EVALUATION OF PRODUCTION PERFORMANCE IN 'F' STRAIN OF WHITE LEGHORN

By

BEENA C. JOSEPH

THESIS

Submitted in partial fulfilment of the requirement for the degree

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences

KERALA AGRICULTURAL UNIVERSITY

Department of Poultry Science

COLLEGE OF VETERINARY AND ANIMAL SCIENCES

MANNUTHY, THRISSUR

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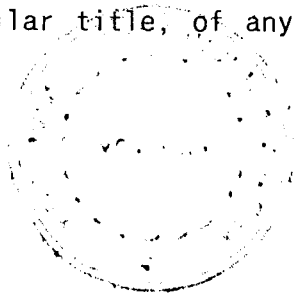
DECLARATION

I hereby declare that this thesis entitled "**EVALUATION OF PRODUCTION PERFORMANCE IN 'F' STRAIN OF WHITE LEGHORN**" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.



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27.12.'95

BEENA C. JOSEPH

CERTIFICATE

Certified that this thesis, entitled "EVALUATION OF PRODUCTION PERFORMANCE IN 'F' STRAIN OF WHITE LEGHORN" is a record of research work done independently by BEENA C. JOSEPH under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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27.12.95

DR. P.A. PEETHAMBARAN
(Chairman, Advisory Committee)
Associate Professor
University Poultry Farm
College of Veterinary and
Animal Sciences
Mannuthy

CERTIFICATE

We, the undersigned members of the Advisory Committee of Smt. **BEENA C. JOSEPH**, a candidate for the Degree of Master of Veterinary Science in Poultry Science, agree that the thesis entitled "**EVALUATION OF PRODUCTION PERFORMANCE IN 'F' STRAIN OF WHITE LEGHORN**" may be submitted by Smt. BEENA C. JOSEPH in partial fulfilment of the requirement for the degree.

Dr. P.A. PEETHAMBARAN
(Chairman, Advisory Committee)
Associate Professor
University Poultry Farm
College of Veterinary and Animal Sciences
Mannuthy

Dr. A. Ramakrishnan
Director, Centre for advanced
Studies in Poultry Science
College of Veterinary and
Animal Sciences, Mannuthy

Dr. G. Reghunathan Nair
Professor
University Poultry Farm
College of Veterinary and
Animal Sciences, Mannuthy

Dr. K.V. Raghunandanan
Associate Professor
Centre for Advanced Studies in
Animal genetics and Breeding
College of Veterinary and
Animal Sciences, Mannuthy

External Examiner
16/5/96
(K.C. SUNDARESAN)

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BEENA C. JOSEPH

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Introduction

INTRODUCTION

Poultry industry has achieved a phenomenal growth in India during the past three decades through new advancements in technology. Poultry meat and eggs have become increasingly important in meeting the animal protein requirement of our people. The availability of mutton and chevon has declined markedly due to the higher production costs and shrinking of grazing lands. The consumption of pork and beef has been reduced due to various reasons. Hence, poultry products are emerging as widely acceptable animal protein source. The increased awareness about value added chicken products has changed the culinary delicacy. At present, vegetarians also accept egg as a part of their diet. The increase in purchasing power among the people and the target to achieve the goal 'health for all' will lead to a rise in demand for eggs and meat by the turn of this century.

The poultry population in the country was estimated to be 258.3 million in the year 1993. Of this, 150 million was laying chicken consisting of 66 million desi and 84 million improved layers. Presently, India ranks sixth position in the world in egg production. The estimated annual egg production in the country during the year 1993 was 24800 million with a per capita annual availability of 28 eggs (Anon, 1994a). This figure is very low in comparison with those of developed countries. Over 60 per cent of population in India is suffering from protein-calorie imbalance and

consequent health problems. In order to meet a minimum requirement of half an egg per person per day, the present annual egg production should increase at least by six folds.

In spite of concerted research and developments in poultry industry in the last decade, the trend in egg production during the period from 1988 to 1993 was almost static. In the years to come, the gap between supply and demand of eggs may get widened due to the increase in human population. The demand for eggs also increases with the awareness about the nutritive value and organoleptic qualities.

According to livestock census 1987, Kerala had 17.9 million poultry consisting of 15.3 million desi stock and 1.8 million improved varieties of chicken and only 0.8 million was other species of poultry. The annual egg production was 899 million during the year 1993. It is evident that organised layer farming could not make any dent in the poultry production scenario in the state. The bottlenecks are low land holdings, higher cost of inputs especially feed and labour; and lack of ready availability of high quality egg type chicks locally.

For a significant achievement in egg production in Kerala a multi-directional approach in the production of hybrids and crossbred chicken layers and thrust in rearing of other avian species is inevitable. It seems nevertheless possible to increase

poultry production significantly through traditionally operated family production units alone. At the same time the traditional systems cannot be ignored in a developing country since it contribute greatly to the national income. Locally available resources must be utilised in the backyard farming systems in order to overcome the constrains that exists in rural areas.

The homestead farming with desi fowls is an extensive system more of free range foraging and scavenging type. Whereas, backyard farming is a semi-intensive system and it is getting momentum not only in rural areas but also in semi and peri-urban areas. The Austrawhite birds popularly known as Gramalekshmi developed in Kerala Agricultural University by crossing Australorp male line with White Leghorn female line is being widely accepted by the farming community. In the above cross breeding programme 'F' strain of White Leghorn was used as the female line consistently. In order to keep a sustainable performance in the crossbred progenies, it is essential to test the efficiency of parental line periodically.

Therefore, the present study was undertaken with an objective to assess the production performance and magnitude of variation among production traits in 'F' strain of White Leghorn.

Review of Literature

REVIEW OF LITERATURE

The literature pertaining to the production performance in White Leghorn layers under various experimental and climatic conditions are reviewed herewith.

Meteorological Observations

Esmay (1969) reported that the upper and lower optimum housing temperature of 29.4°C and 12.8°C provided the desirable range for summer and winter respectively and opined that the upper optimum temperature of 29.4°C is however too high if constant, and associated with high humidities.

The effect of temperature on egg production indicated that rate of lay was probably maximal at around 18-21°C with depression in production at temperature above or below this range (Anon, 1976).

Radhakrishnan (1981) in a study using White Leghorn birds under backyard system reported that the maximum environmental temperature varied from 40.0°C to 31.0°C and minimum temperature from 16.8°C to 20.2°C during the entire period of study from February through July.

Kothandaraman (1985) cited the observation that the mean daily average temperature and egg production showed a highly negative correlation wherein 1°F rise in air temperature resulted in 2.18 per cent decline in egg production.

Deaton *et al.*, (1986) conducted studies to determine the effects of seasonal temperature extremes on laying hen performance. The temperature used were constant 21°C vs 24 h linear temperature cycle that ranged from 24 to 35 to 24°C. Results showed that per cent hen-day production did not differ significantly between the temperature regimes. However, the laying hens exposed to 24-35-24°C regimen gained significantly less body weight, consumed significantly less feed than the hens exposed to a constant 21°C temperature.

In a study with White Leghorn layers, Brahma and Ramakrishnan (1989) reported that the maximum temperature ranged from 32.1 to 37.3°C and variation in the minimum temperature was from 24.6°C to 28.3°C with relative humidity range from 55 to 75 per cent inside the house and claimed that these values were typical of hot-humid climate.

Geo (1992) reported mean maximum temperature of 33.96°C during May-June and 28.11°C during July-August. The mean minimum temperature were 26.92°C and 23.74°C during the above periods. The per cent relative humidity were 79.96 and 89.71 in the forenoon, and 58.04 and 78.89 in the afternoon in the above periods respectively.

Peguri and Coon (1993) studied the influence of three different temperatures viz., 55°F, 75°F and 93°F on egg production. The hen-day per cent production reported was similar at 55°F and 93°F whereas, the production was significantly high at 75°F (82.2 per cent) during the experimental period of 65 weeks.

Singh and Belsare (1994) recorded the egg production in deep litter and cage systems. The over all production was 45.71 per cent where the environmental temperature varied from 26.9°C to 40.1°C with a relative humidity of 56 to 90.5 per cent.

In the twenty third Random Sample Layer Test conducted at Hesserghatta, Bangalore, the maximum and minimum temperature recorded were 29.3 and 18.7°C respectively. The mean relative humidity in the forenoon was 81.3 per cent. In the afternoon, the mean relative humidity was reduced to 50.6 per cent. The experimental period was from 19 to 72 weeks of age in layers (Anon, 1994b).

Production traits

Body weight

Sheriff *et al.*,(1978) studied the effect of body weight in Meyer strain of Single Comb White Leghorn pullets in multiple-bird cages. The average body weight at 20 weeks of age in the experimental groups reported were 870, 973, 1096 and 994 g and the corresponding groups were classified as light, medium, heavy and intermingled. At 40 weeks of age, the average body weights in the respective groups were reported as 1306, 1440, 1564 and 1407 g. No significant difference in production was reported by these authors among the body weight groups.

In a study conducted at the Mannuthy centre of All India Co-ordinated Research Project on Poultry Breeding with 'F' strain of White Leghorn, it was reported that the mean body weight in the flock was 1200 g at 20 weeks and 1400 g at 40 weeks of age (Anon, 1979).

Radhakrishnan (1981) evaluated the production performance in 25 pullets of White Leghorn 'F' strain under backyard system of rearing and the mean body weight at 20 and 40 weeks of age reported were 886 and 1382 g respectively. The period of study was from February to July.

Reddy *et al.*, (1981) reported that the body weight at 40 weeks of age in White Leghorn were 1478 and 1465 g under two different floor spaces of 2.00 and 2.66 sq. feet per bird respectively in deep litter rearing. There was no significant difference in the 40 week body weight due to the difference in floor density.

Singh (1983) stated that the mean body weight of pure strain 'F' of White Leghorn at 20 and 40 weeks of age was 1113 and 1531 g respectively, in 85 birds.

Balnave (1985) stated that the egg production in Single Comb White Leghorn was not affected when body weight varied between 1.3 and 1.8 kg at 21 weeks of age. However, certain production traits showed significant difference among the groups of birds with range of body weights varying in 100 g interval from 1.3 to 1.8 kg.

Bish *et al.*, (1985) divided Single Comb White Leghorn pullets into three groups based on their average body weights at 20 weeks of age as light, medium and heavy groups. The mean body weights in the above respective groups were 1131, 1256 and 1377 g. It was reported that the heavier birds produced heavier eggs.

Zhuvavlev *et al.*, (1986) opined that pullets which exhibited early sexual maturity were characterised by high growth rate prior to onset of laying. Those birds with body weight between 1500 and 1800 g showed high egg production.

Koelkebeck *et al.*, (1987) reported that in deep litter system, a reduction in floor space from 0.373 to 0.094 m^2 resulted in a reduction in body weight gain from 0.05 to 0.02 kg and the weight gain at the different floor space were not significant.

Leeson and Summers (1987) studied the effect of immature body size in White Leghorn pullets on their subsequent laying performance and egg size under individual cage system of rearing in two trials. In the first trial birds at 15 weeks of age were classified as small, medium and heavy and the mean weights in the corresponding groups were 997, 1110 and 1226 g. In the second trial body weights at 19 weeks of age were grouped into mean body weights of 1308, 1411 and 1564 g as small, medium and heavy groups respectively and the corresponding groups showed similar effects.

Okpokho *et al.*, (1987) conducted experiments to compare egg production, feather loss and nervousness in hens kept under homogenous and heterogenous body weight groups. The pullets at 18 weeks of age were classified as light (<1044 g), medium (1044-1250 g) and heavy (>1250 g) groups and housed in laying cages and tested for 50 week production period. It was reported that the homogenous and heterogenous weight groups did not differ in production performance.

Flock uniformity in terms of body weight had been studied by North and Bell (1990) and reported that a flock can be considered as excellently uniform if 78 per cent of the birds in the flock are within 10 per cent of mean body weight. If 70 per cent of birds are within 10 per cent of the mean body weight, the flock has satisfactory uniformity. But the flock is with very poor uniformity if less than 58 per cent of birds are in the range of 10 per cent variation from the mean body weight.

A study was made by Dimitrov (1991) on the effects of body weight at the age of 128 days on production traits. Three groups of birds with body weights ranging from 1020 to 1120, 1160 to 1200 and 1240 to 1360 g were used for the study. The mean values of production traits were numerically similar in all three groups.

Escalante *et al.*, (1991) studied the effects of different body weight grouping at 18 weeks of age on production performance from 21 to 66 weeks of age in White Leghorn. The mean body weights in

different groups were 960, 1020, 1080, 1200 and 1320 g and the study revealed that there was no significant difference in production traits due to pullet body weight.

Geo (1992) reported that the mean body weights in White Leghorn strain cross pullets of ILM-90 ranged from 882.94 to 886.9 g at 20 weeks of age. At 44 weeks of age, the mean body weights were 1411.8, 1426.12 and 1400.8 g under floor space allowances of 1350, 1575 and 1800 sq.cm/bird, respectively in deep litter system of rearing.

In the twenty third Random Sample Laying Test conducted at Hesserghatta, the mean body weight of White Leghorn strain cross, ILM-90 pullets at 18 weeks of age was 1120 g . (Anon, 1994b).

Nahashon *et al.*, (1994b) reported weight gain of 247 and 312 g/bird from 30.5 to 62.5 weeks of age in commercial White Leghorn layers fed two types of diets.

Sikka *et al.*, (1994) studied the performance of Satlej strain of White Leghorn layers and claimed that the gain in body weight was 278 to 284 g/bird.

Summers and Leeson (1994) reported that the lower protein diets resulted in low body weight in the White Leghorn pullets at point of lay.

In a study with White Leghorn pure strains H and C; and their reciprocal crosses, Singh *et al.*, (1995) reported the average body weights at 20 weeks of age as 1184, 1192, 1174 and 1195 g in genetic groups HxH, CxC, HxC and CxH respectively.

Age at Sexual Maturity

Wolf *et al.*, (1969) reported that the age at sexual maturity in pullets that consumed 15 g protein per day from 9 to 18 weeks of age ranged from 152.5 to 157.6 days. A protein intake of 10 g/day produced the greatest delay in sexual maturity.

The age at first egg reported in the flock of 'F' strain White Leghorn was 130 days, (Anon, 1979) and in the particular strain the ages at 10 and 50 per cent production were 150 and 180 days respectively.

Radhakrishnan (1981) studied the production performance in White Leghorn ('F'strain) birds under backyard system of rearing and the mean age at first egg in the flock was 157.8 days. The flock attained 50 per cent production at 182.6 days of age.

