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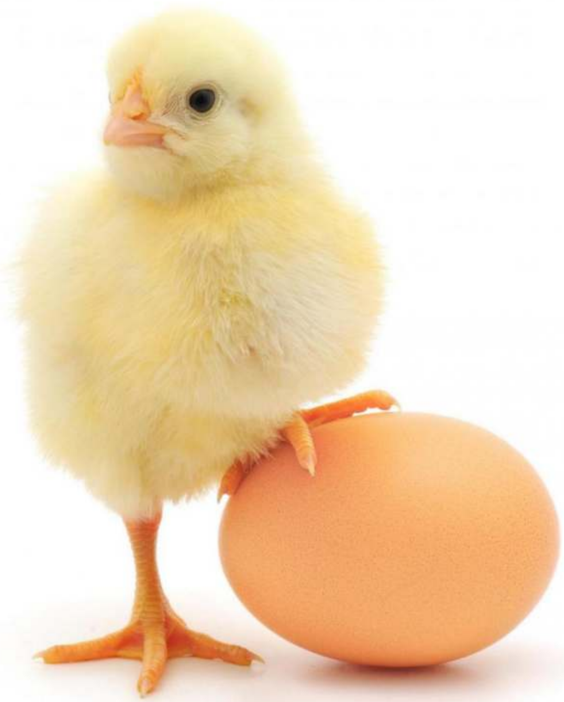

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Performance of Floor Reared White Leghorn Layer on Different Stocking Density and Feed Restriction Regimes

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Abstract: Increase in feed prices in recent years has stimulated renewed interest in the area of feed restriction and simultaneously the birds have to provide space for feeding, watering and normal movements for their optimum growth and production. Thus, a great emphasis has been laid on feeding system, which employs the use of quantitative or qualitative feed restriction. During growing phase 468 White Leghorn (WLH) birds from random bred control population housed on deep litter housing system were exposed to three feeding regimes viz. T_1 (*ad lib.*), T_2 (Skip-two-days a week) and T_3 (75% of *ad lib.*) on three different stocking densities viz. S_1 (2.5 ft^2/bird; 20 birds/pen), S_2 (2.0 ft^2/bird; 25 birds/pen) and S_3 (1.5 ft^2/bird; 33 birds/pen) to form nine combinations of feed regimes and stocking density. Between 20 to 32 weeks of age, T_1, T_2 and T_3 birds gained 31.76, 45.19 and 70.82 percent of body weight. The $T_1 \times S_3$ birds were heavier (1904.5±39.9 g) than other groups at the end of laying phase. The maximum feed consumed by T_1 group (117.91±4.17 g) followed by T_3 (116.61±3.80g) and T_2 group (108.28±3.61 g), which differed significantly. $T_1 \times S_3$ birds consumed daily about 102 g feed and was significantly lower from other interaction groups. The birds kept under $T_3 \times S_1$ treatment gave maximum hen day egg production (64.36±6.78%) followed by $T_1 \times S_2$ (63.83±0.28%) and $T_1 \times S_1$ (61.71±4.84%). Hen housed egg production followed almost the same pattern with hen day egg production. Skip-two-days a week and 1.5-ft^2/ bird treatment ($T_2 \times S_3$) produced eggs of 54.52±1.24 g weights, which were acceptable in market. It appears that skip-two-days fed birds reared on the density of 1.5 ft^2/bird to be the most promising interaction group with respect to lower feed consumption during the laying period without any significant adverse effect on hen housed egg production. It appears that skip-two-days fed birds reared at the density of 1.5 ft^2/bird to be the most promising interaction group with respect to lower feed consumption during the laying period.

Key words: Body weight, feed intake, egg production, layer, stocking density

Introduction

The birds have to provide space for feeding, watering and normal movements for their optimum growth and production. Several management factors influence the early growth and livability of chicken. The stocking density and feeding management during laying phase of the birds are two important factors for optimum body weight, feed consumption, egg production and egg weight of the birds during laying phase. Of these, adequate stocking density was considered the most important one, being observed for the present study.

