THE INFLUENCE OF PULLET BODY WEIGHT ON PRODUCTION TRAITS IN WHITE LEGHORNS

By

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THESIS

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DECLARATION

I hereby declare that the thesis entitled **THE INFLUENCE OF PULLET BODY WEIGHT ON PRODUCTION TRAITS IN WHITE LEGHORNS** is a bonafide record 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.

Mannuthy
25.10.95.

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CERTIFICATE

Certified that this thesis, entitled **THE INFLUENCE OF PULLET BODY WEIGHT ON PRODUCTION TRAITS IN WHITE LEGHORNS** is a record of research work done independently by Sudheesh Kumar, A. S. under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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Introduction

INTRODUCTION

The growth of poultry industry in India has been phenominal during the last two decades. In 1980, the egg production was 13000 million with a per capita availability of 19 eggs, whereas in 1992, the annual egg output was 28000 million with a per capita availability of 33 eggs. In the year 1992, broiler production was 280 million and the per capita availability of poultry meat was 434 g. During the period from 1980 to 1992, the increase in production of eggs was more than two fold and that of broilers was nine fold (Anon, 1994). These achievements were possible by concerted research and developments in the field of poultry breeding, management and nutrition. Technological advancement in poultry housing, equipments and biologicals also contributed a great share towards these developments. The vertical and horizontal integration among entrepreneurs encouraged organised poultry farming keeping away unhealthy and wasteful competition within the industry. However, the present annual egg production has to be increased further atleast by six folds to meet the minimum requirement of our people, i.e. half an egg per person per day.

The poultry population which was 204 million during the year 1982 has increased to 310 million during 1992 (Anon, 1994). Chicken accounted for more than 90 per cent of poultry population. But the number of improved layers were only to the extent of 20 per cent. The layer stock has to be further improved in quality and quantity in order to augment egg production in the country. The genetic potential of our layer flocks has to be modified in desirable directions by using modern poultry breeding techniques.

The layer production in Kerala has not made any substantial progress during the last decade. But the per capita consumption of eggs in the state is higher than the national average and the consumption outnumber the production. The excess of demand is met by the eggs brought in from neighbouring states. The present trend of backyard farming in the state has to be expanded and later to be converted into an organised farming for overcoming the current crisis.

The status of economic traits in promising strains is to be evaluated regularly as it varies widely between populations. Ideal combinations of economic characters have to be identified and that will help the breeders and farmers to raise more efficient birds. The body weight of commercial layers has shown considerable variation. It justifies the need for further studies on the effect of low, medium and heavy body weights of pullets on production traits.

The economic significance of body weight is related with daily feed intake, nutrient requirement for maintenance as well as production and feed conversion efficiency indirectly. Adult body weight directly influences egg weight and productivity. The pullet body weight, i.e. the weight of a bird approaching maturity, is an important factor that influences the age at sexual maturity which in turn regulates the annual egg yield.

In poultry industry, major thrust was given to increased egg production with relatively less emphasis on individual pullet body weight. The functional relationship of body weight with egg weight cannot be ignored while marketing eggs on weight basis. Hence optimum body weight for satisfactory egg production and egg weight is of great relevance in the economy of layer farming.

In commercial practice judicious culling of pullets based on body weight at point of lay will be of great value. Birds which are uneconomical due to late maturity, delayed and low peak production and poor persistency can be eliminated by fixing up body weight as a yardstick for culling pullets. This will save considerable time, effort and expenditure on maintaining undesirable pullets. Variation in pullet body weight is determined not only by genetic factors, but also by environmental influences of management and nutrition. Studies on the effect of body weight on laying performance are limited. Therefore the present study was planned in two strains of White Leghorn with the following objectives:-

1. To study the magnitude of variations in pullet body weight in White Leghorn and

2. To evaluate the influence of pullet body weight on layer production traits so as to determine the optimum pullet body weight for efficient production.

Review of Literature

REVIEW OF LITERATURE

Body weight and Production performance

Johari *et al*. (1977) studied the economic importance of 20 week body weight in 276 birds of a purebred strain of White Leghorn. Pullets of body weight range from less than 700 g to 1200 g and above were classified into seven groups, differing by 100g in each group. The overall mean body weight at 20 weeks of age was 971.6±7.51 g. A definite trend in production traits due to the effect of pullet body weight was reported by these authors. The birds attaining higher body weight at 20 weeks of age showed early maturity and hence laid more number of eggs. The performance of individual birds in different hatches varied significantly.

Jain *et al*. (1980) measured the body weight at sexual maturity in 150 pullets in a closed flock of White Leghorn. Average age at sexual maturity (ASM) was 198.36 days and average weight at maturity was reported as 1320.56±113.10 g with a coefficient of variation (CV) of 8.47 per cent. They concluded that body weight at maturity play a significant role in production performance. Th egg production of birds increased along with body weight only upto an optimal level and thereafter a decrease in egg production was noticed. They also reported that lowering of body weight resulted in an increase in egg production on genetic scale, while it decreased egg production on the environmental scale.

Okada and Bansho (1981) carried out selection studies in fowls for low body weight at 150 days of age in four generations. The base population was randomly divided into three groups. The first group was selected for low body weight, second group for low body weight, high egg production and constant egg weight, using an index and third group was an unselected control. The response to selection was higher in low body weight line for body weight as well as egg production, followed by index selection. In the control line, no obvious changes were observed over four generations. In the selected lines some genes consistently increased in frequency and this trend was particularly noticeable in the line selected for low body weight.

Richter et al. (1981) studied the effect of pullet body weight on laying performance in 450 White Leghorn hybrid layers. Based on 21 week body weight, birds were grouped into three classes with a 100g difference ranging from 1075 to 1374 and the fourth class from 1375 to 1500 g. They reported that the age at sexual maturity as well as the age at 50 per cent production were delayed in birds belonging to class 1075 to 1174 g. This weight class also registered very low mean egg weight in comparison to other heavier birds.

Johari et al. (1982) determined lower level of body weight for culling pullets at the age of 20 weeks. The data were collected from one randombred control line and four strains of White Leghorn subjected to selection for egg production. Data for each strain were classified under five groups based on the 20 week body weight with an uniform interval of 100 g from 800 to 1300 g. Apart from this, one group consisted of birds with body weight less than 800 g and another group consisted of birds weighing above 1300g. These two groups together formed less than four per cent of the population. Birds weighing below 900g which formed 12 per cent of the population laid significantly lesser number of eggs. They concluded that in the population studied, the culling level for 20 week body weight could be around 900g. These authors also opined that selection by independent culling for 20 week body weight would add to the genetic response to egg production in addition to the response achieved by direct selection. The mean egg production also significantly increased in the higher weight classes.

Singh and Nordskog (1982) defined the different body weight classes on genetic and phenotypic scales in pedigreed breeders and in their progenies in two populations of White Leghorn. Based on the body weight at 30 weeks of age, breeders below and above mean weights were classified as light and heavy groups, respectively, in both sexes. Three types of mating using Light, Light x Heavy and Heavy groups were planned and the difference between the progenies from the respective matings served as the estimate of genetic effects of body weight and the progenies were described as Light, Medium and Heavy, respectively. The first and second litter in each mating represented the phenotypic scale for male and female parents respectively. In the light, Medium and Heavy weight classes the genotypic weights were 1506.7, 1611.8 and 1699.8 g, respectively and the corresponding weights on phenotypic scale were 1378.0, 1602.3 and 1859.6 g, in one of the populations studied. In the second population, the corresponding values of body weights on genetic scale were 1465.5, 1573.4 and 1657.4g and 1336.1, 1548.4 and 1782.8 g on phenotypic scale, respectively. In all cases the body weight differences of birds among the three classes were statistically significant within the populations studied. The authors emphasised on the dominant role of management, feeding and disease control over the genetic influence in maintaining optimum body size for satisfactory performance. Heavy birds did not excel in performance over Light and Medium sized birds. This study demonstrated that the influence of body weights in associated traits was greater on phenotypic scale than on the genetic scale.

Singh and Chaudhary (1982) studied the production characteristics in a control line and a selected population of White Leghorn. The mean body weight at sexual maturity was reported as 1467.65±175.3 and 1418.01±293.3 g in the control and selected lines, respectively, at an age of 215.23±17.09 and 203.39±32.71 days.