Reddy *et al.*, (1981) reported that the age at 50 per cent production with floor space allowance of 2.00 and 2.66 sq.ft. per bird were 151.5 and 152.5 days respectively. However this difference was not statistically significant.

In a study conducted by Thyagasundaram *et al.*, (1982) using six genetic groups of White Leghorn strain crosses the mean age at sexual maturity was reported from 157.08 to 161.39 days.

Singh (1983) reported that the mean age at first egg in pullets of White Leghorn pure strain 'F' was 176 days.

Reddy *et al.*, (1989) evaluated the production performance in Single Comb White Leghorn hens and reported the sexual maturity at 162 days of age.

Geo (1992) evaluated the production performance in White Leghorn strain cross ILM-90 and reported the age at first egg as 153.2, 152 and 157 days with age at 50 per cent production at 185, 187.4 and 183.4 days of age respectively under floor densities 1350, 1575 and 1800 cm^2/bird.

In the random sample laying test conducted at Hesserghatta, the age at first egg was 129 days in White Leghorn strain cross (NxP). In this cross, the age at 50 per cent production was reported to be 158 days (Anon, 1994b).

Jadhav *et al.*, (1994) in White Leghorn pullets found that the age at first egg was earlier in an experimental group than control group (137 vs 141 days) and the age at 50 per cent production was 161 and 168 days in the respective groups.

Sikka *et al.*, (1994) evaluated the performance of Satlej strain of White Leghorn and reported 50 per cent production at 157 days of age.

Singh and Belsare (1994) studied the performance of White Leghorn hens in cage and deep litter under field conditions. In this study the ages at first egg and 50 per cent production were lower in cage system (154 and 172 days) than those in deep litter system (196 and 210 days).

Singh *et al.*, (1995) reported the age at first egg as 157 and 154 days in two pure strains H and C of White Leghorn and that in the H x C and C x H crosses were 156 and 154 days respectively.

Egg Production

March and Biely (1963) studied the laying performance of Single Comb White Leghorn hens housed in community cages each containing 15 birds and the hen-day production from February through October was reported as 55.2 per cent.

The egg production in a flock of 'F' strain White Leghorn during a period of eleven months laying was 243.3 eggs on hen-housed basis and 245.8 eggs on hen-day basis (Anon, 1978).

Sivaraman and Jayaraman (1972) stated that the egg production was 46.1 and 45.1 per cent in two trials.

Sheriff *et al.*, (1978) measured the laying performance of Meyer strain Single Comb White Leghorn in multiple-bird cages. No significant difference in egg production was reported by these authors in light, medium, heavy or intermingled weight classes of birds. The average egg production in the above groups were 46.7, 51.7, 55.4 and 47.1 eggs per bird respectively from 20 to 40 weeks of age.

In a study conducted to evaluate the production performance of 'F' strain of White Leghorn, the hen- day production reported was 75.6 eggs per bird upto the age of 40 weeks (Anon, 1979).

Balachandran *et al.*, (1979) compared the production characteristics in the 'F' strain Single Comb White Leghorn hens in cage and deep litter systems of rearing. The mean per cent hen-day production was significantly higher in cage system (61.09) in comparison with deep litter system (54.89) in six, 28-day periods from 156 days of age.

Christmas *et al.*, (1979) studied the production performance in twelve strains of White Leghorn hens at the age of 150 days. Data collected for twelve, 28 day periods showed slightly higher hen-day production only in certain strains and several strains did not perform well due to dietary variations made in the study.

Leeson and Summers (1980) reared commercial strain of Single Comb White Leghorn in individual laying cages and egg production

upto 65 weeks of age was tested with fourteen hours of constant lighting and reported egg production on hen-day basis from 71.3 to 74.2 per cent.

Radhakrishnan (1981) in a study using pullets of 'F' strain White Leghorn claimed that the egg production upto 40 weeks of age was 28.3 per cent under backyard system of rearing.

Thyagasundaram *et al.*, (1982) analysed the degree of genetic divergence for egg production in six groups of White Leghorn strain cross pullets. The rate of lay contributed 19.76 per cent divergence and it was reported to be the highest among the component traits. The egg production upto 15 months of age in six genetic groups were ranged from 63.4 to 68.76 per cent.

Singh (1983) evaluated the part year egg production in pure and crosses of N, P and 'F' strains of White Leghorn. The egg number was reported to be 84 in pure line 'F' strain upto 40 weeks of age, whereas in N and P strains the corresponding values were 72 and 73 eggs per bird .

Kumararaj and Thangaraju (1987) in two flocks of White Leghorn reported that the egg number was 56.9 per bird from 20 to 40 weeks of age in the pooled flocks.

Bhatti and Sharma (1989) studied the efficiency of egg production in White Leghorn hens during post moult laying period. The egg production for 44 weeks before and after 56 weeks of age was reported as 62.38 and 57.91 per cent respectively.

Brahma and Ramakrishnan (1989) reported 77.06 per cent hen-day production in Single Comb White Leghorn strain cross hens during the period from 25 to 65 weeks of age.

Chaithanyam *et al.*, (1989) conducted experiments to study the nature and magnitude of genetic divergence in purebred White Leghorn populations subjected to selection on part year production over a period of six generations. They reported that the egg production upto 40 weeks of age in four lines of White Leghorn did not show any definite trend and were variable in different generations.

Jalaludheen and Ramakrishnan (1989) reported that the hen-day egg production ranged from 35.4 to 45.4 per cent in Single Comb White Leghorn strain cross layers during the period from 20 to 40 weeks of age.

Reddy *et al.*, (1989) studied the production performance in Single Comb White Leghorn hens and stated that the grower dietary protein levels did not influence their subsequent laying performance during 22 to 61 weeks of age. It was reported that the hen-day production was varied from 52.4 to 59.0 per cent in the group of birds fed with 16 per cent crude protein (CP) in grower diet and 18 per cent CP in layer diet.

Thakur *et al.*, (1989) estimated the genetic and phonotypic parameters in a flock of White Leghorn in nine consecutive generations. The least square mean for egg number upto 40 weeks of age was 80.65.

Sudhakar (1990) studied the hen-day production in Single Comb White Leghorn hens for three, 28-day periods from the onset of 50 per cent production. On feeding an aflatoxin free control diet, the hen-day production was 80.2 per cent. It was stated that dietary levels of aflatoxin at the rate of 0.6, 1.25, 2.12 and 2.85 ppm resulted in decrease in egg production from 71.4 to 53.7 per cent.

In a study conducted by Anitha *et al.*, (1992) it was revealed that the egg production in cages were higher than that on litter floor (60.34 vs. 47.98 per cent) during 21 to 72 weeks of age.

In a study by Strong (1992) using a commercial layer strain (Hy-Line W-36) it was reported that the hen housed egg production was similar in paused (231 eggs) and full fed (233 eggs) birds during the first half of a complete laying cycle.

Kutty *et al.*, (1992) evaluated the influence of bird density on layer performance using N x P cross of White Leghorn on litter floor. The hen-day production was not influenced by the different floor space allowances and it was 48.02, 49.36 and 46.17 per cent in birds given floor space of 1350, 1800 and 2250 cm^2/bird respectively during the period from 18 to 45 weeks of age.

Harms and Russel (1993) observed marked variations in egg production due to reduction in protein content in the layer diets and the egg production varied from 74.8 to 84.1 per cent under various dietary protein levels.

Keshavaraz and Nakajima (1993) reported that the egg production in a flock of White Leghorn was 85.4 per cent during the period from 20 to 36 weeks of age.

Koelkebeck *et al.*, (1993) conducted experiments in Single Comb White Leghorn hens of H and N strains in summer and winter by full feeding and feed withdrawal for four and seven days and the hen-day production were reported to be varied from 50.4 to 58.8.

Mandlekar and Thatte (1993a)studied the laying performance in Babcock strain of White Leghorn on feeding various diets and reported egg production in first 20 weeks of age from 81.65 to 86.89 per cent.

Peguri and Coon (1993) studied the relationship between feather coverage, nervousness and environmental temperature on laying performance in 59 week old White Leghorn hens. They reported that at 0, 50 and 100 per cent feather coverage the hen-day production were 74.1, 80.8 and 77.5 per cent respectively.

Sahu *et al.*, (1993) reported that inclusion of polanga oil cake at 15 per cent level in layer feed in White Leghorn resulted in hen-day production of 64.89 per cent.

The hen-housed and hen-day number were reported as 100.0 and 105.3 eggs respectively from 20 to 40 weeks of age in a Single Comb White Leghorn strain cross layer tested in twenty third Random Sample Laying Test held at Hesserghatta, Bangalore (Anon, 1994b).

Ahmed *et al.*, (1994) studied the level of peak production in White Leghorn layers in cages and a significant increase in hen-day production during the period from 33 to 42 weeks of age was reported in comparison with reference and control diets (85.7 vs. 78.5 per cent.).

In a commercial strain of White Leghorn, Arkhipov *et al.*, (1994) reported 73.1 per cent egg production from 145 to 325 days of age.

Caballero *et al.*, (1994) evaluated the effect of yeast supplementation at various levels in hyline birds at 10 months of age and reported that after 92 days of feeding 0, 5 and 10 per cent levels of yeast, the egg production were 78.7, 79.1 and 81.1 per cent respectively.

Grunewald *et al.*, (1994) tested the laying performance on feeding low protein mixtures in LSL hybrids and reported 64 per cent egg production upto nine months of age.

Muller (1994) in a study using 10 strains of Single Comb White Leghorn reported the average egg production from 254 to 304 eggs per hybrid upto 500 days of age in white egg lines and the production varied from 280 to 295 eggs in brown egg lines.

Nahashon *et al.*, (1994a) carried out experiments in Dekalb XL Single Comb White Leghorn and the hen-day production was reported as 88.9 per cent from 28 to 34 weeks of age and then reduced to 85.9 per cent from 34 to 41 weeks of age.

Nahashon *et al.*, (1994b) studied the effects of feeding two diets and reported HD production of 88.5 eggs and 88.7 per cent from 30.5 to 62.5 weeks of age in Dekalb XL strain of Single Comb White Leghorn.

Perez *et al.*, (1994) reported that the annual egg yield from pullets weighing 1058 g at 14 weeks of age were 252.5 eggs/hen/year and pullets weighing 932 g at 14 weeks of age laid 244.8 eggs upto 72 weeks of age.

Sikka *et al.*, (1994) studied the optimum protein and energy requirement in summer season for Satlej strain of White Leghorn developed by Punjab Agricultural University, Ludhiana. With dietary protein levels of 14, 16 and 18 per cent, the hen-day production reported were 57.3, 67.1 and 65.5 per cent respectively and it was significantly lower with 14 per cent dietary protein.

Singh and Belsare (1994) studied the production performance under field conditions in five poultry units and the egg production reported from 36.1 to 53.2 per cent among different seasons was not statistically significant. The overall performance under cage and deep litter systems did not differ statistically but were significantly lower than that observed in organised sector. The peak production was reached at 33 weeks in deep litter and at 34 weeks in cage system. The persistency in production was more or less same in both rearing systems.

Arneja and Dhanda (1995) conducted physiological studies on good layers and poor layers. They classified birds above 65 per cent egg production as good layers and birds below 35 per cent production as poor layers. The overall egg production in good layers was 71.25 per cent as compared to 34.65 per cent in poor layers. The good layers had an average clutch size of four eggs against 1.5 eggs in poor layers. In 30 to 40 per cent of poor layers pause was as big as 4 to 10 days and in some very good layers pause was only 1 to 3 days.

White Leghorn hens in individual cages were examined by Chand *et al.*, (1995) in a 16 week feeding trials. The egg production was reported to be 70.8, 70.9, 67.9 and 61.9 per cent with the inclusion of hot water treated cotton seed meal at the rate of 0, 5.5, 8.25 and 11 per cent respectively.

Kansal *et al.*, (1995a) housed White Leghorn Babcock BV-300 layers at the age of six months in two types of cages having floor area of 375 cm^2/bird and 337.5 cm^2/bird and studied the production performance for 12 months. The hen-day egg production was 279 and 290 eggs respectively but was not statistically significant.

Kansal *et al.*, (1995b) evaluated the effect of foggers on laying performance in Babcock strain of White Leghorn at the age of 41 and 55 weeks. The control group consisted of birds of 46 weeks age. The egg production for 11 weeks was 86.9, 79.81 in 41

and 55 week birds respectively and 70.61 per cent in the control group. The egg number was significantly higher with fogger system as compared to control.

Singh *et al.*, (1995) compared the production traits in two strains of White Leghorn and their crosses. The number of eggs produced upto 40 weeks of age in H and C strains were 83 and 82 eggs. In the genetic groups H x C and C x H, the egg production was 82 and 85 eggs respectively. Among the four genetic groups, the hybrids of C x H cross was reported as superior in egg number over the purebreds.

Feed consumption

March and Biely (1963) reported that the daily feed intake varied from 0.245 to 0.298 pounds in birds fed on a standard layer diet and the decrease in feed intake resulted in lowering of egg weight.

In a study using 170 White Leghorn pullets and 18 cockerels, Sivaraman and Jayaraman (1972) reported that the total feed intake for five weeks was varied from 4.45 to 4.52 kg.

Anon (1978) recorded daily mean feed intake of 130 g in White Leghorn hens in the seventh Random sample Laying Test conducted at Bangalore.

Balachandran *et al.*, (1979) reported the daily feed consumption of 109 g and 102 g in floor and cage systems respectively and the feed intake was significantly lower ($P<0.05$) in caged birds than those on the floor, in F strain of White Leghorn.

Christmas *et al.*, (1979) tested twelve strains of White Leghorn for twelve, 28-day periods and they reported that the feed intake was generally greater for the straight fed birds and the differences were very slight among strains.

Leeson and Summers (1987) claimed that immature body weight had a consistent effect on feed intake wherein the feed intake was varied from 99.8 g to 108.6 g among different body weight groups.

Brahma and Ramakrishnan (1989) in an experiment using White Leghorn pullets reported that the daily feed intake of birds was varied from 104.63 g to 109.3 g during a period of 10 months.

In an experiment using strain cross White Leghorn pullets Jalaludheen and Ramakrishnan (1989) reported that the highest intake of feed was 133.1 g whereas the lowest feed intake was 103.5 g per bird.

Anitha *et al.*, (1992) studied the effect of housing systems in White Leghorn layers during 21 to 72 weeks of age and the daily feed consumption was reported as 110.91 g and 108.64 g in cage and floor systems respectively.

Kutty *et al.*, (1992) studied the influence of bird density on layer performance in White Leghorn and the feed intake were 118.1, 117.2 and 120.7 g in the groups provided floor space allowances 1350, 1800 and 2250 cm^2 per bird respectively.