Materials and Methods

Anand is located at latitude of 22.35° N and 72.55° E. Nineteen weeks old 468 pullets of random bred control population of eight strains of White leghorn (WLH) were used as experimental birds. These birds were exposed to feeding treatments viz. T_1 (*ad lib*), T_2 (Skip-two-days a week) and T_3 (75% of *ad lib*) during growing phase. During laying phase, birds were randomly distributed in three stocking density treatments viz. S_1 (2.5 ft^2/bird; 20 birds/pen), S_2 (2.0 ft^2/bird; 25 birds/pen) and (1.5 ft^2/bird; 33 birds/pen) on deep litter system in 2 replications of each treatment embarrassing 156 birds in each replication. The laying birds were given ration (18.30% CP and 2658 kcal/kg of feed ME) comprised of maize-50%, rice polish-11%, deoiled rice bran-04%, ground nut cake-18%, fish meal-07%, shell grit-06%, molasses-2%, mineral mixture-2% and vitamin preparation-100 g. The birds were maintained under similar managerial condition. A standard schedule was followed in carrying out routine farm operations. The blood samples were collected at 40th and 72nd week for the estimation of total serum protein (Lowery *et al.*, 1951) and total cholesterol (Schoenheimer and Sperry, 1934) from 6 birds per replication. The data of body weight were analyzed by completely randomized design where as data of feed consumption and egg production were analyzed by two factorial completely randomized designs.

Results and Discussion

Body weight: At the end of growing period (20 wks) there were significant differences ($p<0.05$) in body weights among T_1 (1292.51±9.79 g), T_2 (1174. 91±6.19) and T_3 (985.74±7.94 g) feeding treatment groups because of 12

Table 1: Mean (±s.e.) effect of feeding and stocking density on performance of layer

Particular	Feeding treatment *Ad lib*	Skip	75% of *ad lib*	Test of significance	Density treatment 2.5	2.0	1.5	Test of significance
Body weight (g)								
20^{th}wk	1292.51^{a}±9.79	1167.86^{b}±8.89	985.74^{c}±7.94	**	1152.23±10.21	1147.99±9.10	1145.00±7.99	NS
32wk	1702.95±14.65	1695.56±13.92	1683.86±13.83	NS	1696.01±15.29	1684.29±14.81	1702.07±12.82	NS
40wk	1782.18±16.72	1794.22±15.98	1787.12±16.18	NS	1788.50±17.89	1778.25±15.32	1796.77±16.63	NS
56wk	1787.18±18.23	1762.72±19.28	1763.18±19.80	NS	1774.33±21.14	1767.86±19.57	1771.07±17.33	NS
72^{nd}wk	1861.13±21.42	1845.37±21.12	1838.43±23.40	NS	1872.15±23.51	1804.52±20.57	1868.26±20.70	NS
% Increase								
(20-72 wks)	43.99	58.01	86.50	----	62.48	57.19	63.17	
Feed consumption (g/ day)								
20-22wks	74.26±5.44	72.47±1.80	71.88±1.95	NS	76.90±1.27	75.35±2.56	66.36±4.02	NS
40-42wks	144.98^{a}±5.38	131.69^{b}±3.34	137.69^{ab}±1.78	**	146.76^{a}±3.20	141.63^{a}±3.55	128.98^{b}±3.54	**
70-72wks	111.29±5.71	102.10±2.76	107.81±1.64	**	114.64±5.00	106.18±1.13	100.39±2.16	**
Average								
(20-72 wks)	117.91^{c}±4.17	108.28^{a}±3.61	111.61^{b}±3.80	**	120.20^{c}±3.99	113.27^{b}±3.92	104.33^{a}±3.69	**
Egg Production/bird (No.)								
Hen day	224.77±6.76	215.17±2.81	220.40±4.48	NS	221.15±7.31	222.04±5.04	217.15±1.15	NS
%	61.75±1.86	59.11±0.77	60.55±1.23	NS	60.76 ±2.01	61.00±1.39	59.66±0.31	NS
Hen housed	212.85±8.66	197.73±5.90	201.73±6.64	NS	207.63±10.13	205.50±7.04	199.19±4.71	NS
%	58.48±2.43	54.32±1.62	55.42±1.83	NS	57.04±2.78	56.96±1.97	54.72±1.29	NS

**Means with different superscripts (a, b, c, d, e, f) in row differ significantly (p<0.01)

and 28% less feed consumption by T_2 and T_3 birds compared to *ad lib* fed birds. The body weights during laying phase are depicted in Table 1.