Benoff and Renden (1983) established two lines by selecting for low and high body weights at 20 weeks of age from a base population of dwarf line of White Leghorn. Lightest nine percent of the females and heaviest four per cent of males were selected for establishing the above two lines. The base population was randomly mated and served as a control. Significant differences in body weight at 20 and 40 weeks of age were observed among the lines in each of the three generations. In all cases the control line was intermediate in weight. At the third generation the body weights at 20 weeks of age in females averaged 800, 1130 and 1480 g in Light, Control and Heavy lines respectively. The corresponding weights in males averaged 970, 1270 and 1740 g respectively. Thus an assymetry of response was observed in both sexes. The male body weights at 20 weeks of age diverged significantly and the difference between Heavy and Light lines after three generations of selection was 772 g.

Summers and Leeson (1983) studied the effect of two levels of dietary protein and energy in 128 White Leghorn pullets at 18 weeks of age, housed in individual laying cages. The mean body weights at 18 weeks of age in the four experimental groups were 1107, 1205, 1281 and 1383 g and their body weights at 25 weeks of age were 1417, 1511, 1606 and 1691 g respectively. The differences among groups were statistically significant at both ages. All groups gained essentially the same amount of weight from 19 to 25 weeks of age ranging from 306 to 325 g. The true genetic differences in body weight at point of lay may be apparent throughout the production period. These authors confirmed that body weight was the main factor controlling early egg weight in pullets.

Dunnington and Siegel (1984) measured body weight at sexual maturity in two lines of White Leghorns and demonstrated that egg type chickens must reach a minimum age and body weight before commencing egg production. The mean body weight at 24 weeks of age was 1311±18 and 1344±16 g in the two lines tested. In these populations the mean age at first egg was 182±2 and 168±1 days, respectively. These workers stated that specific values of age and body weight were unique for populations and are amenable to modification by non-genetic factors such as management and feeding.

Renden <u>et al</u>. (1984) studied the pattern of body weight maintenance at different ages in three lines of a single comb dwarf White Leghorn. In the low body weight line, the mean body weights at 20, 24, 32 and 40 weeks of age were reported as 760, 880, 970 and 1020 g, respectively. At the respective ages the body weights averaged 1020, 1140, 1240 and 1280g in the randombred control line and 1500, 1700, 1860 and 1970 g in the heavy body weight line. In all these lines, the differences in body weight measured at these ages were statistically significant. The line x age interaction for body weight was highly significant (P <0.01).

Balnave (1984) reported that egg production was not affected when body weight at 21 weeks of age varied between 1300 and 1800 g in a cross between White Leghorn x Australorp. Daily feed access time was restricted to maintain a target body weight of 1540g at 20 weeks of age on full feeding. At 21 weeks of age, birds weighing less than 1300g and more than 1800g were eliminated from the study and the birds within this range were distributed into five classes varying in 100g units. All the traits except production were significantly affected by the different weight classes.

Narayanikutty and George (1985) collected data from 779 progenies obtained from 38 sires and 147 dams of IWN strain of White Leghorn. They constructed seven phenotypic indices using various traits: egg number, egg weight and 20 and 40 week body weights. The relative efficiencies of these indices indicated that the best index was the one made up in combination of 20 and 40 weeks body weights. This had showed a relative efficiency of 132 per cent in comparison with the index based only on egg production.

Bish et al. (1985) divided single comb White Leghorn pullets into three groups viz., light, medium and heavy, based on the body weights at 20 weeks of age. The average body weights in the above groups were 1131, 1256 and 1377 g respectively at 20 weeks of age and body weight differences continued upto 72 weeks of age.

Richter et al. (1986) studied the relationship between pullet body weight and laying performance in 450 White Leghorn pullets classified into four groups based on the average body weight at 21 weeks of age. The different body weight classes averaged 1125, 1236, 1334 and 1450 g at 21st week. The egg production, daily feed consumption and feed efficiency upto 25 weeks of age were significantly lower in birds with average body weight of 1125g in comparison with birds averaging 1450g. But the overall efficiency of egg production was not significantly affected by body weight at 21 weeks of age.

Leeson and summers (1987) evaluated the effects of immature body weights at 15 and 19 weeks of age on laying performance in a commercial strain of White Leghorn. After weighing all birds individually, sample groups relative to the overall mean weight were classified as small, medium and heavy with a mean body weight of 997, 1100 and 1226 g respectively at 15 weeks of age. In a second trial, the mean body weight of 1308, 1411 and 1564 g at 19 weeks of age, formed the light, medium and heavy groups, respectively. In the corresponding groups, the body weight at 39 weeks of age were 1584, 1702 and 1869g in the first trial and 1549, 1724 and 1917g in the second trial. In both trials, the body weight differences among groups were statistically significant. In both trials, immature weight classification had consistent effects and the larger birds consumed significantly more feed and laid larger sized eggs ($P<0.05$). Each 100g increase in body weight was associated with approximately 3.5 g increase in feed intake and 1.2g increase in egg weight. There was no indication of compensatory growth of small pullets within a flock even from 15 weeks of age.

Okpokho et al. (1987) conducted two experiments to compare the effects of homogeneous and heterogeneous body weight groupings on production traits as well as feather loss and nervousness in caged layers. The pullets at 18 weeks of age with body weights less than 1044g was classified as light and those from 1044 to 1250g as medium and above 1250g as heavy. Weight groups differed in age at sexual maturity, egg weight, egg mass and nervousness. However body weight gain, egg production and mortality were similar.

Escalante et al. (1991) studied the effects of 18 week body weight on production performance in White Leghorn pullets. The birds with mean body weight of 960, 1020, 1080, 1200 and 1320g were classified into five groups. At 66 weeks of age, the body weight in the respective groups were 1346, 1466, 1474, 1599 and 1722 g and were significantly different among each other (P<0.01). The 18 week body weight groups showed no significant effect on age at sexual maturity.

Leeson et al. (1991) studied the significance of physiological age of pullets on subsequent reproductive characteristics in a commercial strain of White Leghorn. The economic advantage of moving birds to laying cages at young age was also tested in one experiment. At 15 weeks of age all birds were weighed individually and 40 birds with body weight of around 1234 g were moved to cages and reared under photo period of 14h/day. The procedure was repeated at weekly intervals from the remaining birds. Average body weights from 16 to 21 weeks of age were 1288, 1377, 1425, 1462, 1605 and 1722g respectively, altogether forming seven treatment groups. The birds were weighed at biweekly intervals and there after at four week intervals until 62 weeks of age. The age at moving to laying cages had a significant effect on egg weight, final body weight and feed intake ($P<0.01$). Earlier light stimulation resulted in production of significantly more medium and small eggs in the lower weight classes ($P<0.01$). In a second experiment, at 18 weeks of age, six treatment weight groups with average weights of 1060, 1151, 1252, 1349, 1448 and 1543 g subjected to 14h light per day and tested upto 74 weeks of age. Birds with lower body weights did not exhibit any compensatory growth ($P<0.05$). There was no effect on total eggs due to difference in body weight. In larger birds, higher feed costs offset increased egg income related to increased egg mass output.

Age at sexual maturity

Johari et al. (1977) analysed the data of 276 White Leghorn birds in their study on traits of economic importance. The mean age at sexual maturity for weight groups < 700 g was 184.5 days and for weight groups > 1201 g was 155.6 days with a mean age at sexual maturity of 170.2 days.

Jain et al (1980) studied the age at sexual maturity in 150 half-sib pullets, the progeny of 20 sires and found to be 198.36±15.81 days.

Gurung and Taylor (1981) studied the age at sexual maturity in 511 pullets and reported an average value of 199.34±0.56 days and there was no significant difference in age at first egg between sires but the effect of dam was highly significant.

Richter et al. (1981) found that the age at first egg averaged 158,148,148,149 days respectively for body weight groups 1075 to 1174, 1175 to 1274, 1275 to 1374 and 1375 to 1500 g at 148 days of age. In corresponding groups age at 50 per cent production were 172, 170, 167 and 158 days.

Singh (1982) studied performance traits in 2747 pullets sired by 77 sires and belonging to three generations selected for short term egg number. He opined that the age at sexual maturity was advanced as the body weight at 20 weeks of age increased. The expected genetic gain in three generations was higher for combined selection than for individual selection and there was a decrease in age at sexual maturity by 6.30 days.

Garwood and Lowe (1982) performed two experiments to study the effect of age at maturity on fertility and hatchability in three lines of White Leghorns. In the three lines, age at first egg averaged 159, 174 and 169 days respectively.

Singh and Chaudhary (1982) studied production characters in White Leghorn where in age at sexual maturity averaged 203.39±32.71 and 215.23±17.64 days for hens selected for high egg production and for controls from the same strain respectively.