Mandlekar and Thatte (1993a) reported that the mean feed intake was varied from 111.09 to 111.67 g in White Leghorn hens and this difference was statistically non-significant.

Peguri and Coon (1993) in a study with White Leghorn laying hens reported that there was significant difference in feed intake between the percentage of feather coverage in birds. Highest feed consumption was recorded in zero per cent feather covered birds (0.273 pounds) and the lowest feed consumption was reported in 100 per cent feather covered birds (0.216 pounds).

In a study conducted by Ahmed *et al.*, (1994) in White Leghorn hens it was reported that the daily feed intake among different group of birds varied from 108.33 to 111.67 g which was not statistically different. The duration of study was from 33 weeks to 42 weeks of age.

Bermudez *et al.*, (1994) reported that in 1500 hens classified in a range of 800, 900-980, 1000-1120, 1140-1220 g and >1240 g at 14 weeks of age, feed consumption upto 72 weeks of age were averaged 40.60, 41.04, 41.17, 41.50 and 41.80 kg per bird respectively.

Jadhav *et al.*, (1994) in a study using White Leghorn pullets under deep litter system reported the feed intake from 16 to 26 weeks of age as 6.84 kg/bird.

Muller (1994) evaluated the production potential of hybrid laying hens and reported that the total feed intake was varied from 7.55 to 7.67 kg for a period of 140 days in white egg producing lines.

Singh and Belsare (1994) studied the performance of White Leghorn hens in cage and deep litter under field conditions and the overall feed consumption was 117 g/bird/day wherein the feed intake was higher in deep litter than that in cage system (121.5 vs 114 g).

Chand *et al.*, (1995) conducted experiments using White Leghorn hens and reported that the mean feed intake was only 84 g per bird per day.

Kansal *et al.*, (1995a) in a study conducted specifically to evaluate the effect of cage density in White Leghorn layers reported that there was no significant difference in feed consumption between the cages having floor space of 375 and 337.5 cm^2/bird (126 g vs 124 g/bird/day).

Kansal *et al.*, (1995c) in a study using Babcock layers hatched in seasons of March, May and November reported that the feed intake

was 113.92, 108.41 and 113.53 g respectively for different seasonal hatches and no significant difference between hatches were observed in a semi-slatted floor system of rearing.

Feed efficiency

March and Biely (1963) evaluated the feed efficiency in laying birds and reported that when a standard diet was fed to laying birds in cages, they consumed 5.93 pounds of feed to produce one dozen eggs and 3.65 pounds of feed to produce one pound of egg.

Anon (1978) reported that the feed efficiency in 'F' strain of White Leghorn hens was 2.12 in the Random Sample Laying Test conducted at Bangalore.

Sheriff *et al.*, (1978) reported that there was no significant difference in the feed efficiency between different body weight groups. In the light group, where average body weight at 20 weeks of age was 870 g, the feed efficiency was 2.5 to produce dozen eggs.

Balachandran *et al.*, (1979) found a significant relationship between cage system of rearing and feed efficiency in layers and claimed that birds in cages had significantly better feed efficiency when compared to birds in floor system.

In a study conducted by Christmas *et al.*, (1979) using twelve strains of White Leghorn hens reared on floor and cage systems

showed little differences in feed efficiency due to various protein levels fed during 336 days of laying period.

Mathew *et al.*, (1979) studied the effect of floor and cage housing in relation to stocking densities on the production performance of White Leghorn layers and claimed that the feed efficiency was significantly better at low density (2100 sq. cm per bird) in deep litter system.

Bhatti and Sharma (1989) in a study using laying hens at 56 weeks of age claimed that the hens took 2.54 kg feed to produce one dozen eggs of 56 g each, during the first year of laying. In the second year, the feed efficiency varied from 2.38 to 2.6 in different test groups.

Brahma and Ramakrishnan (1989) evaluated the production performance in strain cross (IWN x IWP) White Leghorn pullets and in their study feed efficiency was varied from 1.72 to 1.90 per dozen eggs and 2.62 to 2.90 per kg egg mass.

In a study by Jalaludheen and Ramakrishnan (1989) the variation in feed efficiency was from 2.54 to 3.63 per dozen eggs in strain cross White Leghorn.

Anitha *et al.*, (1992) found that feed efficiency was better in cage system (2.21) than that in floor system (2.75) of rearing, in White Leghorn layers.

Kutty *et al.*, (1992) observed no significant difference in feed efficiency between floor space allowances 1350, 1800 and 2250 cm^2 per bird and the corresponding feed efficiency values were 2.76, 2.72 and 3.02.

In a study conducted by Sahu *et al.*, (1993) laying hens took 2.91 kg of feed to produce one kilogram egg mass.

Mandlekar and Thatte (1993b) in a study using 48 pullets in individual cages reported that the quantity of feed consumed to produce a dozen egg was varied from 1543.55 to 1653.05 g.

In caged layers Ahmed *et al.*, (1994) reported the feed efficiency from 1.517 to 1.705 per dozen egg and 2.29 to 2.64 to produce one kilogram of egg mass during a period from 33 to 42 weeks of age.

Arkhipov *et al.*, (1994) claimed that the feed efficiency to produce ten eggs was 1.46 in replacement pullets.

Caballero *et al.*, (1994) reported that the feed efficiency was varied from 2.17 to 2.25 in different groups of White Leghorn hens aged 10 months.

Praharaj *et al.*, (1994) in a study using Single Comb White Leghorn hens of 67 weeks of age observed mean feed efficiency of 2.625 during the experimental period of four, 28-day periods.

In an experimental study Jadhav *et al.*, (1994) reported feed efficiency of 2.47 per dozen eggs under deep litter system of rearing.

In a study conducted by Muller (1994) on the production potential of strains producing white eggs and brown eggs it was shown that the feed consumption per kg egg mass was 2.27 to 2.35 vs 2.17 to 2.44 kg in white and brown egg producing lines respectively.

Nahashon *et al.*, (1994a) reported that feed efficiency was varied from 1.58 to 1.62 in Dekalb XL Single Comb White Leghorn pullets in a 28-day period.

Nielson *et al.*, (1994) evaluated the effect of two types of housing systems viz., Hanskier cages where the floor space allotment is 1 m^2/10 birds and Boleg II cages where floor space is 1 m^2/20 birds. Feed efficiency in terms of quantity of feed per kg egg mass averaged 2.75 and 2.57 kg in Hanskier and Boleg caged hens respectively.

Sikka *et al.*, (1994) in a study using Satlej strain of White Leghorn reported that the feed efficiency was varied from 2.57 to 3.15 to produce one kilogram egg mass.

Chand *et al.*, (1995) reported a feed efficiency of 2.27 in White Leghorn hens in 16 week production period.

Kansal *et al.*, (1995a) reported that feed intake per egg was 164 and 157 g with floor space allowance of 375 cm^2 and 337.5 cm^2 per bird respectively. Kansal *et al.*, (1995c) in another study using Babcock layers hatched in varying seasons of March, May and November reported that feed efficiency was 1.72, 1.68 and 1.70 in birds hatched in the corresponding season.

Egg weight

March and Biely (1963) housed laying hens aged 11 months in community cages each containing 15 hens and reported a mean egg weight of 61.4 g from February through October.

In a study with 170 White Leghorn pullets, Sivaraman and Jayaraman (1972) reported that the average weight of eggs during a laying period of 5 weeks as 49 g and 48.7 g in two groups of hens.

Fernandez *et al.*, (1973) in a study using White Leghorn pullets at 20 weeks of age reported that the mean egg weight varied from 59.4 to 60.0 g.

Anon (1978) reported that the average egg weight in the 'F' strain of White Leghorn birds was 53.7 g in the Seventh Random Sample Laying Test conducted at Bangalore.

Sherif *et al.*, (1978) evaluated the effect of body weight on the production performance and found that there was no significant difference between egg weight which varied from 45.2 to 47.1 g.

Anon (1979) reported a mean egg weight of 49.8 g in 'F' strain of White Leghorn in the study conducted at AICRP, Mannuthy Centre.

Balachandran *et al.*, (1979) claimed that there was no significant difference in the egg weight between the floor and cage system of rearing (49.81 vs. 50.25 g).

Radhakrishnan (1981) in a study with 25 pullets of 'F' strain of White Leghorn claimed that the mean egg weight was 53.2 g under back yard system of rearing.

In a study carried out by Thyagasundaram *et al.*, (1982) it was stated that the egg weight varied from 53.0 to 55.16 g in different strain cross pullets of White Leghorn.

Singh (1983) studied the part year production in F, N and P strains of White Leghorn and the mean egg weight reported was 53 g.

Leeson and Summers (1987) in a study with White Leghorn pullets claimed higher egg weight in higher body weight group. Birds were classified as small (997 g), medium (1100 g) and heavy (1226 g) groups at 15 weeks of age. The egg weights in the above groups were 57.0, 58.1 and 60.4 g respectively.

Jin and Craig (1988) studied the effect of different housing environments in three White Leghorn commercial strains and claimed that there was no significant difference in egg weight between cage and floor rearing environment during the 48 week laying period.

Brahma and Ramakrishnan (1989) reported the egg weight range from 54.5 to 55.5 g during a period of ten, 28-day periods from 170 days of age in IWN x IWP strain cross Single Comb White Leghorn hens.

In a study to determine the nature and magnitude of genetic divergence in pure bred White Leghorn, Chaithanyam *et al.*, (1989) reported that the egg weight contributed the maximum divergence (83.83 per cent).

Jalaludheen and Ramakrishnan (1989) claimed that the mean egg weight was varied from 47.8 to 49.3 g in a study using 108 strain cross White Leghorn pullets from 20 to 40 weeks of age, in cages.

Reddy *et al.*, (1989) conducted experiments in Single Comb White Leghorn reared on floor and the egg weight variation was reported to be between 53.5 and 54.6 g.

Anitha *et al.*, (1992) in a study with strain cross White Leghorn (IWN x IWP) layers compared the egg weight on deep litter and cage system. The mean egg weight reported during 21 to 72 weeks of age was 48.58 g in cage and 49.38 g in deep litter rearing.

In an experiment carried out with strain cross White Leghorn pullets from 18 to 45 weeks of age, Kutty *et al.*, (1992) reported that bird density did not influence the egg weight. The mean values of egg weight were 50.8, 51.04 and 50.14 g in floor densities of 1350, 1800 and 2250 cm^2/bird respectively.

Strong (1992) opined that a five day fast at the beginning of production resulted in improvement in early egg size in two trials in a popular commercial layer strain, Hy-line W-36. Egg weight differences ranged from 0.7 to 1.5 g/egg during the first half of a complete laying cycle of 22 to 65 weeks of age. However the same programme did not result in improvement in egg size in another strain, shaver-228.

Mandlekar and Thatte (1993a) determined the egg weight in Babcock-300 layers as 52.83 g during the first 20 weeks of laying.

Sahu *et al.*, (1993) used White Leghorn pullets aged 27 weeks to evaluate the production performance and stated that the mean egg weight was 58.35 g in a period of six months of laying.

Ahmed *et al.*, (1994) reported that the mean egg weight in White Leghorn hens was 53.88 g from 33 to 42 weeks of age.

In the Random Sample Laying Test conducted at Bangalore during 1992-93, the egg weight in strain cross White Leghorn layers was reported to be 52.77 g during the period from 19 to 72 weeks of age (Anon, 1994b).

In a study using replacement pullets of 145 days age Arkhipov *et al.*, (1994) reported the egg weight as 50.0 g.

Nahashon *et al.*, (1994a) studied the production performance in Dekalb XL Single Comb White Leghorn layer pullets and the mean egg weight reported was 59.4 g.

In Satlej strain of White Leghorn layers, Sikka *et al.*, (1994) claimed egg weight variation from 48.88 g to 50.48 g during an experimental period of 130 days.

Singh *et al.*, (1995) determined the variation in egg weight among pure lines and their crosses of H and C White Leghorn and the mean egg weight at 40 weeks of age reported were 51.7, 52.3, 51.4 and 52.5 g in HxH, CxC, HxC and CxH genetic groups respectively.

Egg mass

Thyagasundaram *et al.*, (1982) analysed egg mass upto fifteen months of age in six genetic groups of White Leghorn strain cross and reported variation from 9.83 to 10.46 kg per bird. The maximum egg mass was recorded in their study in L-59 and L-97 strain cross birds.

Jin and Craig (1988) did not find any significant influence associated with cage and floor system of rearing in egg mass and the mean values were 42.7 g and 42.3 g/day respectively during a period from 20 to 68 weeks of age.

Bhatti and Sharma (1989) reported that the egg mass was 9.75 kg per bird upto 44 weeks of age in White Leghorn layers.

Mandlekar and Thatte (1993a) in an experiment with Babcock B-300 layers, claimed the egg mass variation from 6.04 kg to 6.53 kg/bird during the first 20 weeks of laying.

Peguri and Coon (1993) stated that the egg mass was lowest in zero per cent feather covered birds (44.1 g/day) and maximum in birds with 50 per cent feather coverage (47.3g/day). Egg mass was intermediary in 100 per cent feather covered birds (45 g/day).

Ahmed *et al.*, (1994) in a study with White Leghorn hens reported that the egg mass recorded during 33 to 42 weeks of age was 2.96 kg per bird.

Nahashon *et al.*, (1994b) in a study using Dekalb XL Single Comb White Leghorn hens in individual cages claimed the egg mass variation from 52.4 to 55.6 g per hen per day during eight, 28-day periods beginning from 30.5 weeks of age.

Nielson *et al.*, (1994) tested the Hanskier and Boleg systems of housing on production. It was reported that both for debeaked Boleg and Hanskier caged White Leghorn hens, egg mass per hen housed were similar (17.0 kg). The egg mass were 19.3 kg for hens in a standard cage and 15.6 kg for beaked Boleg caged hens. Whereas, the corresponding figures in the above four groups for crossbred hens were 15.0, 16.4 19.2 and 16.0 kg during a test period of 12 months.

Ramteke *et al.*, (1994) reported that the egg mass recorded during 70 days of experimental period in layers of 10 months of age was 3.37 kg per bird.

Chand *et al.*, (1995) reported that egg mass during 16 week laying in White Leghorn hens was 4.15 kg per bird.

Livability

In a study using laying hens in cages, March and Biely (1963) reported 66 per cent livability during February through October.

Fernandez *et al.*, (1973) reported that the mortality in the experimental flock of White Leghorn in cages varied from 5.0 to 11.7 per cent in different groups of birds.

Sheriff *et al.*, (1978) in a study with Single Comb White Leghorn pullets of Meyer strain reported mortality rate from 2.9 to 16.7 per cent in different body weight groups during 20 to 40 weeks of age. Livability in their study was highest in heavy birds followed by medium, intermingled and light body weight groups.