It was observed that between 20 to 32 weeks of age birds on *ad lib* feeding gained 31.76% body weight only (i.e. percent of body weight at 20 week of age), while it was quite significantly (p<0.01) higher to a level of 45.19% and 70.82% in T_2 and T_3 birds, respectively. Thus, they compensated their body weight deficit at 32 week of age. Surprisingly, T_3 birds showed 1.4 and 2.2 times more growth rate than those of T_2 and T_1 birds, respectively. Rapid gain in body weight due to higher feed consumption by previously restriction fed birds (Lee and Moss, 1986) resulted into comparable body weight of *ad lib* in restricted groups in even less than 5 weeks of *ad lib* feeding period. Similarly, Naraharl *et al*. (1975) also observed non-significant (p>0.05) difference in body weight at 32 weeks in egg type pullets fed with 20 or 30% feed restriction Vs *ad lib* during growing period while Robbins *et al*. (1986) in broiler breeders did not observe significant (p<0.05) difference in body weight at 42 week of age in 20 and 30% and 50% feed restriction compared with *ad lib* feeding. Thus, 25% feed restriction during growing phase seems to be not so severe and at par with body weight at 32 week as well as 40 weeks of age. The rate of increase from 40 to 56 weeks was static and small with 0.29% only in T_1 birds and while negative for restricted birds in T_2 (-1.76%) and T_3 (-1.34%). This might be due to phase of higher egg production and less body fat reserve in restricted group in addition to nutritional availability even at *ad lib* feeding. Balnave (1984) concluded that the loss of body weight during the period of peak egg production was because the nutrient intake failed to meet the metabolic requirement and it was again more severe in previously restricted birds with had less body reserve. Concomitantly, a consistent increase in ambient temperature from 15.31°C at 39 weeks to 34.66°C (peak) at 60 weeks of age (January to May) also contributed substantially to lower feed consumption and in turn lower body weight. The ideal temperature for chicken ranges from 15 to 20°C. Above 25°C there is reduction in feed efficiency (Singh, 1990). Naraharl *et al*. (1975) observed non-significant (p>0.05) difference in body weight at 64 weeks of age between *ad. lib*. (1700 g) and 80% (1775 g), 70% (1795 g) and even 60% (1660 g) of *ad lib* fed birds.

The average body weight at the end of 20th week was 1152.23±10.21, 1147.99±9.10 and 1145.00±7.99 g on stocking density treatments of S_1 (2.5 ft^2), S_2 (2.0 ft^2) and S_3 (1.5 ft^2), respectively (Table 1). Rapid increase in body weight was observed in all the density groups from 20 weeks through 32 weeks of age. At 32 weeks of age the birds weighed 1696.01±15.29, 1684.29±14.81 and 1702.07±12.82 g for S_1, S_2 and S_3 treatment respectively. This reflected that the birds with lower floor space of 1.5 ft^2 per bird grew better (48.54%) in comparison to 2.0 ft^2 (46.72%) or 2.5 ft^2 (47.19%) floor space per bird. Subsequently, at 40, 56 and 72 weeks of age also there was no significant (p>0.01) effect of stocking density on body weights of the birds, indicating the same magnitude of growth rate. However, during 40 to 56 weeks, there was a decline in the rate of body weight gain in all density treatment groups being -0.79; -0.58 and -1.43% for S_1, S_2 and S_3 groups respectively. This was also coincided with decreasing trend in feed consumption as well as an intensive phase of egg production. Non significant (p>0.05) difference in body weight for different stocking density observed in the present finding agrees with the reports of Lee (1989).