Shanawany (1983) analysed 39 research papers on the effect of age at sexual maturity on laying performance in order to quantify the relationship between these characters. When normal photo periods were employed, egg out put could be explained as a curvilinear function of age at sexual maturity. There was an approximate linear regression of egg output on age at 50 per cent lay for values between 142 and 160 days. But there was little further change in egg output for values between 160 and 180 days. The quadratic curve suggested that late maturing birds over 180 days of age gave lower egg output than those matured at about 160, 170 or 180 days.

Benoff and Renden (1983) observed significant differences on sexual maturity between the light and heavy lines in each generation. The light line females were observed to mature 2.1 days later as generations progressed whereas only a slight reduction in age at sexual maturity over generations was observed for heavy line females.

Summers and Leeson (1983) studied the effect of diet composition on body weight and early egg size in White Leghorn pullets from 18 to 32 weeks of age. Age at sexual maturity was 150.8, 149.8, 150.1 and 148.2 days respectively for 18 week body weights of 1107, 1205, 1281 and 1383 g. Although the 18 week body weights of four groups of pullets used in the experiment differed significantly, little differences were noted in their age at first egg except for those in the heaviest body weight group.

Dunnington and Siegel (1984) measured the age at sexual maturity in White Leghorn chicken that were divergently selected for high (HA) and low (LA) levels of antibody production. The age at first egg for early and late maturing birds in HA line was 173 and 193 days, respectively with a population mean of 182±2 days. The age at sexual maturity of early and late maturing birds in LA line were 161 and 175 days respectively with a population mean of 168±1 days. The LA line females reached sexual maturity at significantly younger ages than HA line pullets. Body weight at 168 days of age was significantly lower in the HA line than that in LA line.

Renden et al. (1984) evaluated egg characteristics and production efficiency in dwarf White Leghorn hens. The age at sexual maturity in high, low and control body weight lines were 164, 172 and 164 days respectively. There were no significant differences among the lines for this trait (P<0.05).

Richter et al. (1986) studied laying performance based on the average body weight at 21 weeks of age in four body weight groups of White Leghorn. The age at onset of laying in the lower body weight group of 1125 g was 158 days, whereas in the other body weight groups of 1236, 1334 and 1450 g, the age at sexual maturity were from 148 to 149 days. The age at 50 per cent laying was 158 days for body weight group of 1450 g. But in the other groups, it was 167 to 171 days.

Zhuvavlev et al. (1986) studied the effect of live weight and the age at first egg on the productivity of White Leghorn and stated that pullets which exhibited early sexual maturity were characterized by high growth rate in the period prior to laying of the first egg. Those birds which had body weight of 1500 to 1800 g reached sexual maturity at 140 to 150 days of age and subsequently showed high egg production performance.

Okpokho et al. (1987) studied the effect of body weight groups on productivity and found that age at sexual maturity in weeks were 22.6, 23.3 and 23.0 for heavy, light and medium weight groups.

Egg production

Hurnik et al. (1977) conducted experiments in 270 White Leghorn hens from 23 to 48 weeks of age to study the effect of age on laying performance. The individual hens were fed ad-libitum with isocaloric diets containing 15 per cent and 17 per cent protein. The resultant egg production was 73.2 per cent and 71.9 per cent respectively. In the corresponding groups, the mean daily egg mass were 46.33 vs 46.3 g and showed significant differences due to diets. Significant interaction between diets and age were detected for egg mass.

Johari et al. (1977) studied certain traits of economic importance in a strain of White Leghorn and found that the egg production up to 40 weeks of age was 90.9 eggs for body weight group of birds weighing 1201 g and above. The production was only 64.8 eggs for body weight group less than 700 g. The overall average egg production upto 280 days of age was 78.9±0.88 eggs.

Jain et al. (1980) studied the production traits in White Leghorn and found that the mean egg production up to 50 weeks of age was 93.29±19.18 eggs.

Richter et al. (1981) found that in White Leghorn hybrids, the annual egg production was 238, 234, 241 and 240 eggs/bird in body weight groups of 1075 to 1174, 1175 to 1274, 1275 to 1374 and 1375 to 1500 g, respectively at 148 days of age

Singh (1982) studied performance traits of pullets belonging to three generations selected for short term egg number and found that the number of small eggs laid increased as the body weight at 20 weeks of age increased. The expected genetic gain in egg number in three generations was higher for combined selection. Combined selection for high egg number over two generations resulted in an increase of 10.44 eggs which was 74.25 per cent of the predicted response.

Johari et al. (1982) compared the egg production between strains and among different weight classes in White Leghorn. The mean egg production was 80.61, 74.71, 72.06, 69.02, 65.71, 59.13 and 49.31 for seven body weight groups of above 1300 g, 1201 to 1300g, 1101 to 1200, 1001 to 1100 g, 901 to 1000 g. 801 to 900 g and below 800 g respectively. Pullets weighing more than 900 g at 20 weeks formed the 80 per cent of the population and laid more than 66 eggs. This was very close to overall mean egg production. Pullets weighing less than 900 g constituted 12 per cent of the population and laid significantly less number of eggs.

Singh and Nordskog (1982) classified Leghorn birds into two classes of light and heavy. Progenies were classified according to parental mating type. Light birds had the poorest rate of lay on the phenotypic scale but had the best rate of lay on genetic scale.

Singh and Chaudhary (1982) studied production characters in 471 White Leghorn hens selected for high egg production. The 90 day egg production percentage averaged 61.62±11.36 compared to 59.25±6.72 for 167 controls from the same strain.

Summers and Leeson (1983) evaluated the factors influencing early egg size. The per cent egg production from 19 to 25 weeks of age was 48.1, 51, 50.7 and 53.6 for weight groups of 1107, 1205, 1281, 1383 g respectively. The heavier pullets laid significantly more eggs than the lighter group.

Balnave (1984) studied the influence of body weight at point of lay on the production response of restricted reared pullets. The egg production was not affected and body weight varied between 1.3 and 1.8 kg. Daily egg mass was significantly affected by body weight at 21 weeks of age.

Brister (1986) reported that the egg production of commercial laying fowls increased as body weight at housing increased from 1000 g to 1599 g and egg production decreased significantly as body weight at housing increased beyond 1599 g.

Bish _et al_. (1985) studied the influence of body weight at 20 weeks of age on egg production in three weight groups of 1131, 1256 and 1377 g. The hen day and hen housed number and age at 50 per cent production were not affected by body weight groups. Heavy hens produced heavier eggs and consumed more feed to produce dozen eggs than light and medium hens.

Leeson and Summers (1987) studied the effect of immature body weight on laying performance. The egg production in one trial averaged 78.2,79.7 and 76.1 per cent for light, medium and heavy body weight groups from 19 to 67 weeks of age. In a second trial the egg production per cent averaged 78.5, 79.7 and 79.2 for light, medium and heavy hens from 19 to 67 weeks of age. The birds were moved to laying environment at 15 weeks of age in first trial. There was no indication of body weight influence on onset of egg production. But in birds moved at 19 weeks of age (second trial) the heaviest birds produced significantly more eggs during the first 28 day period and after this initial effect, body weight had no significant effect on egg production.

Okpokho et al. (1987) conducted experiments to compare egg production, feather loss and nervousness of hens kept in homogenous and heterogenous body weight groups. Rate of lay for heavy, light and mixed groups were 76.8, 69.1, 74.9 respectively and hen day production were 72.5, 64.8 and 71.1 per cent for the three weight groups respectively.

Dimitrov (1991) studied the effect of body weight of pullets at the age of 128 days and grouped birds into three body weight classes. Age at 50 per cent production was 159, 158 and 159 days, respectively for weight classes of 1020 to 1120, 1160 to 1200 and 1240 to 1360 g. Maximum production intensity was reached at the age of 181, 176 and 176 days in the respective groups.

Escalente et al. (1991) evaluated body weight at 18 weeks of age on performance of White Leghorn pullets from 21 to 66 weeks of age. The per cent production was 66.8, 62.7, 67.0, 65.6 and 73.9 for mean body weight of 960, 1020, 1080, 1200 and 1320 g respectively.

Egg weight

Hurnik et al. (1977) conducted an experiment using 270 White Leghorn hens to study the effect of age on laying performance from 23 to 48 weeks of age. A daily photoperiod of 14 h was followed consistently during the whole experimental period. The effect of age during the laying season significantly influenced the feed consumption and efficiency and the weight of fresh and freeze dried egg components.

Richter et al. (1981) studied the effect of body weight at 148 days of age and subsequent laying performance and they obtained egg weight of 55.6, 57.4, 57.9 and 58.1 g for body weight groups of 1075 to 1174, 1175 to 1274, 1275 to 1374 and 1375 to 1500 g respectively at 148 days of age.

