11	$0.91^{c} \pm 0.10$
T4 (100 sq. inch /bird)	$0.53^{a} \pm 0.07$	$0.22^{b} \pm 0.01$	0.84 ± 0.02	$1.65^{b} \pm 0.07$
N	8	8	8	8
SEM	0.026	0.011	0.062	0.128
P-Value	*	*	NS	**

Means bearing superscript within a column differ significantly. NS- Non -significant, *P<0.05, **P<0.01.

but were non-significant, also T2 was non-significant with T3 and T4 groups (Table 2). Similar H/L ratio results of better welfare in better space allowance was reported by Onbasiler and Akshoy (2005) and Kang *et al*. (2016). Corticosterone (ng/ml) at the end of the trial reported significantly (P<0.01) lowest in T3 group indicating the birds were in better welfare than the rest of the groups Similarly, Onbasiler and Akshoy (2005) and Kang *et al*. (2016) reported higher level of corticosterone at higher stocking density which is reflective of higher stress.

CONCLUSION

It was recorded that birds maintained at stocking density of 100, 85 and 75 sq. inch/bird treatments were non-significantly different in production and welfare parameters but was significantly better than 60 sq. inch space per bird. This indicated that the increasing space allowance is beneficial and hence, recommended that commercial layers may be reared in conventional California cage system by providing 85 sq. inch/ bird with due weightage to welfare, production and COP/egg.

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