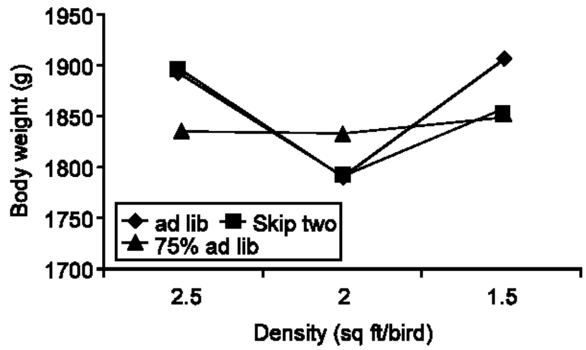

Fig. 1: Body weight (g)

Under Indian conditions, for egg-type light birds, floor space allowance of 2300-2800 cm^2/bird (Banerjee, 1987; Singh, 1990) and 1800-2000 cm^2/bird (Panda and Mohapatra, 1989) has been recommended. However, considering the present findings on body weight, it seems that the above recommendations are on higher side and birds can be kept comfortably and hygienically with floor allowance of 2025 cm^2 (1.5 ft^2) per bird under deep litter system without any adverse effect on body weight of the birds at different ages.

Effect of the feeding×density interaction on body weight at 20, 32, 40, 56 and 72 weeks of age showed non significance ($p>0.05$), reflecting independent effect of feeding and density on body weight during laying period. However, during 32, 40 and 56 weeks of age, skip-two-days a week fed birds reared at 2.5 ft^2/bird density were heavier (1741.56 to 1819.50 g) followed by *ad lib* fed birds kept at 1.5 ft^2/bird (1718.80 to 1799.20 g) or 2.0 ft^2/bird (1716.26 to 1804.97 g) density. At the end of laying period (72 weeks), *ad lib* fed birds kept at higher stocking density of 33 birds/pen (Table 2) provided with 1.5 ft^2/bird space had the highest body weight (1904.51 g) and did not show any significant advantage at 2.0 (1790.2 g) or 2.5 ft^2/bird space (1888.7 g). Skip-two-days a week fed birds kept at 2.5 ft^2/bird space (1892.58 g) and 1.5 ft^2/bird (1853.2 g) weighed equally to *ad lib* fed birds on 2.5 ft^2/bird space (1888.7 g). While 75% *ad lib* fed birds behaved equally at 2.5, 2.0 or 1.5 ft^2 space/bird but was lower than *ad lib* fed birds on 1.5 ft^2/bird and skip-two-days fed bird on 2.5 ft^2/bird spaces (Fig. 1).

Irrespective feeding and density effect, the body weights at 20, 32, 40, 56 and 72 weeks of age were 1148.70±5.12; 1694.12±8.16; 1787.84±9.41; 1771.08±11.03 and 1848.31±12.35 g respectively and they differed significantly ($p<0.01$) except between 40 and 56 weeks of age. The body weight gain was rapid between 20 to 32 weeks (47.48% of age). This is the period of sexual maturity and early part of egg production. The increase in weight gain between 32 to 40 weeks and between 56 to 72 weeks of age was only 5.53 and 4.36% respectively and it was negative (-0.94%) between 40 to 56 weeks of age.

Feed consumption: The average daily feed consumption (g/d/bird) from 20-72 weeks was maximum (117.91±4.17) under T_1 group followed by 75% *ad lib* (111.61±3.80) and skip-two-days birds (108.28±3.61). There were significant ($p<0.01$) differences between all the treatment groups. Thus, compared to skip-two-days a week, 75% *ad lib* fed birds during growing phase were fully adjusted to *ad lib* feeding system during laying phase. The feed consumption increased recorded between 20-22 to 40-42 and then decline upto 70-72 wks of age (Table 1). It is likely that the restricted fed birds have developed an apparent adaptive process for low maintenance requirement or might have improved their feed utilization efficiency per unit body weight gain (Nair *et al.*, 1977). Reddy and Eswaraiah (1988) and Fattori *et al.* (1991) observed higher feed consumption during laying phase in *ad lib* fed birds than birds on 70% *ad lib* feeding during growing phase. But Lee *et al.* (1971) could not observe significant differences in feed intake from 20-60 weeks of age between 10 or 30% feed restricted and *ad lib* fed birds during growing phase. However, Johnson *et al.* (1984) observed significantly more feed consumption during laying phase in skip-two-days a week fed birds than 70% *ad lib* fed birds relating to higher egg production.