Shanawany (1983) studied sexual maturity and subsequent laying performance of fowls under normal photoperiods. For birds maturing between 140 and 160 days, average egg output during the first laying year increased by about 1.68 g/bird day of every 10 days delay in maturity. With later maturity over 180 days egg output declined by about 1.77 g/ bird day for every 10 days increase in age at sexual maturity.

Benoff and Renden (1983) studied the growth and reproductive responses to selection in dwarf White Leghrons that were divergently selected for mature body weight. The egg weights varied significantly among the lines with the heavy line laying the smallest egg. After three generations of selection, the weight differences between heavy and light line was approximately 10 g while the control line was intermediate in weight.

Summers and Leeson (1983) studied the factors influencing early egg size. They obtained egg weights of 46.9, 48.4, 48.8 and 49.7 g at 25 weeks for body weight groups averaging 1107, 1205, 1281 and 1383 g respectively. The weight of first egg was 40.7, 42.0, 43.7 and 42.5 in four weight groups, respectively. With the exception of heavy weight pullets the size of first egg was correlated with body weight.

Renden et al. (1984) studied egg characteristics and production efficiency of dwarf White Leghron hens. The egg weights in high body weight lines were 46.2, 55.0, 59.3 g, in control line 45.1, 51.8, 55.1 g and in low body weight line 38.9, 45.4 and 48.6 g, respectively, at 24, 32 and 40 weeks of age.

Richter et al. (1986) showed the relationship between pullet body weight and some performance traits during the rearing and laying periods. The egg weight of three body weight groups averaging 1236, 1334 and 1450 g ranged from 57.4 to 58.1 g. The egg weight was 55.6 g in birds averaging 1125 g body weight at 21 weeks of age.

Leeson and Summers (1987) conducted two experiments to study the influence the immature body weight on laying performance and reported that the egg weights were 57.0, 58.1 and 60.4 g for light, medium and heavy hens in trial-1 and 57.7, 59.7 and 61.8 g in trial-2 respectively.

Okpokho et al. (1987) compared egg production, feather loss and nervousness in different body weight groups of hens. The observed egg weights were 60.2, 52.9 and 57.2 g for the heavy, light and mixed body weight groups respectively.

Dimitrov (1991) measured the effect of body weight of young hens on some performance traits in three body weight groups. The mean egg weight reported was 59.5, 58.7 and 59.8 g for body weights of 1020 to 1120, 1160 to 1200 and 1240 to 1360 g, respectively.

Escalente et al. (1991) measured the effect of body weight on laying performance at 18 weeks of age in White Leghorn pullets. The mean egg weight were 53.8, 55.3, 54.5, 56.3 and 57.6 g, respectively, for body weight groups of 960, 1020, 1030, 1200 and 1320 g, respectively.

Livability

Richter et al. (1981) studied the effect of live weight of young hens on livability. The laying house mortality for body weight groups of 1075 to 1174, 1175 to 1274, 1275 to 1374 and 1375 to 1500 g were 13.0, 10.0, 9.3 and 16.0 per cent respectively.

Egg Quality Traits

Hussain et al. (1982) conducted periodic shell quality studies on 284 light, 256 medium and 246 heavy hens of Lohman super brown hybrid layers. Egg weight, specific gravity, breaking strength and shell weight were determined and found that lighter birds produced eggs of superior shell quality.

Bermudez et al. (1992) studied the effect of body weight groups of below 900, 900 to 980, 1000 to 1120, 1140 to 1220 and above 1240 g at 14 weeks of age and found that the egg shell quality deteriorated with increasing body weight. But there was no significant difference between the groups in the percentage of cracked eggs.

Meteorological observations

Muller (1961) studied the effect of constant and fluctuating environmental temperature on the biological performance of layers from 150 to 435 days of age and found decreased egg production, feed intake, egg weight, shell quality and increased mortality at a constant temperature of 90°F than at a constant temperature of 55°F. Pullets kept in a cycling environment of 55°F to 90°F and back to 55°F in every 24 h. produced more eggs than the pullets kept at a constant temperature of 55°F.

McDowell (1972) reported reduced production in livestock when the temperature was 21°C or above and when the relative humidity was 60 per cent and above.

Somanathan (1980) recorded five year monthly average of meteorological data at Mannuthy. He had reported that when the meteorological factors from June to December were compared, the highest mean maximum temperature was recorded during September and December (30.25°C) and lowest during July (28.15°C). The highest mean minimum temperature of 24.06°C was recorded in September and the lowest mean minimum temperature of 22.52°C during December. The daily average of per cent relative humidity varied between 86.52 during July to 64.84 during December.

Materials and Methods

MATERIALS AND METHODS

An experiment was carried out at the All India Co-ordinated Research Project (AICRP) on Poultry for eggs, Mannuthy centre to evaluate the influence of pullet body weight on production performance in IWN and IWP strains of White Leghorn.

The two strains, IWN and IWP have been maintained separately as closed flocks at Mannuthy centre of AICRP since 1979. They were subjected to selection for improving egg production for the past 14 generations. The experimental birds for the study were generated in four pedigreed hatches in each strain during the period from March to April 1993. The interval between successive hatches was ten days in each strain.

One-day old female chicks hatched out from 240 dams mated to 40 sires were obtained in each strain and were reared upto 18 weeks of age on deep litter. They were transferred to alifornia type individual cages having dimension of 25 x 37 x 37 cm for conducting the experiment. The allotment of birds to cages was made at random.

The experimental birds consisted of 1271 pullets of IWN strain and 1317 of IWP strain. The body weight of these birds were recorded individually to the nearest 10 g at 20 weeks of age and birds were identified by cage numbers. This weight was reckoned as pullet body weight

Based on pullet body weight, the experimental birds were classified into six classes with a class interval of 100 g as detailed below.

Experimental groups	Body weight classes
I	1000-1100 g
II	1101-1200 g
III	1201-1300 g
IV	1301-1400 g
V	1401-1500 g
VI	Greater than 1500 g.

Since no birds were available in the below 1000 g class, the classification was made from 1000 g onwards.

The birds were fed with standard layer mash. Standard routine managemental practices were followed throughout the study.

The following observations were recorded during the experimental period from 20 to 40 weeks of age in both strains.

1. Body weight at 20 and 40 weeks of age
2. Date of first egg
3. Hen housed number and per cent
4. Egg weight at 32 and 40 weeks of age.
5. Livability.
6. Egg quality parameters and
7. Meteorological observation inside the experimental house.

The body weight of birds were recorded individually at 40 weeks of age to the nearest 10 g in both the strains.

The age at first egg of each bird was calculated as the age in days when the bird started egg production.

The egg production in each bird was recorded daily and the number of eggs laid was tabulated at weekly intervals. The weight of four consecutive eggs laid by the bird at 32 and 40 weeks of age was recorded to arrive at mean egg weight of the bird at that particular age.

The livability was calculated as the percentage of birds surviving the experimental period in each class.

Ten eggs from each weight class were taken random at 40 weeks of age to study the external and internal egg quality traits. Shape index, yolk and albumin indices, shell thickness and Haugh unit scores were recorded.

Meteorological observations in respect of minimum and maximum temperature and relative humidity were recorded inside the experimental house for the period from July 1993 to December 1993.

The data collected were subjected to statistical analysis by appropriate techniques described by Snedecor and Cochran (1968).

Results

RESULTS

The experiment was conducted to assess the influence of pullet body weight on egg production parameters. The six weight classes studied were:-

I	1000-1100 g
II	1101-1200 g
III	1201-1300 g
IV	1301-1400 g
V	1401-1500 g and
VI	Greater than 1500 g

Variation in pullet body weight

The total number of birds used for the study in IWN strain were 1271. The pullet body weight of the individual birds ranged from 1000 to 1680 g. The overall mean pullet body weight was 1304.7 g with a standard error of 4 g. The coefficient of variation was 10.1 per cent. (Table 2).

A total number of 1317 birds were used for the study in IWP strain. The pullet body weight of the birds ranged from 1000 to 1740g. The overall mean pullet body weight was 1335.2 g with a standard error of 3.5 g and coefficient of variation of 9.5 per cent.

Frequency distribution

The frequency distribution of different body weight classes in IWN and IWP strains are presented in Table 1 and graphically represented in Figs I and II. The results showed that there was considerable amount of variation in pullet body weight within the two strains studied.