Anon (1979) reported that mortality was 3.0 per cent during the period from 20 to 40 weeks of age in 'F' strain of White Leghorn.

Balachandran *et al.*, (1979) studied the production characteristics in White Leghorn birds under cage and deep litter

systems of housing. During the experimental period of six, 28-day periods, the livability was 82.2 and 86.6 on floor and cage systems respectively. There was no significant difference in the livability per cent.

In backyard system of rearing White Leghorn birds, Radhakrishnan (1981) reported the livability of 88 per cent during a laying period of 20 weeks.

Jin and Craig (1988) reared commercial strains of White Leghorn in cage and deep litter and stated that no significant difference was associated with rearing environments and livability during the whole 48 week laying period.

Bhatti and Sharma (1989) studied the efficiency of production in White Leghorn hens and it was reported that mortality rate was 13.89 per cent during the first 56 weeks of age. Whereas during the second year of laying cycle the same group exhibited only five per cent mortality.

Kutty *et al.*, (1992) studied the bird density and layer performance in White Leghorn strain cross birds for seven, 28-day periods. Livability was recorded as 97, 97.25 and 84.5 per cent in three different floor densities viz., 1350, 1800 and 2250 cm^2 per bird respectively.

Anon (1994b) reported that the mortality in White Leghorn strain cross was 15 per cent during a period upto 72 weeks of age in the random sample laying test conducted at Bangalore.

Muller (1994) reported that for hens producing white eggs, the livability was varied from 85.5 to 100 per cent vs 97.3 to 99.8 per cent in brown egg producing lines upto 500 days of age.

Nahashon *et al.*, (1994a) in a study using Dekalb XL Single Comb White Leghorn reported that the cumulative mortality ranged from 0.08 to 0.27 per cent during six, 28-day periods.

Nielson *et al.*, (1994) tested the effect of two types of cages viz., Hanskier and Boleg II wherein floor space allowance was 10 hens/m^2 and 20 hens/m^2 respectively. It was reported that mortality was 14 per cent in the former and 40 per cent in the latter during 12 months of study.

Singh *et al.*, (1994) studied the production performance of White Leghorn birds under field conditions in different seasons and the mortality per cent varied from 2.81 to 12.27 per cent. In different farms, the mortality range was from 4.77 to 7.95 per cent with an overall value of 6.17±1.08 per cent.

Kansal *et al.*, (1995a) claimed that the mortality was 9.8 per cent in cages having floor space of 375 cm^2/bird in comparison

with 11.9 per cent in cages with floor area of 337.5 cm^2/bird during a period of 12 months. However the mean values were not statistically significant.

Kansal *et al.*, (1995b) also studied the mortality rate in Babcock BV-300 layers during hot-dry climate and reported that mortality was reduced to 1.84 per cent by using foggers in comparison with 6.5 per cent mortality in a control group.

In another study, Kansal *et al.*, (1995c) stated that the mortality rate of layers hatched in varying seasons of March, May and November was 11.93, 14.37 and 16.3 per cent respectively for a period of 12 months in semi-slatted floor system of rearing.

Materials and Methods

MATERIALS AND METHODS

An experiment was carried out with 'F' strain of White Leghorn laying hens at the University Poultry Farm, Kerala Agricultural University, Mannuthy in order to evaluate the production potential of the particular strain.

History of the strain

The 'F' strain birds were being maintained in the University Poultry Farm, Mannuthy since 1975. The birds in this strain were not subjected to any systematic selection for the last ten years. This particular strain was being used as female parental line for evolving the crossbreds namely Gramalekshmi (Austrawhite) for backyard rearing.

Technical programme

The pullets were obtained from a small closed flock of White Leghorn 'F' strain parents. Four hundred pullets at the age of 18 weeks were used for the study. The pullets were vaccinated against Ranikhet disease. The experimental birds belonged to four hatches taken seven days apart. The number of birds in the hatches 1 to 4 were 104, 64, 92 and 140 in that order.

At the age of 18 weeks, the pullets were housed in 100 multiple-bird cages of identical size at the rate of four hens per cage. Each cage had a dimension of 60 x 45 x 45 cm. The allotment of birds to the cages were made at random. The production performance of the birds were studied for five, 28-day periods from 21 to 40 weeks of age during the period from February through August 1994.

Standard managemental practices were followed routinely throughout the experiment. A standard layer mash as per BIS (1993) was fed to the birds *ad libitum.* The composition of the layer mash is presented in Table 1. The proximate composition of the ration was estimated according to the procedure described in AOAC (1970). The mean values of per cent chemical composition of nutrients in layer mash on dry matter basis is projected in Table 2.

The following observations were recorded during the period of study.

1. Body weight at 20 and 40 weeks of age
2. Age at first egg in the flock
3. Age at 10 and 50 per cent production
4. Hen-housed and hen-day number and per cent
5. Mean daily feed consumption
6. Mean feed efficiency
7. Mean egg weight

Table 1. Per cent composition of layer mash used in the experiment

Sl. No.	Ingredients	Per cent
1	Yellow maize	47.00
2	Ground nut cake	16.00
3	Gingelly oil cake	5.00
4	Rice polish	23.00
5	Dried fish	5.00
6	Shell meal	2.00
7	Mineral mixture	1.75
8	Salt	0.25
	To each 100 kg the following supplements were added	
	* i) Rovimix (AB_2 D_3)	30.00 g
	** ii) Rovibe	20.00 g

* Each gram contains:

Vitamin A	:	40000 IU
Vitamin B_2	:	20 mg
Vitamin D_3	:	5000 IU

** Each gram contains:

Vitamin B_1	:	4 mg
Vitamin B_6	:	8 mg
Vitamin B_{12}	:	40 mcg
Niacin	:	60 mg
Calcium pantothenate	:	40 mg
Vitamin E	:	40 mg

Table 2. Percent chemical composition of nutrients in layer mash, on dry matter basis

Sl. No.	Nutrients	Per cent
1	Dry matter	87.31
2	Crude protein	18.02
3	Crude fat	4.31
4	Nitrogen free extract	48.76
5	Crude fibre	3.82
6	Total ash	12.68
7	Acid insoluble ash	4.56
8	Calcium	3.68
9	Phosphorus	0.89
10	Metabolizable energy Kcal/kg (calculated)	2646.67

8. Egg mass
9. Mean maximum and minimum temperature and
10. Mean per cent relative humidity in the experimental house

The body weight of pullets at 20 and 40 weeks of age were recorded individually to the nearest 10 g accuracy. The age at first egg was recorded in each of the replicate. The ages at 10 and 50 per cent production were recorded in each hatch. From these data, the age at sexual maturity of the flock was determined. Hen-housed and hen-day egg number and per cent production were estimated period-wise. The level and duration of peak production were also determined. A weighed quantity of feed was issued in each cage daily and the balance of feed available in the hopper at the end of each period was recorded. From this data the period-wise mean daily feed consumption per bird in each replicate was worked out.

Feed efficiency was calculated period-wise in each replicate as kilogram of feed consumed to produce dozen eggs as well as kilogram of feed to produce one kilogram of egg mass.

All eggs from each replicate during the last three consecutive days at 24, 28, 32, 36 and 40 weeks of age were weighed individually. Apart from this, the egg mass from each hatch was also worked out replicate-wise based on the total weight of eggs recorded daily.

The livability was recorded period-wise. The maximum and minimum temperature inside the experimental house were recorded daily and the mean values were arrived at in each period. The dry and wet bulb readings in the forenoon (F.N.) and afternoon (A.N.) were recorded daily based on which the respective mean per cent relative humidity was determined.

The data collected were subjected to statistical analysis using appropriate procedures described by Snedecor and Cochran (1967).

Results

RESULTS

The data recorded on the production traits in 'F' strain of White Leghorn layers are presented in this chapter. The hatch-wise performance on statistical analysis was found to be homogenous in this study.

Meteorological Observations

The micro-climate in terms of ambient temperature and relative humidity as influenced by the experimental periods are presented in Tables 3 to 6.

Temperature

The variations in maximum temperature revealed that the period-wise mean values were 34.98, 34.24 and 34.44°C respectively during periods I, II and III (Table 3). At the fourth period it was reduced to 30.4°C and subsequently in the fifth period further reduced to 28.39°C. Over the entire period of study the overall mean maximum temperature was 32.5°C. The mean values of minimum temperature in the above periods differed from 24.53 to 27.38°C, the lowest being in the fifth period and the highest in the second period. In periods I, III and IV the mean values were 26.77, 26.45 and 25.49°C respectively (Table 4). Over the entire period of study the mean minimum temperature was 26.12°C.

Table 3. Mean maximum temperature (°C) in the experimental house during the period from February through August

Hatch number	Periods					Overall mean
	I	II	III	IV	V	
	Feb-Apr	Mar-May	Apr-Jun	May-Jul	Jun-Aug	Feb-Aug
1	35.42	35.33	34.56	31.77	29.62	33.34
2	35.14	34.84	34.96	30.29	29.24	32.89
3	34.74	34.33	33.96	29.50	25.93	31.69
4	34.62	32.44	34.29	31.29	28.75	32.27
Overall mean	34.98	34.24	34.44	30.40	28.39	32.50

Table 4. Mean minimum temperature (°C) in the experimental house during the period from February through August

Hatch number	Periods					Overall mean
	I	II	III	IV	V	
	Feb-Apr	Mar-May	Apr-Jun	May-Jul	Jun-Aug	Feb-Aug
1	26.66	26.82	27.40	25.38	24.65	26.18
2	26.82	26.88	26.96	25.24	25.16	26.21
3	26.33	26.83	26.52	25.69	23.71	25.81
4	27.26	29.00	24.92	25.67	24.58	26.29
Overall mean	26.77	27.38	26.45	25.49	24.53	26.12

Relative Humidity

The mean values of per cent relative humidity (R.H) in the forenoon presented in Table 5 revealed that it was lower during the initial three periods (75.32, 71.67 and 73.61 per cent) and was higher in the latter two periods (83.71 and 89.04 per cent). The overall mean per cent R.H. in the forenoon was 76.67. Similar trend was also observed in the afternoon wherein the per cent R.H. was lower in the initial three periods and higher in the latter two periods. The period-wise mean values were 64.71, 61.75 and 61.67 per cent in periods I, II and III respectively (Table 6). Whereas in periods IV and V it was 76.94 and 80.80 per cent respectively. The overall mean R.H. during the entire period of study was 69.18 per cent in the afternoon.

Body Weight

The mean body weight at 20 weeks of age along with its range of variation are presented in Table 7. The overall mean body weight in the flock was 944.05 ± 8.86 g. The range of values varied from 630 to 1450 g.

The mean body weight at the end of 40 weeks of age is presented in Table 8. The overall mean value was 1346.67 ± 12.19 g. The range of variation was from 930 to 2060 g. Thus, the difference between overall mean body weights at 20 and 40 weeks of age was 402.62 g. This was considered as the gain in weight per bird during the above period.

Table 5. Mean per cent relative humidity in the forenoon in the experimental house during the period from February through August

Hatch number	Periods					Overall mean
	I	II	III	IV	V	
	Feb-Apr	Mar-May	Apr-Jun	May-Jul	Jun-Aug	Feb-Aug
1	76.82	74.70	71.36	77.04	88.13	77.61
2	75.44	70.69	74.60	81.45	88.48	78.13
3	74.38	70.55	73.52	87.29	90.04	79.16
4	74.62	70.74	74.94	89.04	89.50	79.77
Overall mean	75.32	71.67	73.61	83.71	89.04	76.67

Table 6. Mean per cent relative humidity in the afternoon in the experimental house during the period from February through August

Hatch number	Periods					Overall mean
	I	II	III	IV	V	
	Feb-Apr	Mar-May	Apr-Jun	May-Jul	Jun-Aug	Feb-Aug
1	66.72	64.30	60.19	78.47	76.76	69.29
2	64.28	61.70	55.31	76.93	79.77	67.60
3	64.31	61.58	61.52	76.43	83.18	69.40
4	63.52	59.43	69.66	75.93	83.50	70.41
Overall mean	64.71	61.75	61.67	76.94	80.80	69.18

Table 7. Mean body weight (g) at 20 weeks of age in 'F' strain of White Leghorn

Hatch number	Number of birds housed	Range	Mean
1	104	690-1450	975.42±10.77
2	64	710-1330	926.44±25.27
3	92	630-1330	919.70±17.35
4	140	630-1450	944.80±17.17
Overall	400	630-1450	944.05± 8.86

Table 8. Mean body weight (g) at 40 weeks of age in 'F' strain of White Leghorn

Hatch number	Number of birds at 40 weeks	Range	Mean
1	98	1110-1900	1358.35±15.47
2	61	1080-2060	1455.55±27.42
3	88	1010-2000	1368.18±25.33
4	135	930-1850	1274.07±18.85
Overall	382	930-2060	1346.67±12.19