The average daily feed consumption g/bird/day during the laying phase by S_1 birds (2.5 ft^2/bird) was significantly ($p<0.01$) higher (120.20±3.99) than birds on S_2 (113.27±3.92) and S_3 (104.33±3.69). The birds kept at the highest density of 1.5 ft^2/bird consumed significantly ($p<0.01$) the lowest feed (Table 1). This might be due to competition for feeding space (Mench *et al.*, 1986), increased stress and higher corticosterone level in blood (Pesti and Howarth, 1983) or reduced activity (Chand and Razdan, 1976). Reddy *et al.* (1981) observed more feed consumption (99.75 g) in less densely (2.66 ft^2/bird) birds than those of more densely (2.0 ft^2/bird) kept birds (97.26 g). The increased feed consumption with increase in stocking density has been observed (Lee, 1989; Chand and Razdan, 1976). However, Koelkebeck and Cain (1984) could not observe this effect ranging from 940 to 3730 cm^2/laying bird densities.

Ad lib fed birds reared on larger floor space of 2.5 ft^2/bird (T_1×S_1) had significantly ($p<0.01$) higher feed consumption (129.55±4.45g) than other interaction groups (Fig. 2). However, *ad lib* fed birds (T_1×S_3) and skip-two-days a week (T_2×S_3) consumed significantly ($p<0.01$) lower feed (102 g) compared to other interaction groups. This reflecting severe effect of space stress compared to 75 percent *ad lib* fed birds (108.43±3.70 g/bird/day) at the same floor space (T_3×S_3) due to higher stress adaptation to both feeding and density treatments. At 2.0 ft^2/bird spaces (T_1) the feed intake was the highest (121.76±4.28) and differed significantly ($p<0.01$) from the lowest feed intake

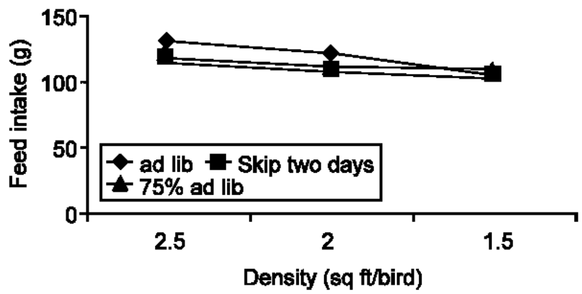

Fig. 2: Average feed consumption (g/bird/d)

(107.15±3.69) by skip-two-days fed birds (T_2). Skip-two-days and 75 percent *ad lib* fed birds at 2.5-ft^2/bird floor space were at par for feed consumption and significantly lower ($p<0.05$) than other interaction groups (Table 2).

There was a sharp linearly increase in feed consumption observed between 20 to 22 weeks of age (72.87±1.91 g) to a peak observed between 38 to 40 weeks of age (141.13±2.58 g) resulted into 56% rapid increase in body weight from 20 (1149 g) to 40 (1788 g) weeks of age. This was also coupled with decrease in environmental temperature (August to December) from 28°C at 22 weeks to 20.8°C at 36 weeks of age. After 40 weeks of age, there was little variation in feed consumption upto about 50 weeks of age. But, thereafter a rapid decline in feed consumption was observed to the lowest at 60 weeks of age (82.53±1.90), pointing the effect of higher ambient temperature that was peaked (34.75°C) at 60 weeks of age of the birds. The lowest feed consumption at high environmental temperature with period effect was also recorded by Chand and Razdan (1976) to balance heat.