IWN strain

Out of the 1271 birds tested in IWN strain, 71 birds belonged to Class I, 212 birds to Class II, 362 birds to Class III, 339 birds to Class IV, 221 birds to Class V and 66 birds to Class VI. The per cent distribution of birds were 5.59, 16.68, 28.49, 26.68, 17.38 and 5.18 for Classes I to VI, respectively. The number of birds distributed in weight Class III was the highest (28.49 per cent). The results also showed that 89.23 per cent of birds in IWN strain were distributed in four classes II to V (from 1101 to 1500 g). The classes I and VI together represented 10.77 per cent only.

IWP Strain

Out of the 1317 birds in IWP strain, 37 birds were distributed in Class I, 156 in Class II, 362 in Class III, 378 in Class IV, 271 in Class V and 113 in Class VI. The per cent distribution of birds were 2.81, 11.84, 27.49,

Table 1. The frequency distribution of birds in different body weight classes in two strains of White Leghorn.

Body weight classes	Class interval (g)	IWN strain		IWP strain	
		No.	Per cent	No.	Per cent
I	1000-1100	71	5.59	37	2.81
II	1101-1200	212	16.68	156	11.84
III	1201-1300	362	28.49	362	27.49
IV	1301-1400	339	26.68	378	28.70
V	1401-1500	221	17.38	271	20.58
VI	Greater than 1500	66	5.18	113	8.58
Total		1271	100	1317	100

Fig.I Frequency distribution (%) of pullet body weight – IWN strain

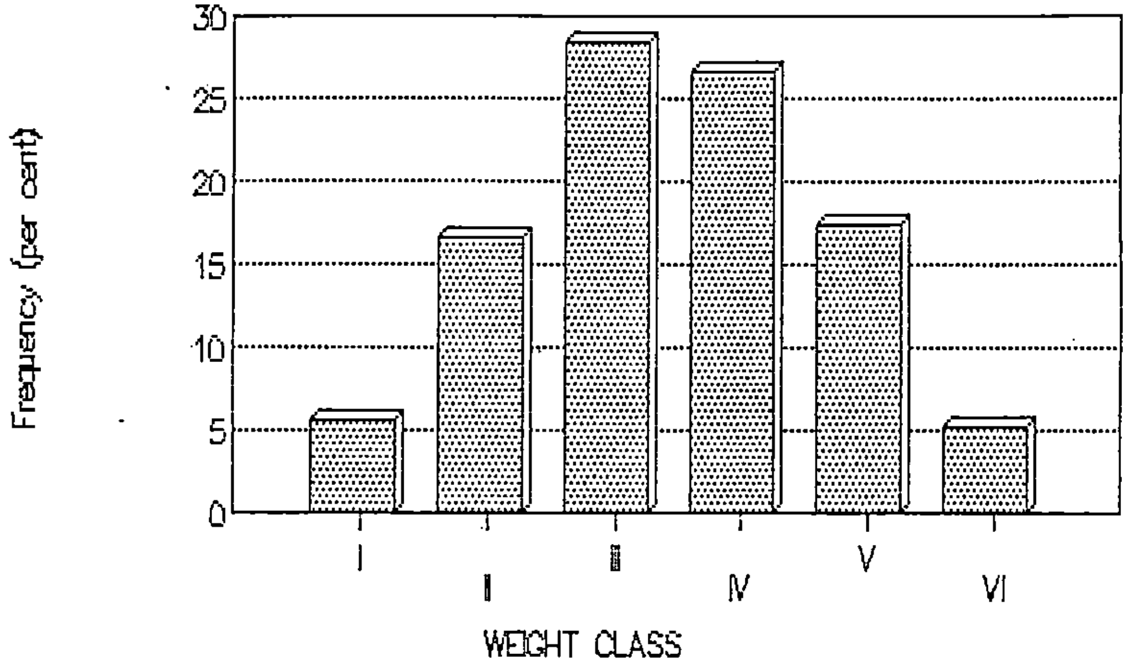
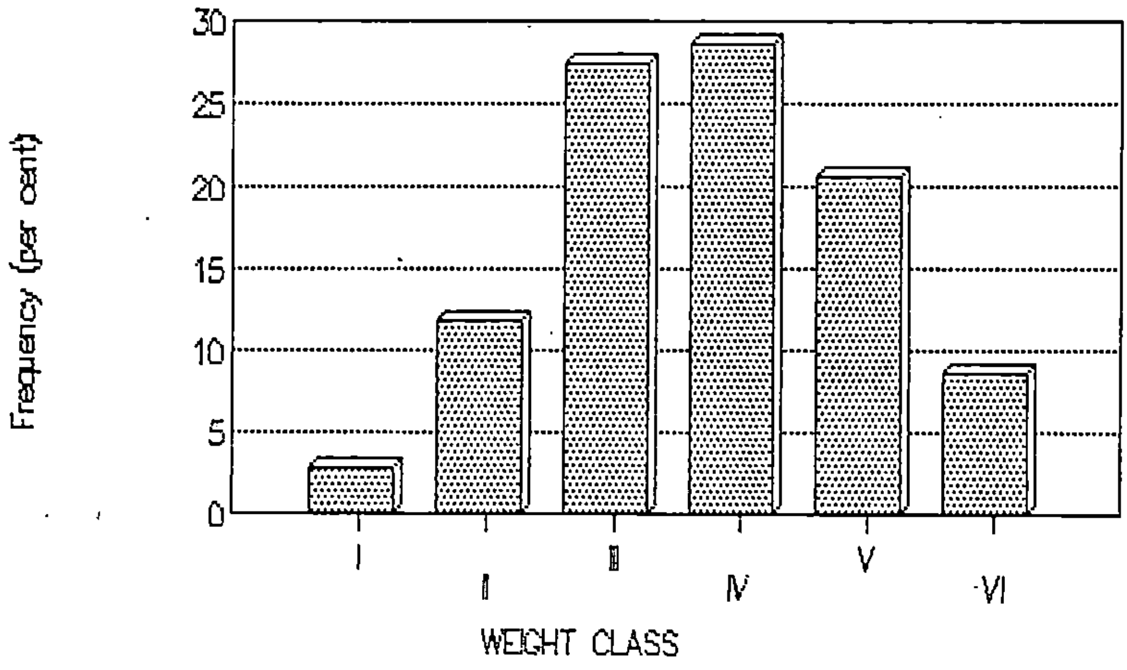


Fig.II Frequency distribution (%) of pullet body weight – IWP strain



28.70, 20.58 and 8.58 in Classes I to VI respectively. The results also showed that 76.77 per cent birds in IWP strain were distributed in the range of 1201 to 1500 g.

Pullet body weight

The mean values of pullet body weight (PBW) along with standard error recorded at 20 weeks of age in different body weight classes in IWN and IWP strains are presented in Table 2 and illustrated in Fig. III and IV, respectively.

IWN Strain

The overall mean PBW was 1304.7±4 g in IWN strain. The mean weight of birds in the class I was 1054.8±14.0 g. In class II the mean body weight of birds was 1162.2±2g. The difference between these two classes was 107.4 g. In Class III the mean body weight recorded was 1256.1±2 g with an increase of 93.9 g, compared with class II. In class IV the mean body weight was 1350.6±2 g and it was 94.5 g higher than that of class III. The difference between classes IV and V was 99.4 g. The mean body weights in classes V and VI were 1450.0±2 and 1576.5±6 g, respectively, with a difference of 126.5 g.

The lowest difference of 93.9 g was recorded between class II and III and the highest difference of 126.5 g, between class V and VI. The overall mean body weight of IWN

Table 2. Mean pullet body weight (g) in differnt body weight classes in two strains of White Leghorn (Mean ±SE).