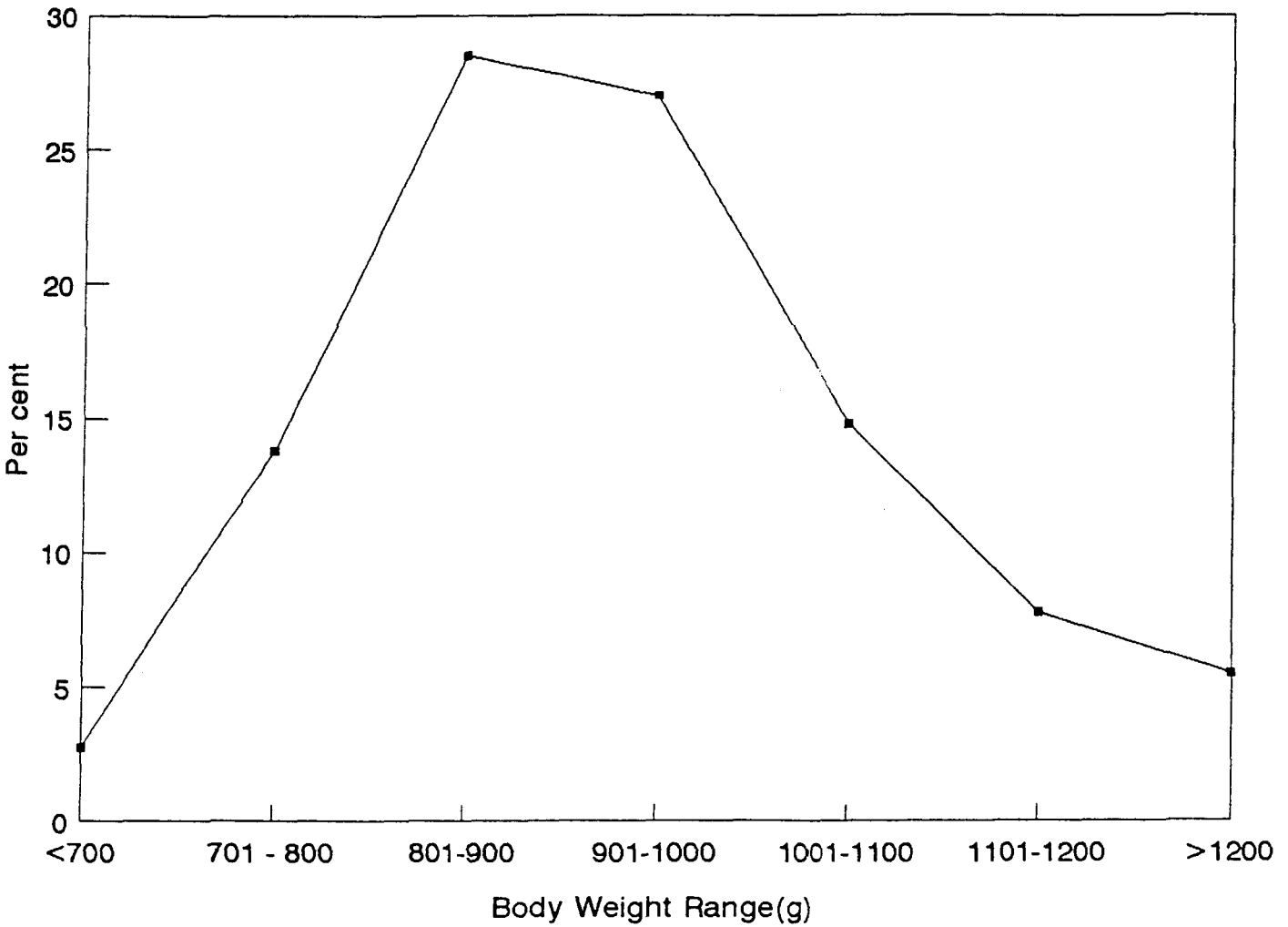
The frequency distribution of body weight at 20 weeks of age is presented in Table 9. The pattern of distribution is illustrated graphically in Figure 1. Table 9 revealed that there was poor uniformity in 20 week body weight of pullets in the flock. The lowest body weight range was 630 to 700 g and it was 2.75 per cent of the flock and birds in the range from 701 to 800 g was 13.75 per cent. A higher proportion of birds were in the range from 801 to 1000 g. These two classes put together formed 55.5 per cent of the flock. Thus, birds below 1000 g body weight constituted 72 per cent. Birds above 1000 g contributed 28.0 per cent of which 14.75 per cent from 1001 to 1100 g, 7.75 per cent from 1101 to 1200 g and 5.50 per cent from 1201 to 1450 g. Figure 1 indicated a normal distribution curve having more birds in the middle ranges from 801 to 1100 g.

The frequency distribution of body weight at 40 weeks of age presented in Table 9 indicated that the proportion of birds in the lowest class, that is 930 to 1100 g, was 6.54 per cent. Next class, from 1101 to 1200 g was 12.83 per cent. Higher proportion of birds were distributed in weight classes 1201 to 1300 g (26.18 per cent) and 1301 to 1400 g (23.04 per cent). These two classes put together formed 49.22 per cent. Birds over 1400 g body weight was 31.41 per cent which constituted 14.14 per cent birds from 1401 to 1500 g, 9.95 per cent from 1501 to 1600 g and 7.32 per cent from 1601 to 2060 g body weight at 40 weeks of age.

Table 9. Frequency distribution of body weight (g) at 20 and 40 weeks of age in 'F' strain of White Leghorn

Sl. No.	20 weeks		40 weeks	
	Body weight Range (g)	Per cent	Body weight Range (g)	Per cent
1	630-700	2.75	930-1100	6.54
2	701-800	13.75	1101-1200	12.83
3	801-900	28.50	1201-1300	26.18
4	901-1000	27.00	1301-1400	23.04
5	1001-1100	14.75	1401-1500	14.14
6	1101-1200	7.75	1501-1600	9.95
7	1201-1450	5.50	1601-2060	7.32

Fig.1 Frequency distribution of Body weight (g) at 20 weeks of age in 'F'strain of White Leghorn



Sexual Maturity

Age at first egg

The mean Age at First Egg (AFE) in days and its range of variation in each hatch are presented in Table 10. The overall mean value of AFE was 174.67 ± 0.95 days. This was based on the ages at first egg recorded in 100 pullets at the rate of one from each cage. The range of values (153 to 195 days) provided valuable informations pertaining to the trend of sexual maturity in the flock. The age at which first egg laid in the flock was 153 days.

Age at 10 and 50 per cent production

The ages in days at 10 and 50 per cent production are presented in Table 11. The mean age at 10 per cent production was 178 days ranging from 169 to 184 days in different hatches. The age at 50 per cent production was ranged from 189 to 200 days with an overall mean value of 191.5 days. The mean difference between values of 10 and 50 per cent production in the flock was 13.5 days.

Egg Production

Hen-housed number

The mean Hen-Housed Number (HHN) of eggs as influenced by age of birds are presented in Table 12. Two hundred and sixty birds did lay only very few eggs during 21 to 24 weeks of age. The remaining 140 birds, however laid at the rate of 0.64 eggs per bird during the same period. From 25 to 28 weeks of age, these birds laid at a rate of 6.81 eggs per period with mean values of 4.80 to 10.71

Table 10. Mean Age at First Egg (AFE) in days in 'F' strain of White Leghorn

Hatch Number	Number of observations recorded	Range	Mean
1	26	158-195	177.27±1.62
2	16	165-191	177.56±1.94
3	23	168-192	180.17±1.63
4	35	153-191	167.80±1.37
Overall	100	153-195	174.67±0.95

Table 11. Age at 10 and 50 per cent production (in days) in 'F' strain of White Leghorn

Hatch Number	Number of birds housed	10 per cent	50 per cent
1	104	179	200
2	64	184	197
3	92	180	200
4	140	169	189
Overall	400	178	196.5

Table 12. Mean Hen-housed egg number from 21 to 40 weeks of age in 'F' strain of White Leghorn

Hatch number	Age in weeks/periods					Overall mean
	21-24	25-28	29-32	33-36	37-40	
	I	II	III	IV	V	
1	0.09	5.41 ±0.73	17.22 ±0.49	18.67 ±0.38	15.50 ±0.46	56.89 ±1.17
2	0.06	6.33 ±0.95	18.33 ±0.68	19.22 ±0.52	16.10 ±0.48	60.04 ±2.10
3	0.01	4.80 ±0.63	16.93 ±0.48	16.42 ±0.31	13.67 ±0.41	51.83 ±1.27
4	0.64	10.71 ±0.70	17.67 ±0.44	15.78 ±0.36	13.35 ±0.31	58.14 ±1.65
Overall mean	0.20	6.81 ±0.45	17.54 ±0.25	17.52 ±0.23	14.66 ±0.23	56.73 ±0.75

eggs among hatches. In the third period comprising of 29 to 32 weeks of age, the mean hen-housed egg number was 17.54. While that during the period from 33 to 36 weeks of age it was 17.52 eggs per bird. However, there was a drop in production at 37-40 weeks of age during which period the mean hen-housed egg number was 14.66 only.

The period-wise four week interval mean egg production was 0.2, 6.81, 17.54, 17.52 and 14.66 eggs. This showed a very slow onset of production during 21 to 24 weeks and a gradual increase at 25-28 weeks of age. A sharp increase in production at 29-32 weeks of age and a sustenance at the same rate during 33 to 36 weeks of age was observed. But a drastic reduction in egg yield was noticed at 37-40 weeks of age. The overall mean HHN was 56.73±0.75 per bird from 21 to 40 weeks of age.

The Figure 2 depicts slow onset of production and poor rate of lay upto 28 weeks of age and an abrupt increase in egg production from 29 to 32 weeks of age. This level was maintained during 33 to 36 weeks of age followed with a sharp decline in egg yield at 37 to 40 weeks of age.

Per cent Hen-housed production

The mean Hen-Housed (HH) per cent production as influenced by age of birds are given in Table 13. The overall mean per cent HH

Fig.2 Mean per cent Hen-housed production from 21 to 40 weeks of age in 'F' strain of White Leghorn

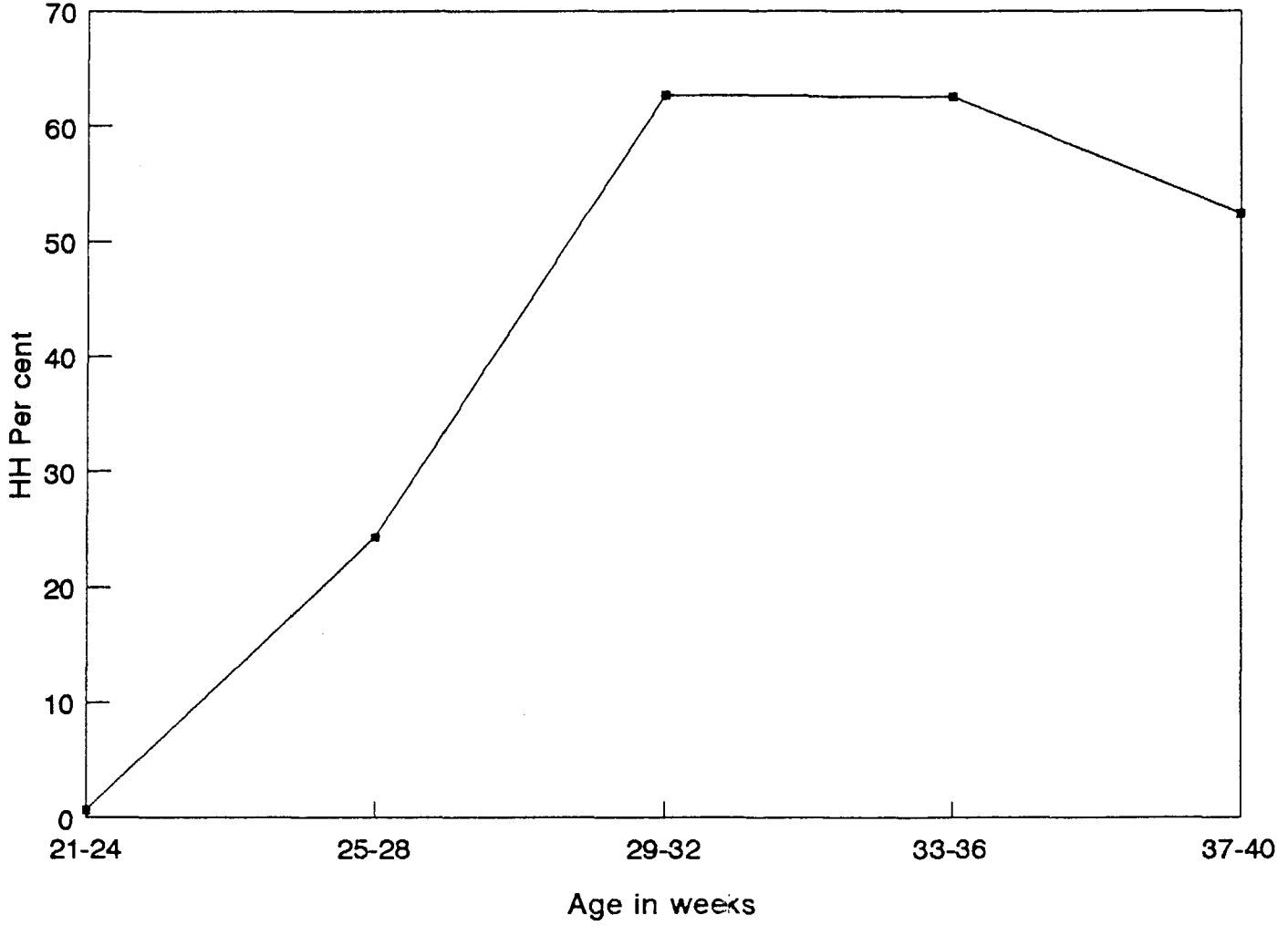


Table 13. Mean per cent Hen-housed production from 21 to 40 weeks of age in 'F' strain of White Leghorn

Hatch number	Age in weeks/periods					Overall mean
	21-24	25-28	29-32	33-36	37-40	
	I	II	III	IV	V	
1	0.34	19.33	61.51	66.58	55.34	40.64
2	0.22	22.60	65.46	68.66	57.49	42.89
3	0.08	17.16	60.48	58.63	48.82	37.02
4	2.27	38.24	63.11	56.34	47.68	41.53
Overall mean	0.71	24.32	62.64	62.57	52.36	40.52

production was 40.52 from 21 to 40 weeks of age. In the first period ie. from 21 to 24 weeks of age, the per cent production was very poor and was only 0.71 per cent on hen-housed basis. In the second period, the over all mean was only 24.32 per cent. Subsequently, the production increased to 62.64 per cent at 29 to 32 weeks of age. This trend was maintained in the fourth period with an overall period-wise mean of 62.57 per cent, same as in the previous period. But at 37 to 40 weeks of age the egg yield was only 52.36 per cent. Thus a sharp decline in percentage of production was observed during the fifth period. The overall mean egg yield from 21 to 40 weeks varied between 37.02 and 42.89 per cent among hatches.

Hen-Day Number

The Hen-Day Number (HDN) of eggs as influenced by age of birds in different hatches are presented in Table 14. The overall mean Hen-day number in the flock upto the age of 40 weeks was 57.09. The egg yield was low because 65 per cent of the population produced at a very low rate during the first period. The overall egg yield from 21 to 24 weeks on hen-day basis was same as that of the hen-housed production as the mortality was nil. The mean Hen-day number increased from 6.82 to 17.72 as age advanced from second to third period. The overall mean value in the fourth period was 17.6. The difference in mean egg number during third and fourth period was only 0.12. But the production decreased to 14.71 in the fifth period indicating a reduction of 2.95 eggs per bird. The overall

Table 14. Mean Hen-day egg number from 21 to 40 weeks of age in 'F' strain of White Leghorn

Hatch number	Age in weeks/periods					Overall mean
	21-24 I	25-28 II	29-32 III	33-36 IV	37-40 V	
1	0.09	5.42	17.33	18.97	15.53	57.34
2	0.06	6.33	18.72	19.22	16.19	60.52
3	0.01	4.80	17.10	16.42	13.84	52.17
4	0.64	10.71	17.74	15.80	13.46	58.34
Overall mean	0.20	6.82	17.72	17.60	14.71	57.09

egg yield on hen-day basis was 57.09 ranging from 52.17 to 60.52 in various hatches.