Hen-day egg production (%): The hen day egg production (%) from 20 to 72 weeks of age was 61.75±1.86, 59.11±0.77 and 60.55±1.23 percent for T_1, T_2 and T_3 birds, respectively. Correspondingly, the total egg production number was 224.77±6.76, 215.17±2.81 and 220.40±4.48, respectively. However, the treatment groups have non significant ($p>0.05$) difference (Table 1). Initially during 4 weeks of laying, *ad lib* fed birds (T_1) had significantly ($p<0.01$) higher hen-day egg production (30.03±6.10%) by 2.7 times more than skip-two-days (T_2) fed birds (11.26±2.65%) and by 15 times than 75 percent *ad lib* fed birds (1.91±0.57%) due to significant ($p<0.01$) delay in egg laying (age at first egg) in T_2 (143.7 days) and T_3 (160.3 days) birds compared with T_1 (125.2 days) birds. Similarly, during 24-28 weeks also T_1 birds laid maximum (68.57±4.30%) followed by T_2 (52.89±3.04%) and T_3 (37.90±1.38%) reflecting significant ($p<0.01$) differences between the feeding groups. The egg production during 28-32 weeks (3rd period) the increase in egg production over previous period was 35.08% (T_3-72.98±2.13), 21.72% (T_2-74.61±1.03) and 9.33% (T_1-77.89±1.18) percent respectively and resulted into non-significant ($p>0.05$) differences. The higher egg production by 75 percent *ad lib* fed birds over *ad lib* fed birds continued upto the end of laying phase lead to non-significant ($p>0.05$) differences in egg production. All the treatment groups showed peak production during 32-36 weeks of age producing maximum eggs by T_3 birds (82.64±1.74%) followed by T_2 (82.03±1.51%) and T_1 (81.82±0.95%) birds. The trend of decline in egg production was practically the same in three feeding treatment birds. Lee (1987) observed higher egg production in restricted fed birds (70 or 80% of *ad lib*) than those of control birds on account of maturation of oviducts and greater rate of follicular growth, possibly caused by altered gonadotropin output. While non significant ($p>0.05$) feeding effect on hen-day egg production between 70 percent *ad lib* (74.1%), skip-two-days (65.5%) and control (70.7%) birds were recorded by Lee (1987). However, egg production in skip-two-days group and 70 percent *ad lib* fed birds were lower than control birds. Similarly, Nair *et al.* (1977), Lee (1987) and Reddy and Eswaraiah (1988) also failed to observe significant difference ($p<0.01$) in egg production between *ad lib* and restricted fed egg-type or broiler breeder birds ranging from 70 to 90 percent of *ad lib* feeding.

The birds on 2.0 ft^2/bird space had maximum egg production of 222.04±5.04 (61.00±1.39%) eggs. While birds on 2.5 ft^2/bird space gave only 221.15±7.31egg (60.76±2.01%) showing that more space did not turn to be advantageous where as birds on 1.5 ft^2/bird also did not differ significantly from both the space treatments and gave 217.5±1.15 eggs (59.66±0.31%). Lee (1989) observed nonsignificant ($p>0.05$) differences in hen-day egg production by keeping the birds in stocking densities ranging from 1 ft^2 (929 cm^2) to 4.3 ft^2 (4000 cm^2) floor space per bird. While, Mohan *et al.* (1991) observed significantly ($p<0.01$) higher egg production with the birds provided with higher floor space of 2.0-2.5 ft^2/bird (82.34%) than the birds provided with the lower floor space of either 1.75-2.00 ft^2/bird (79.68%) or 1.50-1.75 ft^2/bird (77.39%). It is interesting to note that during 56-60 weeks of age, which was coincided with the hottest period of the season (May, 32.53°C), the birds provided with medium space of 2.0 ft^2/bird were more comfortable and produced maximum egg (54.66%) which was 7.05 and 6.34 percent higher than the birds provided with space of 2.5 or 1.5 ft^2/bird (48.32%) respectively. Reddy *et al.* (1981) observed higher egg production in the birds kept at the space of 2.0 ft^2/bird (76.53%) than less densely kept birds at 2.66 ft^2/bird (76.01%).

Seventy five percent *ad lib* fed birds with lowest density of (2.5 ft^2/bird) gave comfort and resulted into maximum hen-day egg production (64.36±6.78%) in spite of stresses of higher body weight (1670 to 1780 g), higher

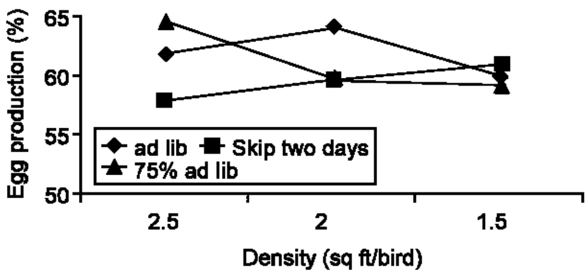

Fig. 3: Percent hen day egg production

metabolism and increase in ambient temperature from 15.31 to 31.09°C. While the same feeding group at 2 ft^2/bird space (59.67±6.06%) and 1.5 ft^2/bird space (59.15±5.94%) gave significantly lower even than *ad lib* fed birds (Fig. 3) with space of 2.5 ft^2 (61.71±4.84%) and 2.0 ft^2 (63.83±0.28%) per bird (Table 1).