Weight classes	No.	Pullet body weight (g) IWN strain	No.	Pullet body weight (g) IWP strain
I	71	1054.8±14	37	1078.4±4
II	212	1162.2±2	156	1160.1±2
III	362	1256.1±2	362	1255.2±2
IV	339	1350.6±2	378	1353.2±1
V	221	1450.0±2	271	1450.1±2
VI	66	1576.5±6	113	1581.2±4
Overall Mean	1271	1304.7±4	1317	1335.2±3.5

Fig.III Pullet body weight – IWN strain

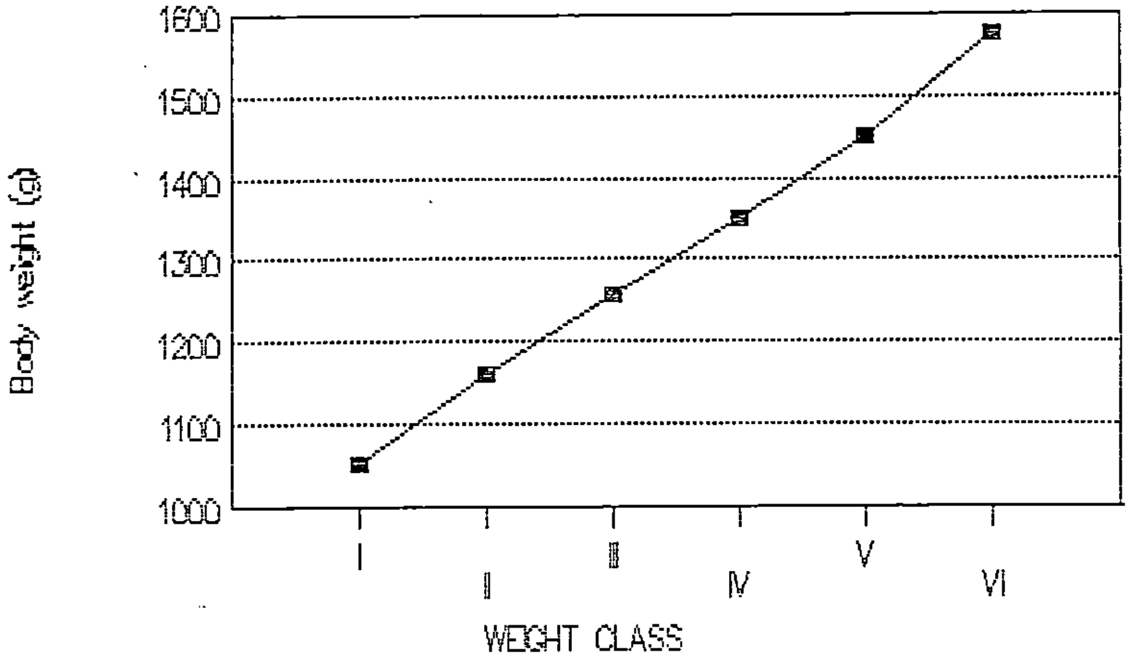
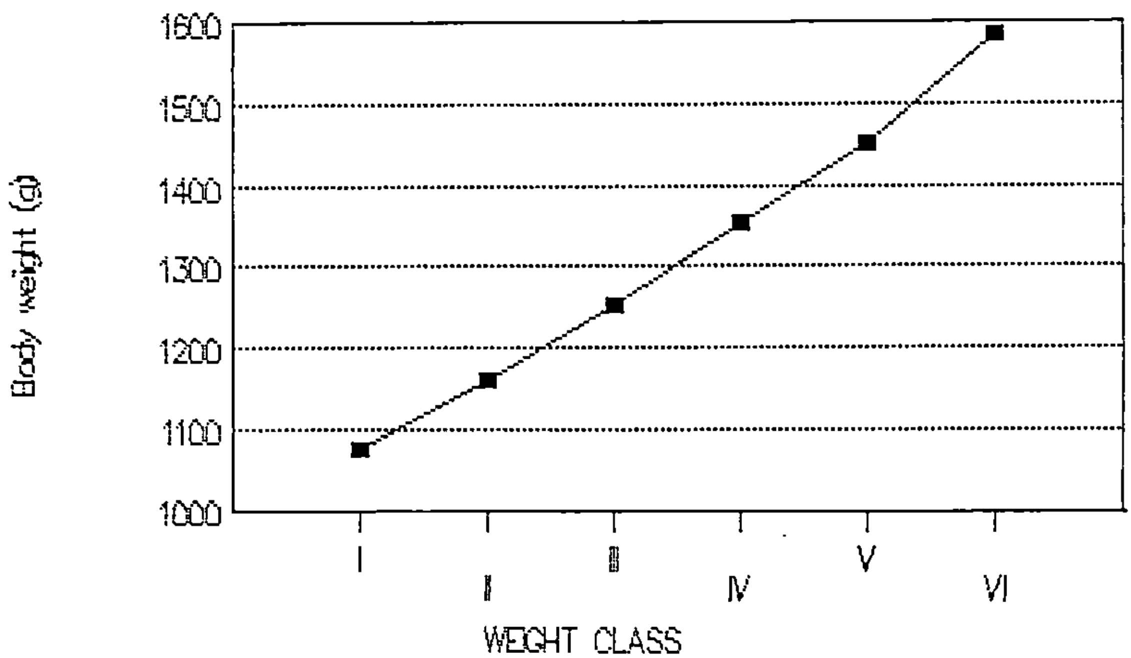


Fig.IV Pullet body weight – IWP strain



strain birds fell within the class IV (1301 to 1400 g). The difference between means of the extreme classes was 521.7 g in IWN strain.

IWP Strain

The trend of results in respect of mean PBW was similar to that showed by IWN strain. The mean 20 week body weights registered were 1078.4±4, 1160.1±2, 1255.2±2, 1353.2±1, 1450.1±2 and 1581.2±4 in classes I, II, III, IV, V and VI respectively. The magnitude of difference between mean body weights were 81.7, 95.1, 98.0, 96.9 and 131.1 g respectively. The overall mean body weight in IWP strain was 1335.2±3.5 g which fell in the weight class IV (1301 to 1400 g). The difference between the mean body weights of the extreme classes was 502.8 g in IWP strain.

Body weight at 40 weeks

The mean body weight at 40 weeks of age in different weight classes of IWN and IWP strains are presented in Table 3 and represented in Figs V and VI. Statistical analysis of data revealed that the mean body weight in different classes were significantly different among each other both in IWN and IWP strains ($P<0.05$). The results also revealed that the magnitude of differences in mean body weight between classes at 40 weeks were not similar to that observed at the age of 20 weeks.

IWN strain

The mean body weight in class I was 1396.5±19 g and in class II 1467.9±8 g. In classes III, IV, V and VI, the mean body weights were 1502.7±10, 1540.3±9, 1617.8±10 and 1720.4±36 g, respectively. The differences between mean body weights were 71.4, 34.8, 37.6, 77.5 and 102.6 g, respectively between two successive weight classes.

IWP strain

The mean body weights at 40 weeks of age were 1425.9±29, 1461.2±10, 1517.6±8, 1564.5±8, 1621.6±10 and 1740.2±15 g in classes I, II, III, IV, V and VI, respectively. The differences in mean body weights between successive classes from I to VI were 35.3, 56.4, 46.9, 57.1 and 118.6 g, respectively.

Body weight gain

IWN strain

Results revealed that there was an average increase of 341.7 g in body weight during 20 to 40 weeks of age in class I (Tables 2 and 3). In class II the gain in body weight was 305.7 g. In classes III, IV, V and VI, the gains in weight were 246.6, 189.7, 167.8 and 143.9 g, respectively. This showed that the rate of weight gain in different body weight classes were not uniform. Higher weight gain was observed in lower body weight classes and lower weight gain in higher body weight classes.

Table 3. Mean body weight (g) at 40 weeks of age in different body weight classes in two strains of White Leghorn (Mean ±SE).

Weight classes	Body weight 40 weeks (g)	
	IWN strain	IWP strain
I	1396.5±19[a]	1425.9±29[a]
II	1467.9±8[b]	1461.2±10[b]
III	1502.7±10[c]	1517.6±8[c]
IV	1540.3±9[d]	1564.5±8[d]
V	1617.8±10[e]	1621.6±10[e]
VI	1720.4±36[f]	1740.2±15[f]
Overall Mean	1533.3±5	1562.6±5

Means bearing same superscript within a strain do not differ significantly ($P < 0.05$)