Per cent Hen-day production

The mean per cent Hen-Day (HD) production is presented in Table 15. The per cent production during 21 to 24 weeks was below 0.5 per cent in 65 per cent of the flock and slightly higher in rest of the flock. The mean Hen-Day per cent production during 21 to 24 weeks was 0.71 and was same as that of Hen-housed per cent production. The mean Hen-day production during 25 to 28 weeks of age varied from 17.16 to 38.24 with an overall mean of 24.35 per cent. The highest overall per cent production among periods was 63.29 per cent and was recorded at the age of 29 to 32 weeks. During the period from 33 to 36 weeks, the mean per cent production was from 56.43 to 68.66. The overall production during this period was 62.86 per cent. But the production abruptly decreased by 10.32 per cent and was 52.54 per cent in the fifth period. The overall per cent production from 21 to 40 weeks was 40.79 with mean values ranging from 37.26 to 43.23 among hatches.

Peak Production

The week-wise mean per cent Hen-day production during third and fourth periods are set out in Table 16. This is also represented graphically in Figure 3 in order to decipher the peak

Table 15. Mean per cent Hen-day production from 21 to 40 weeks of age in 'F' strain of White Leghorn

Hatch number	Age in weeks/periods					Overall mean
	21-24 I	25-28 II	29-32 III	33-36 IV	37-40 V	
1	0.34	19.37	61.90	67.75	55.48	40.97
2	0.22	22.60	66.84	68.66	59.82	43.23
3	0.08	17.16	61.07	58.63	49.44	37.26
4	2.27	38.24	63.34	56.43	48.06	41.68
Overall mean	0.71	24.35	63.29	62.86	52.54	40.79

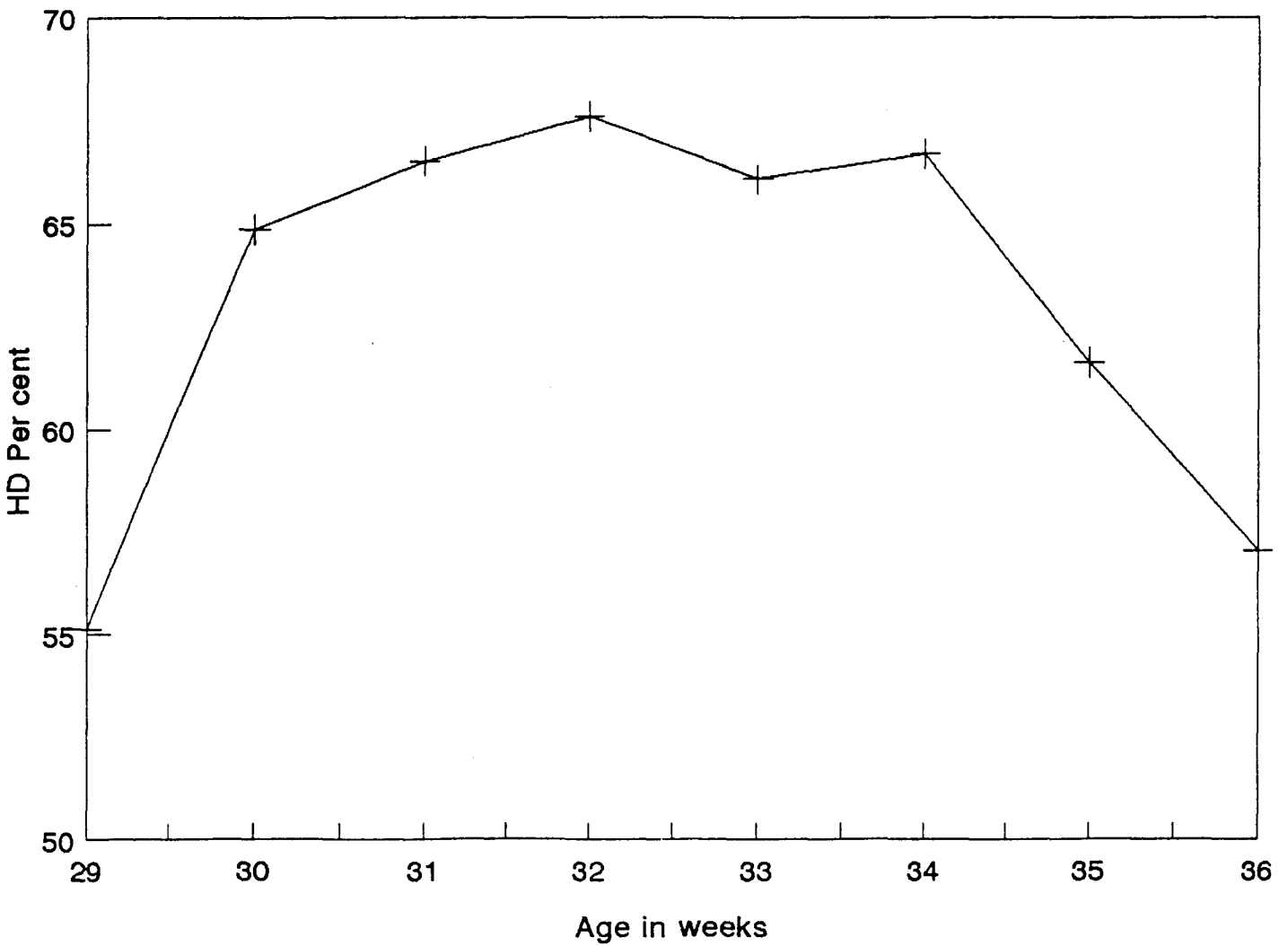
Table 16. Week-wise mean per cent Hen-day production from 29 to 36 weeks of age in 'F' strain of White Leghorn

Hatch number	Age in weeks/periods								Overall mean
	29	30	31	32	33	34	35	36	
	III				IV				
1	51.60	61.78	63.86	70.45	65.64	69.02	68.51	67.77	64.83
2	54.81	66.36	72.12	74.42	71.89	71.20	74.19	57.37	67.80
3	50.63	62.48	65.46	67.35	67.82	67.77	48.98	50.08	60.07
4	63.49	68.87	64.69	58.18	59.01	58.80	54.87	53.02	60.12
Overall mean	55.13	64.87	66.53	67.60	66.09	66.70	61.64	57.06	63.21

production and rate of lay. Birds in the fourth hatch which was thirty five per cent of the flock performed well during 29th week at the rate of 63.49 per cent. The overall mean values during 29th and 30th week were 55.13 and 64.87 per cent respectively. At 31 week, the mean per cent HD was 66.53. Birds in the first and second hatches attained peak production of 70.45 and 74.42 per cent at 32 weeks of age. Whereas the production in the third hatch was peaked at 33 weeks of age (67.82 per cent) and in the fourth hatch at 30th week (68.87 per cent). However the overall peak production was 67.6 per cent and was recorded in 32nd week. A sudden drop in production was noticed immediately after the peak production. This drop was varied from 0.05 to 4.81 per cent among hatches. But the overall production in 33rd week was 66.09 per cent and 66.70 per cent in 34th week and was comparable with each other. At 35 and 36 week of age, the egg yield was 61.64 and 57.06 per cent respectively.

The Figure 3 depicts the intensity of production from 29 to 36 weeks of age wherein a steady rise in egg yield was noticed from 55.13 per cent (29 week) to the level of peak production of 67.6 per cent (32 week). Thereafter, a decline of 1.51 per cent was recorded at 33 week followed by an increase in production by 0.61 per cent at 34 week. A general decline in production was observed to the tune of 5.06 and further 4.58 per cent in 35 and 36 weeks respectively.

Fig.3 Weekwise mean per cent Hen-day production from 29 to 36 weeks of age in 'F' strain of White Leghorn



Feed Consumption

The period-wise and hatch-wise mean daily feed consumption of birds is given in Table 17 and plotted in Figure 4. The overall mean value during 21 to 24 weeks of age was 57.14 g. In the second period ie., from 25 to 28 weeks, the values varied from 68.86 to 92.01 g. The overall mean value for the period was 78.66 g which indicated an increase in feed intake by 21.52 g/bird during 25 to 28 weeks. The overall mean feed intake of the flock in period III was 92.83 g. In period IV, the feed intake was 117.92 g. The mean increase between these periods was 25.09 g per bird. During 37 to 40 weeks, the feed intake was 122.66 g which showed an increase of 4.74 g/bird/period. Thus the overall mean feed intake from 21 to 40 weeks were uniform in hatches 1 to 3. But a higher intake (103.3 g) was recorded in the fourth hatch. Figure 4 explains that overall feed intake was low (57.14 g) in the first period and then gradually increased to 78.66 g in the second period and 92.83 g in the third period. A marked increase in feed intake was observed in fourth and fifth periods.

Feed Efficiency

Period-wise mean feed efficiency per dozen eggs was calculated for the period from 25 to 40 weeks of age and is presented in Table 18 and also represented as histogram in Figure 5.

Since the egg production during 21 to 24 weeks was only 0.71 per cent on HH and HD basis, the feed efficiency was not worked out

Table 17. Mean daily feed consumption (g) from 21 to 40 weeks of age in 'F' strain of White Leghorn

Hatch number	Age in weeks/periods					Overall mean
	21-24 I	25-28 II	29-32 III	33-36 IV	37-40 V	
1	54.61 ±2.01	83.60 ±0.79	74.39 ±1.54	115.97 ±0.34	123.05 ±0.25	90.32 ±0.99
2	60.51 ±2.48	70.18 ±0.74	82.81 ±0.44	117.74 ±0.40	122.88 ±0.29	90.82 ±0.87
3	45.93 ±1.32	68.86 ±1.28	98.86 ±0.27	118.42 ±0.32	122.42 ±0.28	90.89 ±0.69
4	67.50 ±0.37	92.01 ±2.19	115.25 ±0.55	119.55 ±0.38	122.43 ±0.31	103.30 ±0.76
Overall mean	57.14 ±1.10	78.66 ±0.30	92.83 ±1.74	117.92 ±0.28	122.66 ±0.15	93.83 ±0.71

Fig.4 Mean daily feed consumption (g) from 21 to 40 weeks of age in 'F' strain of White Leghorn

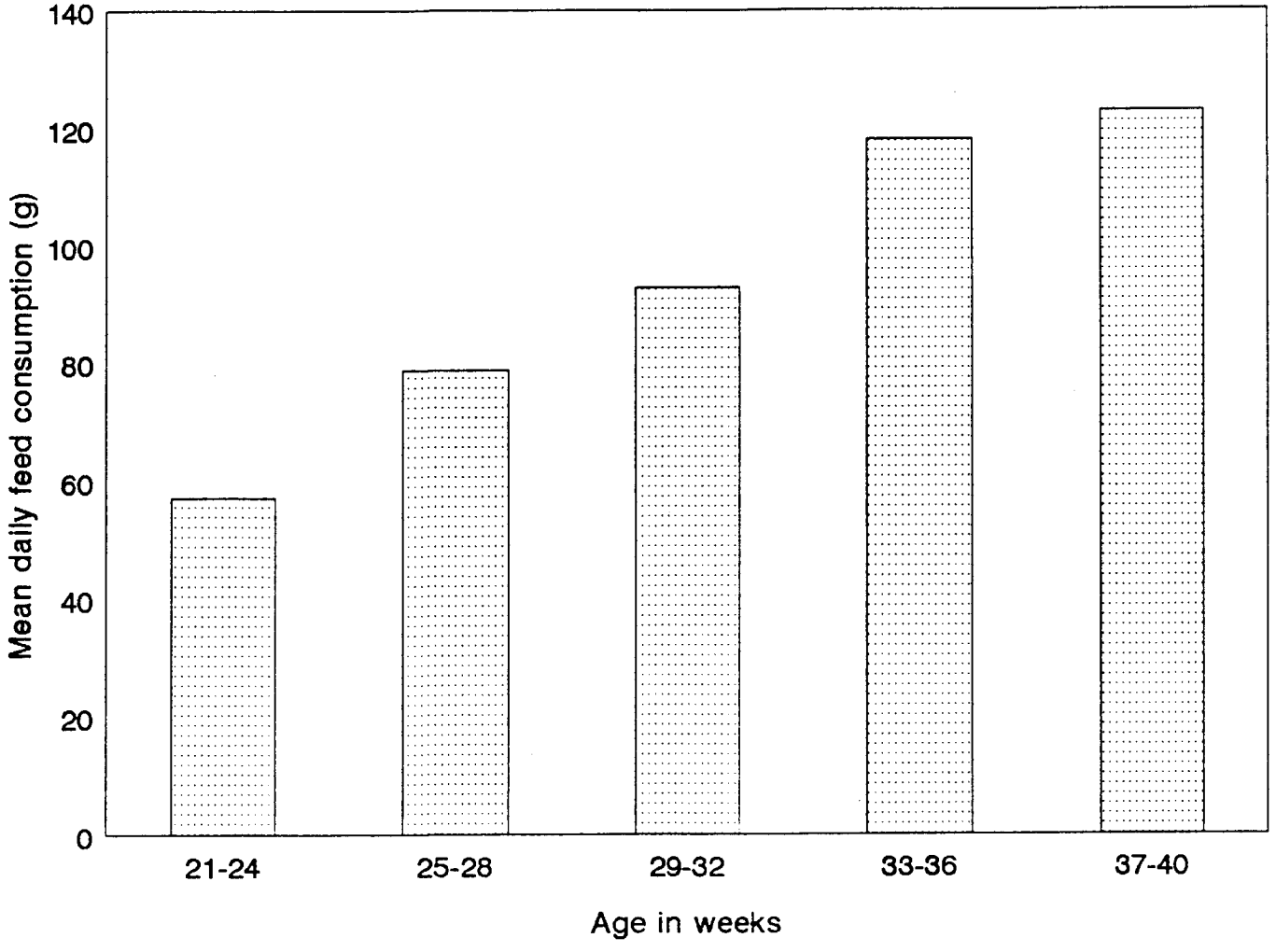


Table 18. Mean feed efficiency per dozen eggs from 25 to 40 weeks of age in 'F' strain of White Leghorn

Hatch Number	Age in weeks/periods				Overall mean
	25-28 II	29-32 III	33-36 IV	37-40 V	
1	5.18	1.44	2.05	2.66	2.32
2	3.13	1.49	2.05	2.55	2.19
3	4.81	1.94	2.42	2.97	2.63
4	2.89	2.18	2.54	3.05	2.61
Overall mean	3.66	1.77	2.29	2.79	2.47