The hen-day egg production during the laying cycle (20 to 72 weeks) was 60.47±0.78 percent. However, during 20-24 weeks of age, hen-day egg production was 14.40±4.61 percent. It rapidly and significantly ($p<0.01$) increased during 24-28 weeks (53.12±4.71%) and attained peak production during 32-36 weeks (82.16±0.81%). Subsequently, the egg production declined marginally and non-significantly upto 44-48 weeks of age (76.27±1.53%). But it turned to significant decline from 48-52 weeks (69.72±0.96% upto 56-60 weeks (50.19±2.33%). From 60 weeks egg production remained almost constant upto 72 weeks of age ranging from 45.5 to 51.06 percent. The higher ambient temperature (34.75°C) during May adversely affected the egg production during 60-64 weeks (45.49±2.07).

Hen housed egg production: The hen-housed production was maximum for *ad lib* fed birds (58.48±2.43%) followed by 25% restriction (55.42±1.83%) and 11 percent restriction birds (54.32±1.62%). This corresponded with the higher liveability percent during the laying period of T_1 birds (89.28%) followed by T_3 (84.93%) and T_2 (84.81%) birds (Table 1). There were significant ($p<0.01$) differences between the treatment groups during 20-28 weeks of age while 28-32 weeks there were at par between *ad lib* and skip two days. After 32-36 weeks, there were no significant differences between the treatment groups upto the end of laying period at 72 weeks. Fattori *et al.* (1991) did not observe significant difference in mean hen-housed egg production between lower restriction of 8 percent (60.00%) and higher restriction of 24 percent (59.8%) or the standard treatment (59.8%).

During 32-36 weeks, S_1 birds had the highest hen-housed egg production (78.57±1.61%) followed by S_3 (77.16±2.04%) and S_2 (76.91±1.54%) birds. However, the differences were nonsignificant ($p>0.05$). Unlike hen-day production, S_1 birds had the highest pooled period mean (20-72 weeks) hen-housed egg production (57.04±2.78%) followed by S_2 (56.46±1.93%) and S_3 (54.72±1.29%) birds. This was a result of highest liveability of the S_1 birds (87.50%) followed by S_2 (86.67%) and S_3 (84.85%) birds. In agreement with the present finding, Reddy *et al.* (1981) observed higher hen-housed egg production in the birds kept in 2.66 ft^2/bird (75.64%) than the birds kept in density of 2.00 ft^2/bird (74.26%).

The pooled mean (20-72 weeks) $T_1 \times S_1$ (60.04±4.78%), $T_1 \times S_2$ (59.73±3.60%) and $T_3 \times S_1$ (58.74±6.21%) birds were the better producers after reaching peak production (Table 2), but $T_3 \times S_1$ ranked third position as the birds can not compensate their lower egg production during the early phase lay. $T_3 \times S_3$ birds had lowest egg production (51.11±5.39%). During the early phase of lay (20-36 weeks) *ad lib* fed birds (T_1) with significantly ($p<0.01$) higher body weight than the restricted groups produced maximum egg either at the density of 2.0 or 2.5 ft^2/bird. But from 36 weeks onwards to 68 weeks *i.e.* after reaching peak production, in almost all the laying periods 75 percent *ad lib* either at 2.5 ft^2/bird or 2.0 ft^2/bird space performed best and $T_2 \times S_3$ birds ranked third.

The pattern of period effect on hen-housed egg production was the same as hen-day egg production but the values were at a lower side by about 7 percent. This difference was due to the difference in mortality at different periods.

Conclusion: The birds compensated their body weight deficit of growing phase during 20-32 weeks of age resulted in to non significant effect of either feed or density on body weight at the end of laying period. It appears that skip-two-days fed birds reared at the density of 1.5 ft^2/bird to be the most promising interaction group with respect to lower feed consumption during the laying period without any significant adverse effect on hen housed egg production.