Fig.V Body weight at 40 weeks of age

IWN strain

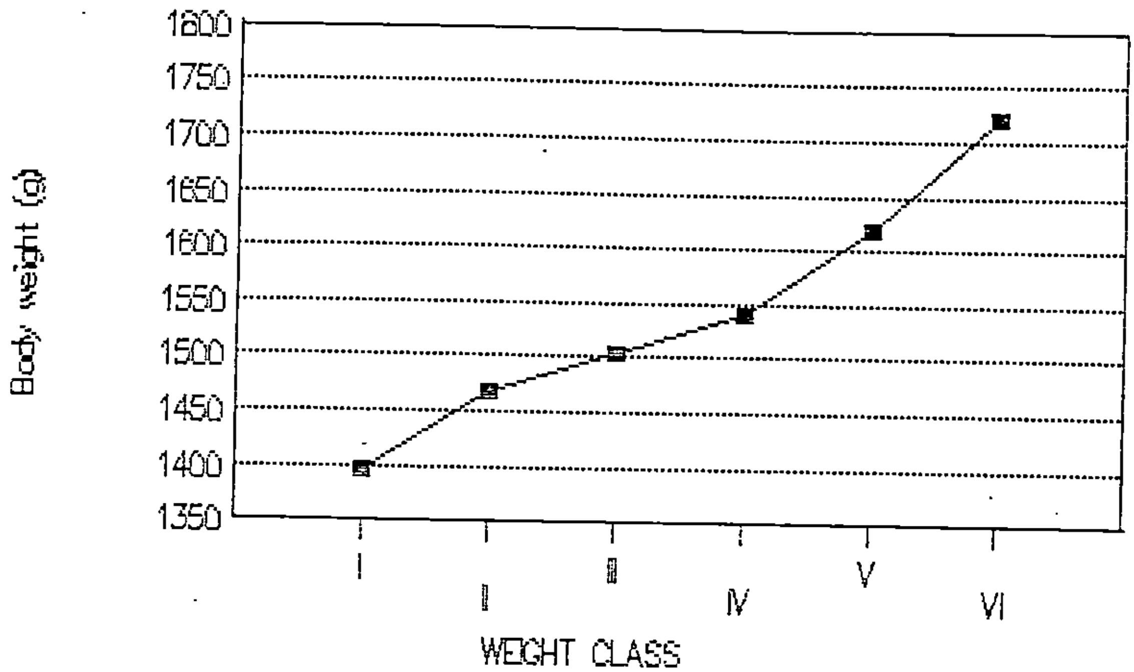
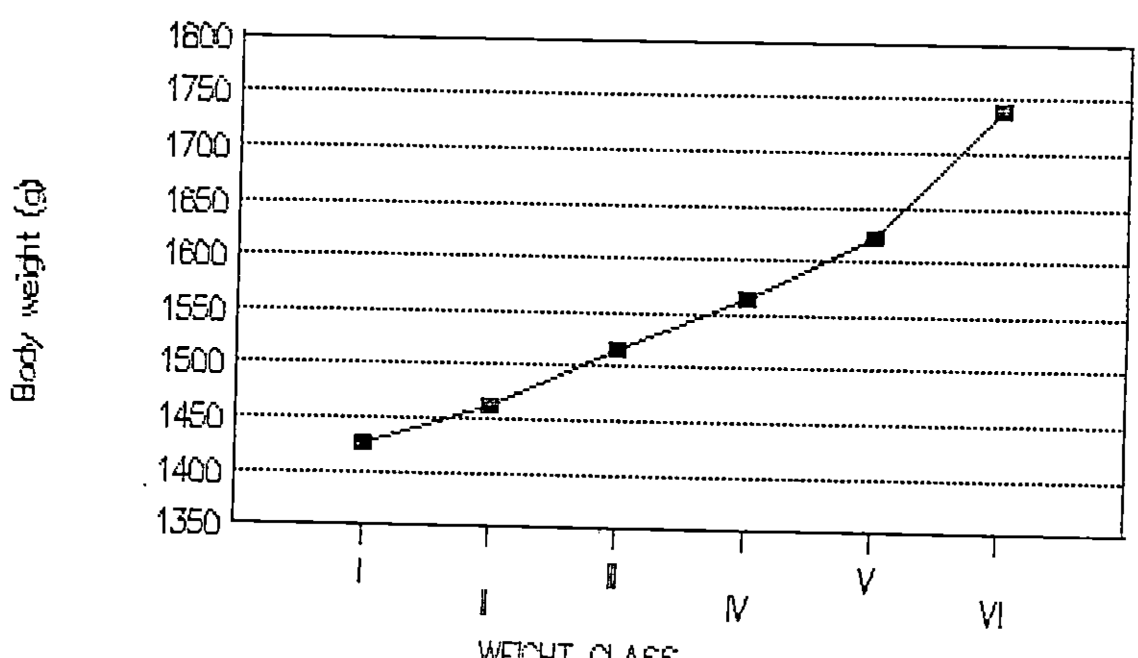


Fig.VI Body weight at 40 weeks of age

IWP strain



IWP strain

The mean weight gain during 20 to 40 weeks of age were 347.5, 301.1, 262.4, 211.3, 171.5 and 159.0g in classes I, II, III, IV, V and VI respectively (Tables 2 and 3). In IWP strain also higher weight gain was recorded in lower body weight classes and lower weight gain in higher body weight classes.

Age at first egg

The mean age at first egg (days) in different weight classes in IWN and IWP strains are presented in Table 4 and represented graphically in Figures VII and VIII. Statistical analysis of data revealed that age at first egg was significantly influenced by differences in body weight in IWN and IWP strains ($P<0.05$).

IWN strain

The mean age at first egg in birds of class I was 163.5±1 days. As the body weight increased, the mean age at first egg decreased and the mean values were 161.1±0.6, 154.5±0.5, 150.2±0.5, 147.8±0.6 and 146.2±0.9 days in body weight classes II, III, IV, V and VI respectively.

The differences in age at first egg between classes were statistically significant ($P < 0.05$). The birds in class VI matured early with a mean value of 146.2±0.9 days.

It was comparable with that of class V wherein the mean was 147.8±0.6 days. Both these values were significantly lower than those in other groups. The age at first egg in classes III and IV differed significantly (154.5±0.5 Vs 150.2±0.5). The mean age at first egg in birds of class I (163.5±1) and II (161.1±0.6) were statistically similar. The overall mean age at first egg in IWN strain was 153.4±0.3 days. The age at first egg in different weight classes ranged from 146.2±0.9 to 163.5±1 days with a variation of 17.3 days between the highest and lowest body weight classes.

IWP strain

The mean value of age at first egg in IWP strain were 164.1±3.0, 157.1±1.0, 152.3±0.7, 146.1±0.6, 143.9±0.5 and 141.4±0.7 days for body weight classes I, II, III, IV, V and VI respectively. The sexual maturity was early in birds with higher body weight.

The overall mean value of age at first egg were 148.7±0.4 days. The age at first egg ranged from 141.4±0.7 to 164.1±3.0 days with a difference of 22.7 days between the lowest and highest body weight classes. The differences in age at first egg between classes was not uniform. No significant ($P < 0.05$) difference was observed between classes V and VI. All other classes differed from each other

Table 4. Mean age at first egg (days) in different body weight classes in two strains of White Leghorn. (Mean ±SE)

Weight classes	Age at first egg (Days)	
	IWN strain	IWP strain
I	163.5±1.0[a]	164.1±3.0[a]
II	161.1±0.6[a]	157.1±1.0[b]
III	154.5±0.5[b]	152.3±0.7[c]
IV	150.2±0.5[c]	146.1±0.6[d]
V	147.8±0.6[d]	143.9±0.5[e]
VI	146.2±0.9[d]	141.4±0.7[e]
Overall Mean	153.4±0.3	148.7±0.4

Means bearing same superscript within a strain do not differ significantly ($P < 0.05$)