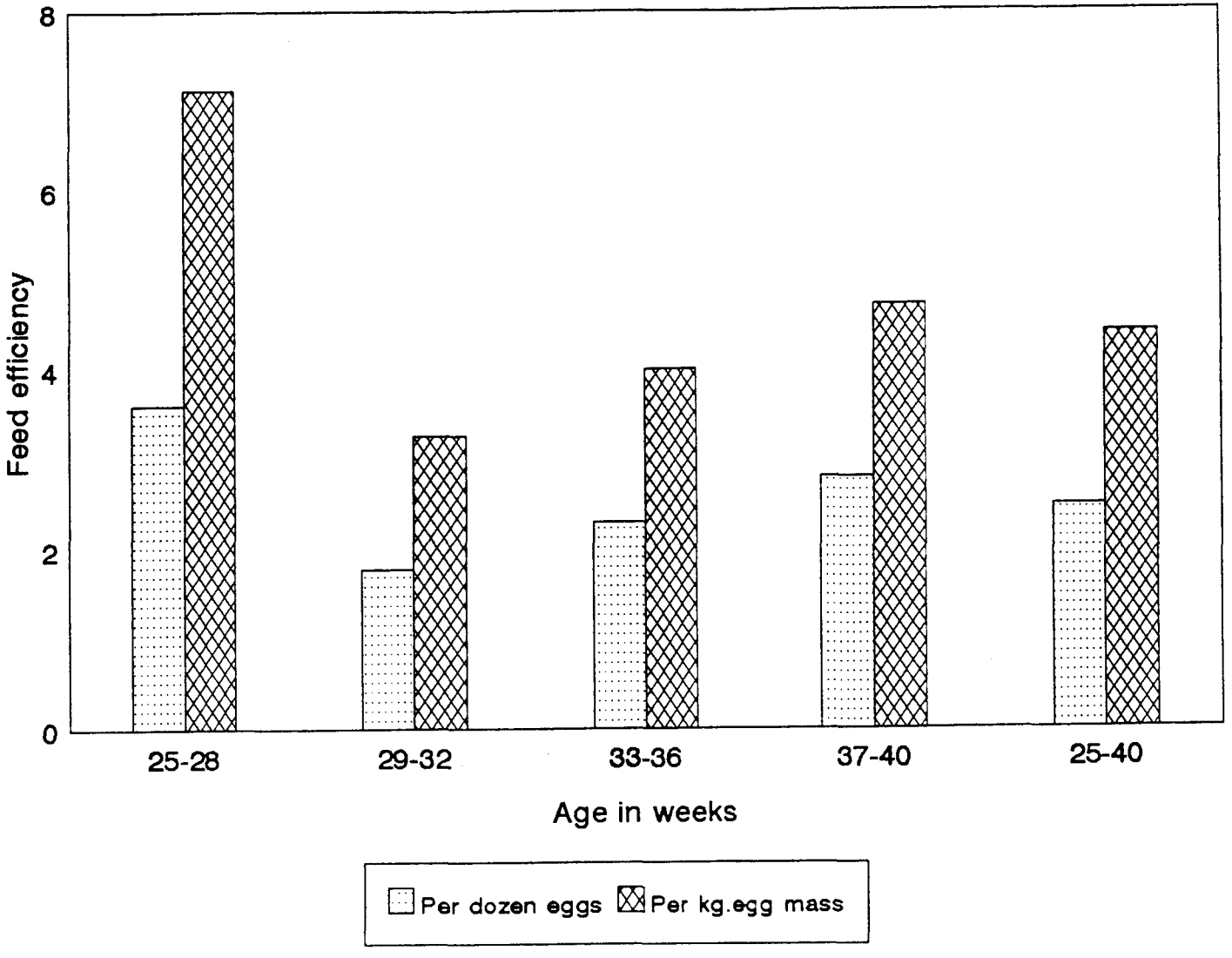
for the first period. The overall mean feed efficiency from 25 to 28 weeks of age was 3.66 and varied between 2.89 and 5.18 among hatches. The best feed efficiency in the flock was in the third period. This value was 1.77. During the fourth period, the overall mean FE recorded was 2.29. However, the feed consumed to produce dozen eggs was 2.79 in the fifth period. In this period, the efficiency was varied among hatches from 2.55 to 3.05.

The mean feed efficiency per kilogram egg mass basis was also calculated and is set out in Table 19 and its comparison with dozen egg basis is represented in Figure 5. The overall feed consumption to produce one kilogram egg mass was 4.41 kg for the period from 25 to 40 weeks of age. The FE for first period was not worked out as production was very low. In the second period considerably high values were recorded in all hatches (Table 19). The mean values ranged from 5.83 to 9.56 with an overall mean of 7.12. In the third period fairly good feed efficiency for egg mass was recorded. The overall value of 3.25 recorded in the third period was better in comparison with mean values in other periods. The overall mean feed efficiency in the fourth period was 4.00 with values ranging from 3.52 to 4.47. During the fifth period, the feed efficiency was poor and the overall value was 4.74. These results exhibited considerably better feed efficiency during third period. On an average, to produce one kilogram egg mass, 3.63 kg feed was utilised during the periods from 29 to 36 weeks of age. The Figure 5 indicated better feed conversion during third period, to produce

Table 19. Mean feed efficiency per kilogram of egg mass from 25 to 40 weeks of age in 'F' strain of White Leghorn

Hatch Number	Age in weeks/periods				Overall mean
	25-28 II	29-32 III	33-36 IV	37-40 V	
1	9.76	2.68	3.60	4.54	4.15
2	6.76	2.64	3.52	4.15	3.76
3	9.56	3.63	4.47	4.94	4.77
4	5.83	4.00	4.33	5.27	4.71
Overall mean	7.12	3.25	4.00	4.71	4.41

Fig.5 Mean feed efficiency per dozen eggs and kilogram egg mass from 25 to 40 weeks of age in 'F' strain of White Leghorn



dozen eggs as well as one kilogram eggs. The poorest feed conversion was recorded during the second period. The feed conversion efficiency was intermediary in the fourth and fifth periods.

Egg Weight

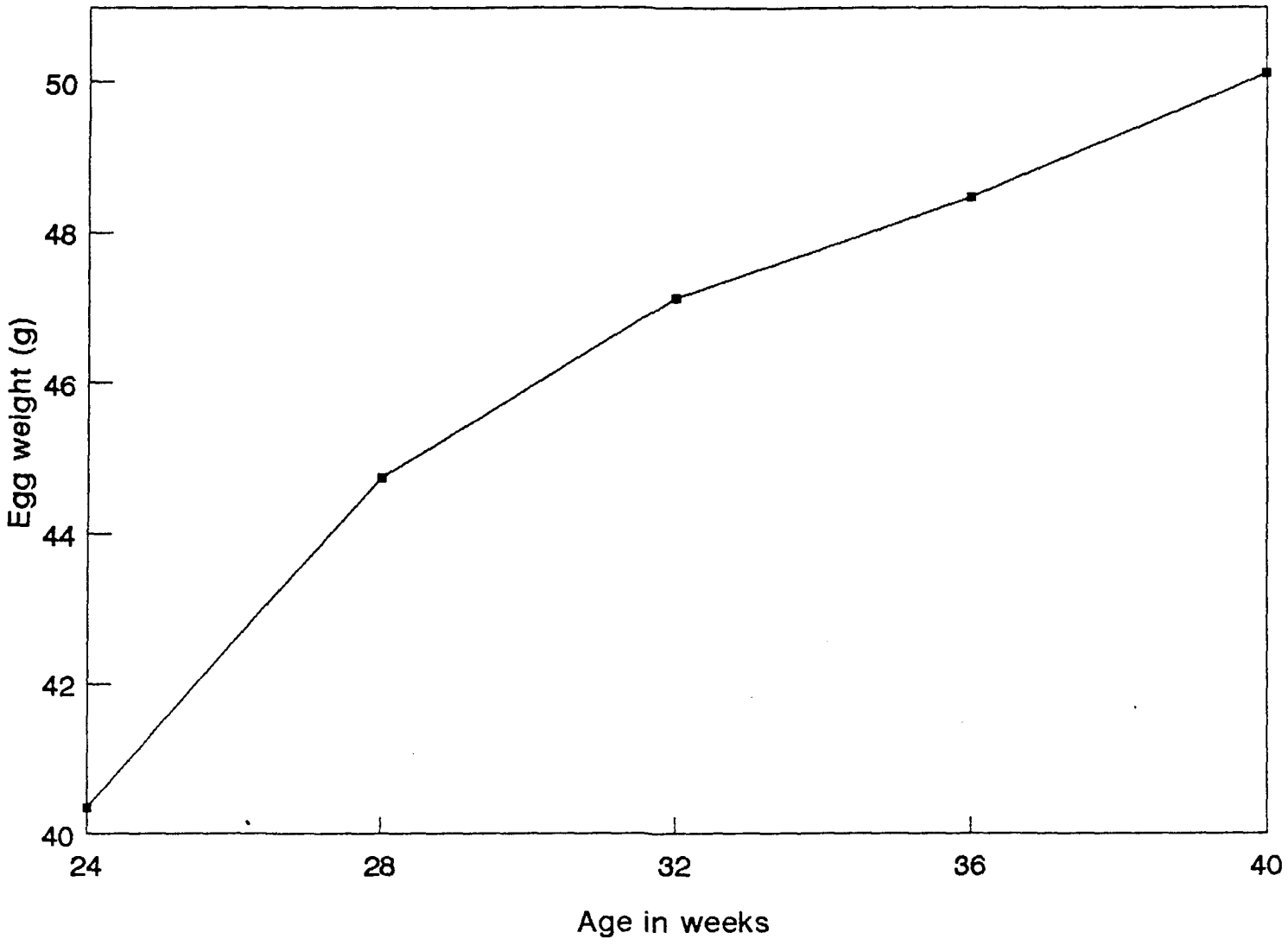
The mean Egg Weight (EW) at 24, 28,32,36 and 40 weeks of age are presented in Table 20 and the pattern of egg weight profile is plotted in Figure 6. The overall mean egg weight was 46.21 g in the flock during the period from 24 to 40 weeks of age.

The mean egg weight was only 40.35 g at the end of 24 weeks. This was considered as the mean EW for the first period although egg production was very low from 21 to 24 weeks of age. Likewise the egg weight recorded at an interval of four weeks was taken as the mean EW for that particular period. In the second period the mean EW was 44.74 g at 28 weeks. This showed a mean increase of 4.39 g in EW by twenty eight days. The mean egg weight at 32 weeks varied among hatches from 46.25 to 48.28 with an overall mean egg weight of 47.12 g in the third period. Here the mean increase in egg weight as age advanced from 28 to 32 weeks was 2.38 g. While the egg weight at 36 weeks of age was 48.48 g with an overall increase of 1.36 g between third and fourth period from 32 to 36 weeks of age. The overall egg weight in the fifth period at 40 weeks averaged to 50.13 g showing a difference 1.65 g with that of fourth period.

Table 20. Mean egg weight (g) in 'F' strain of White Leghorn as influenced by age in weeks

Hatch number	Age in weeks/periods					Overall mean
	24	28	32	36	40	
	I	II	III	IV	V	
1	41.08	44.75	46.33	48.82	50.23	46.24
		±0.41	±0.33	±0.33	±0.37	±0.36
2	41.70	44.88	47.62	49.06	51.55	46.96
		±0.28	±0.36	±0.53	±0.53	±0.43
3	38.13	44.94	48.28	47.62	50.48	45.89
		±0.47	±0.43	±0.41	±0.45	±0.44
4	40.47	44.40	46.25	48.41	49.19	45.75
		±0.43	±0.32	±0.38	±0.47	±0.40
Overall mean	40.35	44.74	47.12	48.48	50.13	46.21
		±0.22	±0.20	±0.48	±0.24	±0.29

Fig.6 Mean egg weight (g) as influenced by age in weeks in 'F' strain of White Leghorn



The Figure 6 indicated a steady and slow increase in egg weight from 40.35 to 50.13 g as age advanced from 24 to 40 weeks. Thus, the overall increase in mean EW was 9.78 g in five periods.

Egg Mass

Period-wise egg mass was worked out based on the daily egg mass out put and data are presented in Table 21. The corresponding egg number is also given in parenthesis in the same Table. The over all egg mass obtained from the flock upto 40 weeks of age was 1044.07 kg. The total number of eggs produced was 22371. The egg mass during the first period was only 3.98 kg wherein the egg production was 105. In the second period, the total egg mass was 123.68 kg with 2909 eggs. The period-wise egg mass was higher (322.63 kg) in the fourth period when compared to that of third period (316.79 kg). The egg production was higher in the third period. There was an increase of 206 eggs in the third period in comparison with that of fourth period (6979 vs 6773). The egg mass in the fifth period was 276.77 kg contributed by 5605 eggs. The total egg mass of 1044.77 kg resulted in an average output of 2.61 kg eggs on hen-housed basis.

Livability

The per cent livability was studied in the laying period from 21 to 40 weeks of age and is presented in Table 22. The number of mortality in each period is given in parenthesis. During the first period 100 per cent livability was recorded in the flock. In the

Table 21. Period-wise egg mass (kg) from 21 to 40 weeks age in 'F' strain of White Leghorn

Hatch number	Age in weeks/periods					Overall
	21-24	25-28	29-32	33-36	37-40	
	I	II	III	IV	V	
1	0.41	24.89	79.70	90.68	74.86	270.54
	(10)	(563)	(1774)	(1910)	(1534)	(5791)
2	0.16	18.60	55.02	58.03	51.07	182.88
	(4)	(405)	(1173)	(1192)	(998)	(3772)
3	0.08	18.56	69.50	67.48	62.37	217.99
	(2)	(442)	(1558)	(1494)	(1244)	(4740)
4	3.33	61.85	112.57	106.44	88.47	372.66
	(89)	(1499)	(2474)	(2177)	(1829)	(8068)
Overall	3.98	123.68	316.79	322.63	276.77	1044.07
	(105)	(2909)	(6979)	(6773)	(5605)	(22371)

Note: Figures in parenthesis indicate egg number

Table 22. Per cent livability from 21 to 40 weeks of age in 'F' strain of White Leghorn

Hatch number	Number of birds housed	Age in weeks/periods					Overall
		21-24 I	25-28 II	29-32 III	33-36 IV	37-40 V	
1	104	100	99.03 (1)	99.02 (1)	97.06 (3)	98.99 (1)	94.23 (6)
2	64	100	100	96.88 (2)	100	98.39 (1)	95.31 (3)
3	92	100	100	98.91 (1)	100	96.70 (3)	95.65 (4)
4	140	100	100	98.57 (2)	99.28 (1)	98.54 (2)	96.43 (5)
Overall	400	100	99.75 (1)	98.49 (6)	98.73 (4)	98.20 (7)	95.50 (18)

Note: Figures in parenthesis indicate number of mortality

second period the livability was 99.75 per cent. In other periods, livability was 98.2, 98.49 and 98.73 per cent in periods III, IV and V respectively. Thus, the overall mean per cent livability from 21 to 40 weeks of age was 95.5 in the flock.