References

Balnave, D., 1984. The influence of body weight at point of lay on the production responses of restricted reared pullets. Aus. J. Agric. Res., 35: 845-849.

Banerjee, G.C., 1987. Housing and equipment 'Poultry' 2nd Edn. Reprinted, Oxford and IBH publishing Co. Pvt. Ltd., New-Delhi, pp: 63.

Chand, D. and M.N. Razdan, 1976. Effect of housing condition and month of the year on egg production, feed consumption, mortality and weights of various organs at slaughter after complete pullet year production.

Fattori, T.R., H.R. Wilson, R.H. Harms and R.D. Miles, 1991. Responses of broiler breeder females to feed restriction below recommended level. 1. Growth and reproductive performance Poult. Sci., pp: 26-36.

Johnson, R.J., A.D. Choice, J. Farrell and R.B. Cumming, 1984. Production responses of layer strain hens to food restriction during rearing Br. Poult. Sci., pp: 369-387.

Koelkebeck, K.W. and J.R. Cain, 1984. Performance behaviour, Plasma corticosterone and economic returns of laying hens in several management alternatives Poult. Sci., pp: 2123-2131.

Lee, K., 1987. Effect of different methods and severity of growing period feed restriction on growth and laying performance of White Leghorn. Poult. Sci., 63: 1895-1897.

Lee, K., 1989. Laying performance and fear responses of White Leghorn as influenced by floor space allowance and group size. Poult. Sci., 68: 1322-1336.

Lee, K. and C. Moss, 1986. Effect of daily restrictive feeding during the growing period on the performance of egg type chicken. Poult. Sci., 65: 76 (Abst.).

Lee, P.J., W.A.L. Gulliver and T.R. Morris, 1971. Restricted feeding of broiler breeder pullets during the rearing period and its effect on productivity and breeding Br. Poult. Sci., 12: 499-510.

Lowery, O.H., N.J. Rosenburg, A. Farn lewis and R.J. Randall, 1951. Effect of stocking density on the performance of layer. J. Biol. Chem., 193: 268.

Mench, J.A., T.A. Van, J.A. Marsh, C.C. McCormick, D.L. Cunningham and R.C. Baker, 1986. Effect of cage and floor per management on behaviour, production and physiological stress responses of laying hens. Poult. Sci., 65: 1058-1069.

Mohan, B.V., M. Mani and Ramakrishan, 1991. Influence of floor space and literacy level of the farmers on egg production. Poult. Sci., 54: 1631.

Nair, S.D., D. Narahari, T. Jayaprasad and I.A. Thyagarajan, 1977. Skip-a-day feeding programme in replacement pullets. Indian J. Poult. Sci., 12: 26-30.

Naraharl, D., C.V. Reddy and S.M. Siddiqui, 1975. Restricted feeding of growing pullets at different levels and durations, effect on egg production, egg quality and profits. Indian J. Poult. Sci., 10: 10-18.

Panda, B. and S.C. Mohapatra, 1989. Layer management 'Poultry production' Indian council of Agricultural Research, New Delhi, pp: 82.

Pesti, G.M. and B. Howarth, 1983. Effects of population density on the growth, organ weights and plasma corticosterone of young broiler chicks.

Reddy, C.V. and Eswaraiah, 1988. Restricted feeding of growing pullets. 1 Its effects on laying house performance. Indian J. Poult. Sci., 23: 79-84.

Reddy, D.N., P. Varadarajulu, S.M. Siddiqui and S.J. Reddy, 1981. Production performance of egg type chicken under different housing systems. Indian J. Poult. Sci., 16: 318-323.

Robbins, K.R., G. Cmcghee, P. Osel and R.E. Beauchene, 1986. Effect of feed restriction on growth, body composition and egg production of broiler females through 68weeks of age. Poult. Sci., 65: 2226-2231.

Schoenheimer, R. and W.M. Sperry, 1934. A micro method for the determination of free and combined cholesterol J. Biol. Chem., 105: 745-760.

Singh, R.A., 1990. Housing and equipment, 'Poultry Production'3rd Edn. Kalyani Publishers, New Delhi.