The summary of production performance of 'F' strain is set out in Table 23. The salient features of this strain are late maturity, low body weight, low egg production, low egg weight, low feed intake, better feed conversion efficiency and good survivability.

Table 23. Summary of production performance from 21 to 40 weeks of age in 'F' strain of White Leghorn

Sl. No.	Parameter	Mean value
1	Body weight at 20 weeks of age (g)	944.05
2	Body weight at 40 weeks of age (g)	1346.67
3	Age at first egg (days)	174.67
4	Age at 10 per cent production (days)	178.00
5	Age at 50 per cent production (days)	196.50
6	Hen-housed egg number	56.73
7	Hen-housed per cent production	40.52
8	Hen-day egg number	57.09
9	Hen-day per cent production	40.79
10	Feed consumption (g/bird/day)	93.83
11	Overall feed efficiency per dozen eggs	2.81
12	Feed efficiency per dozen eggs (25-40 weeks)	2.47
13	Overall feed efficiency per kg eggs	5.01
14	Feed efficiency per kg eggs (25-40 weeks)	4.41
15	Overall mean egg weight (g)	46.21
16	Total egg mass (kg)	1044.07
17	Egg mass output per hen housed (kg)	2.61
18	Total eggs produced	22371
19	Overall per cent livability	95.50
20	Overall mean maximum temperature (°C)	32.50
21	Overall mean minimum temperature (°C)	26.12
22	Overall mean per cent relative humidity (F.N.)	76.67
23	Overall mean per cent relative humidity (A.N.)	69.18

Discussion

DISCUSSION

The present study was carried out to evaluate the production performance of 'F' strain of White Leghorn maintained in the Kerala Agricultural University Poultry Farm, Mannuthy. The results obtained in the study are discussed here.

Meteorological Observations

Results presented in Table 3 to 6 revealed that the study was undertaken during hot-humid climate and hence stress due to high maximum temperature during the initial three periods and stress due to high relative humidity during fourth and fifth periods affected the production traits in this strain.

Body Weight

The mean body weight presented in Table 7 revealed that the overall mean body weight at 20 weeks of age in the flock was 944.05±8.86 g with a range of variation from 630 to 1450 g. This clearly indicates that there was a wide variation among the individual birds in the population studied. It is obvious from this study that only 52.5 per cent of birds are within 10 per cent of the mean body weight indicating very poor uniformity (Table 9). This value is close to that reported by Radhakrishnan (1981) but lower than those reported by Anon (1979) and Singh (1983) for the same strain.

This implies that the 'F' strain has potential for higher body weight. The lowered body weight observed in this study (Fig.1) might be due to absence of a well planned selection in the flock or due to the hostile environment to which the experimental flock was subjected to during the early growing period.

The mean body weight at 40 weeks of age was 1346.67±12.19 g with a range from 930 to 2060 g (Table 8). These values are in close agreement with those reported by Anon (1979) and Radhakrishnan (1981) but lower than that reported by Singh (1983) for this strain. Singh (1983) has drawn his birds from a selected population. Whereas the other two observations were from unselected lots.

The lower body weight at 20 and 40 weeks of age as well as the high variability observed in the flock for this trait, indicate that the 'F' strain has a genetic potential for on reaching an acceptable pullet body weight. This also shows that the population from which the experimental lot was chosen calls for a systematic selection procedure using appropriate technique. Since body weight being a highly heritable trait, family selection can be adopted to achieve quick results.

Age at Sexual Maturity

The age at sexual maturity in this study was evaluated based on age at first egg in the flock, age at 10 and 50 per cent production. The data pertaining to these parameters presented in

Tables 10 and 11 revealed that the onset of production was delayed markedly. The mean age at first egg recorded in the flock was 174.67±0.95 days. This is in close agreement with that reported by Singh (1983) but much delayed than those reported by Anon (1979) and Radhakrishnan (1981). The mean ages at 10 and 50 per cent production were 178 and 196.5 days respectively. These values are higher than those reported by Anon (1979) and Radhakrishnan (1981).

It can be concluded that 50 per cent of hens matured sexually at the age on or before 196.5 days. Since the body weight is in poor uniformity, age at sexual maturity is late and not uniform.

Egg Production

The egg production was measured both on hen-housed and hen-day basis from 20 weeks onwards. The egg production presented in Tables 12 and 13 revealed that the overall HH egg number upto 40 weeks of age was 56.73±0.75 per bird and per cent HH production was 40.52 during the same period. These values are lower than those reported by Anon (1978), Anon (1979), Balachandran *et al.* (1979) and Singh (1983). The low egg production is mainly due to delayed sexual maturity. It could be seen from Tables 12 and 13 that the production was considerably low during the first two periods from 21 to 28 weeks of age. It is an expected outcome since there was delay in attaining sexual maturity as indicated earlier. However, the data in Table 13 also revealed that the birds peaked with 62.54 HH per cent during the period from 29 to 36 weeks of age, thus

indicating that the flock has a potential for high peak and but for the delay in sexual maturity the birds would have laid more eggs. Further the body weight of experimental birds at sexual maturity are lighter and flocks that are too light do not produce well. The differences between hen-housed and hen-day production depicted in Tables 12, 13, 14 and 15 revealed that the mortality during laying period upto 40 weeks is minimal which is an indication of hardiness of this strain.

The quick rise in the production curve (Fig.2) leading to peak egg production during 29-32 weeks was mainly due to the differences in age at sexual maturity in the replicated cage groups in the population. The weekly egg production (Table 16) indicated a quick rise in egg yield at 32 weeks and showed an abrupt decline at 33 weeks of age (Fig.3) and thereafter a natural and slow decrease in the rate of lay at 34, 35 and 36 weeks of age.

Since the birds were tested in groups of four birds per cage, individuals with zero eggs could not be identified, and also the onset of production in each hen could not be assessed. However, the hen-day estimation formed the accurate assessment of survivors and the intensity of production on per bird basis is a correct measure of its efficiency.

Feed Consumption

The feed intake data presented in Table 7 reveal that the mean intake for the experimental period of 21 to 40 weeks is 93.83 g/ bird/day. The mean feed intake which was 57.14 g at 21 weeks increased to 122.66 g at 40 weeks (Fig.4). The lower feed intake during the early phase is due to lower body weight. The feed consumption is comparable with the figures reported by Balachandran (1979). However, results in this study contrast the results obtained in the random sample laying test conducted in 'F' strain of White Leghorn at Hesserghatta, Bangalore (Anon, 1978). The reduced feed consumption recorded in the first three periods can be attributed to several factors viz., younger age of the birds, low body weight and high environmental temperature which prevailed at this period. Similar results have been reported by Esmay (1969) and Anon (1976).

Feed Efficiency

The feed efficiency presented as feed per dozen eggs in Table 8 indicate poor capacity of conversion of feed. This value is lower compared to those reported by Brahma and Ramakrishnan (1989), Mandlekar and Thatte (1993b), Sahu (1993) and Ahmed *et al.* (1994). On the contrary similar values were recorded by Jalaludheen and Ramakrishnan (1989), Anitha *et al.* (1992) and Kutty *et al.* (1992) in different strains of White Leghorn. The poor overall feed efficiency is due to the fact that during the period from 25 to 28 weeks of age only less number of eggs were produced which has

shifted the mean value. The efficiency of feed conversion from 29 to 40 weeks of age is comparable to many strains of White Leghorn. Thus, even though the experimental flock has a genetic potential for better feed conversion it is masked by the delay in sexual maturity. The feed efficiency calculated on the basis of egg mass presented in Table 19 also reveal similar picture and it is illustrated in Fig.5.

Egg Weight

The egg weight data presented in Table 20 revealed that the mean egg weight was 40.35 g at 24 weeks of age which gradually increased to 50.13 g at 40 weeks. These figures are comparable to those reported by Anon (1979), and Balachandran (1979) but lower than those reported by Anon (1978) and Singh (1983).

The poorer egg weight recorded in the experimental flocks (Fig.6) was essentially due to poor body weight.

Egg Mass

The data presented in Table 21 revealed that the total egg mass output was 1044.07 kg resulting in an egg mass of 2.61 kg per hen housed. This low output was due to low mean egg weight coupled with low egg production recorded in this study.

Livability

The mean livability from 21 to 40 weeks is 95.5 per cent (Table 22) is comparable with those reported by Anon (1978), Anon (1979) and Balachandran (1979) confirming the hardiness of the strain.

When the results obtained in the study (Table 23) are compared with those reported by Anon (1978), Anon (1979) and Balachandran (1979) who have evaluated the same strain it is clear that the body weight of the bird both at 20 and 40 weeks have become reduced. Possibly as a consequence, the sexual maturity has been delayed; egg production and egg weight has suffered. But the potential of the bird for better production scale, better feed efficiency and hardiness cannot be over looked. Thus, it implies that the capabilities of the bird have not been maintained possibly because of non-application of appropriate selection techniques over generations. The stock can still be salvaged as a potent strain for production of chicks intended for low technology management with back yard and homestead systems of rearing if only selection to improve body weight at 20 weeks of age is attempted.

Summary

SUMMARY

An experiment was carried out with 'F' strain of White Leghorn maintained in the University Poultry Farm for the past two decades. The objective of the study was to evaluate the production performance from 21 to 40 weeks of age in this particular strain.

White Leghorn pullets at the age of 18 weeks were housed in multiple-bird cages at random at the rate of four hens per cage. The pullets belonged to four consecutive hatches. A total of 400 pullets were used for this study. A layer mash with BIS specifications was fed throughout the experimental period. Standard routine managemental practices were followed in the study. The production performance and meteorological observations were studied for five, 28-day periods during the period from February through August 1994.

Body weight, age at sexual maturity, egg production, feed consumption, feed efficiency, egg weight, egg mass and mortality were the major criteria considered for evaluation.

The results obtained in this study are summarised below:

1. The mean body weight at 20 weeks of age was 944.05±8.86 g and that at 40 weeks of age was 1346.67±12.19 g. Thus the gain in body weight was 402.62 g per bird from 21 to 40 weeks of age.

2. The age at sexual maturity was estimated based on age at first egg and ages at 10 and 50 per cent production. The respective mean values were 174.67, 178 and 196.5 days.

3. The mean egg production was determined on hen-housed and hen-day basis from 21 to 40 weeks of age. The mean hen-housed number and per cent were 56.73 and 40.52 respectively. The mean hen-day number was 57.09 and per cent was 40.79.

4. The mean daily feed consumption during the period from 21 to 40 weeks of age was 93.83 g.

5. The mean feed efficiency was 2.81 in terms of kilogram feed per dozen eggs and 5.01 per kg egg mass during the period from 21 to 40 weeks of age.

6. The mean egg weight recorded during the period from 21 to 40 weeks of age was 46.21 g.

7. The total egg mass out put from the flock upto the end of 40 weeks of age was 1044.07 kg. Thus the egg mass output per hen housed was 2.61 kg.

8. Livability was 95.5 per cent from 21 to 40 weeks of age.

9. Mean of the maximum and minimum temperature recorded in the experimental house were 32.5 and 26.12°C respectively.

10. The mean relative humidity in the forenoon and afternoon were 76.67 and 69.18 per cent respectively.

Based on the above results, it is evident that the body weight, egg production, feed consumption and egg weight are considerably low in 'F' strain of White Leghorn. The sexual maturity is also delayed in this strain. The low body weight at 20 and 40 weeks of age and the high variability observed in this trait indicate that the 'F' strain has genetic potential for achieving acceptable pullet body weight. The need for a systematic selection procedure in 'F' strain to improve the production traits is suggested. However, the strain has proved its potential for high peak production and better feed efficiency. In this study the stress due to environmental temperature and relative humidity also might have affected the egg production adversely. It was revealed that the 'F' strain can still be salvaged as a potent strain for low technology management, if selection is applied by fixing independent culling levels for body weight at 20 weeks of age.

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EVALUATION OF PRODUCTION PERFORMANCE IN 'F' STRAIN OF WHITE LEGHORN

By

BEENA C. JOSEPH

ABSTRACT OF A THESIS

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Department of Poultry Science

COLLEGE OF VETERINARY AND ANIMAL SCIENCES

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ABSTRACT

A study was carried out with 'F' strain of White Leghorn maintained at University Poultry Farm, Mannuthy in order to evaluate the production potential of the particular strain based on the part year performance.

At the age of 18 weeks, 400 pullets belonging to four consecutive hatches were taken and housed in 100 multiple-bird cages of identical size at the rate of four hens per cage at random. Feed and water were given *ad lib* and the managemental practices were uniform for all cages. The production performance as well as meteorological observations were studied for five, 28-day periods from 21 to 40 weeks of age during the period from February through August 1994.

Body weight at 20 and 40 weeks of age were recorded individually and the respective mean values were found out to be 944.05±8.86 g and 1346.67±12.19 g. The first egg in each cage was recorded and the mean age at first egg was 174.67±0.95 days. The mean ages at 10 and 50 per cent production in the flock were 178 and 196.5 days respectively. These values indicated very late maturity in the strain. The egg production was recorded as 56.73 eggs with 40.52 per cent on hen-housed basis and 57.09 eggs with 40.79 per cent on hen-day basis. The peak production was obtained at 32 weeks of age. The mean daily feed consumption was worked out

as 93.83 g per bird. Feed efficiency worked out in terms of dozen eggs and kilogram egg mass were 2.81 and 5.01 respectively. Egg weight at last three days in each period were individually recorded and the overall mean egg weight for 21 to 40 weeks of age was 46.21 g. The total egg mass out put in the flock upto 40 weeks of age was 1044.07 kg with an average output of 2.61 kg per hen housed. Livability was found to be excellent (95.5 per cent) in the strain. The mean of the maximum and minimum temperature recorded in the experimental house were 32.5°C and 26.12°C respectively. The mean per cent relative humidity was 76.67 in the F.N. and 69.18 in the A.N.

On analysis of results, it was found that the body weight, egg production, feed consumption and egg weight are considerably low in this strain. There was poor uniformity in pullet body weight and also in age at sexual maturity. These traits can be improved if independent culling levels are fixed for body weight as well as for minimum rate of lay per bird. This strain can be improved further by applying selection for body weight at 20 weeks of age.