Fig.VII Age at sexual maturity – IWN strain

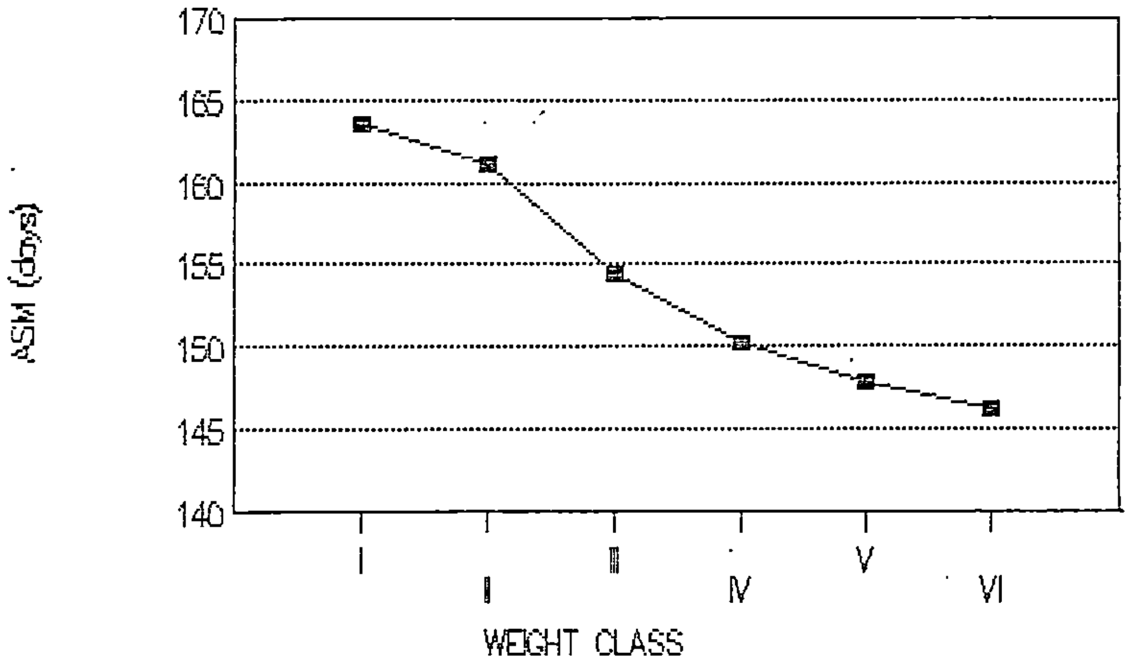
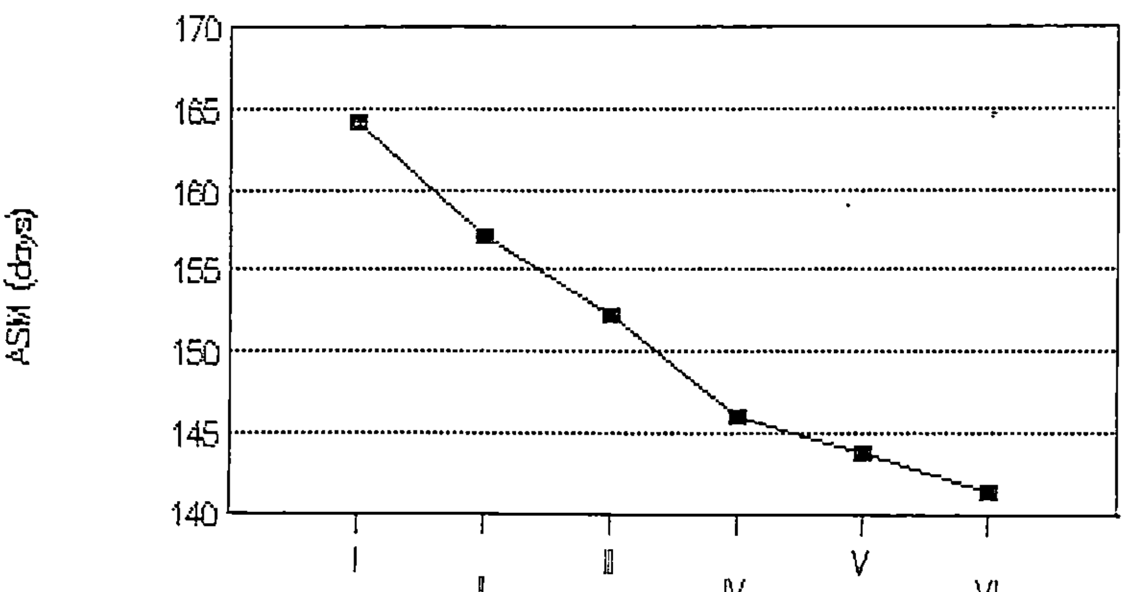


Fig.VIII Age at sexual maturity – IWP strain



significantly and mean values were higher than those in classes V and VI.

Egg Production

Hen housed number and per cent

IWN strain

The egg production up to 40 weeks of age in various body weight classes in IWN strain are presented in Table 5 and graphically represented in Fig. IX (a). The weekly hen housed per cent is depicted in Table 6 and illustrated graphically in Fig. IX (b).

The hen housed number recorded in weight classses I and II were 79.9 and 83.5 respectively and were statistically similar. The corresponding hen housed percentages were 57.1 and 59.6. For body weight classes III, IV, V and VI, egg production started at 19 weeks of age. The peak production of 76.3, 80.7, 81.8 and 80.5 per cent was observed for classes III, IV, V and VI at 26, 26, 25 and 27 weeks of age, respectively.

In body weight classes III and IV the hen housed number was 88.8 and 93.8 respectively (63.4 and 67.1 per cent). These values were significantly different between each other but were lower than those of classes V and VI. The mean egg production was 98.8 and 100.5 in class V and VI

Table 5. Hen housed number and per cent upto 40 weeks of age in different body weight classes in two strains of White Leghorn.

Weight classes	IWN strain		IWP strain	
	Egg No.	Per cent	Egg No.	Per cent
I	79.9^{a}	57.1	72.7^{a}	51.9
II	83.5^{a}	59.6	87.5^{b}	62.5
III	88.8^{b}	63.4	91.8^{c}	65.6
IV	93.8^{c}	67.1	97.0^{d}	69.3
V	98.8^{c}	70.5	99.3^{d}	70.9
VI	100.5^{c}	71.8	97.0^{d}	69.3
Overall Mean	91.1	65.1	94.2	67.3

Means bearing same superscript within a strain do not differ significantly ($P < 0.05$)

Fig. IXa Egg number upto 40 weeks of age – IWN strain

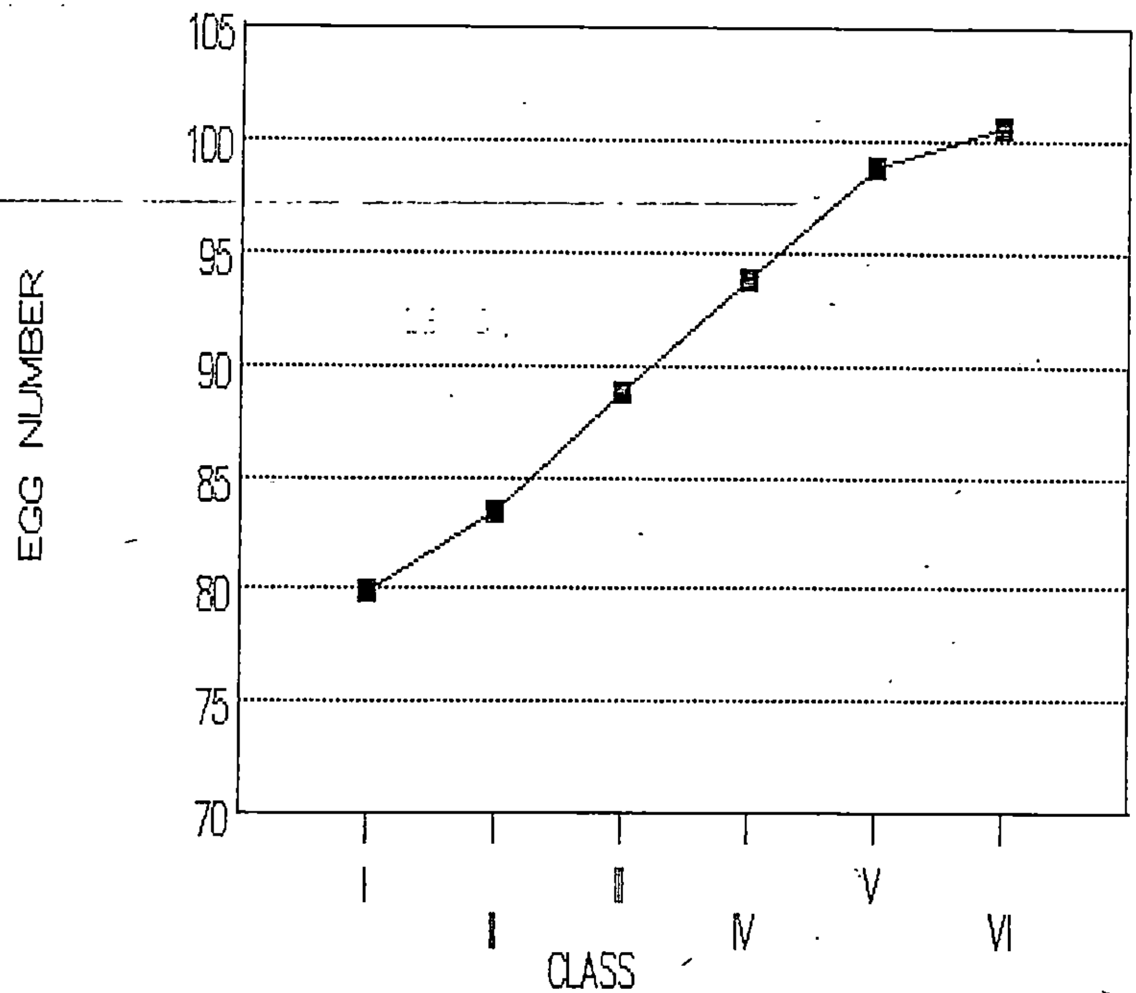
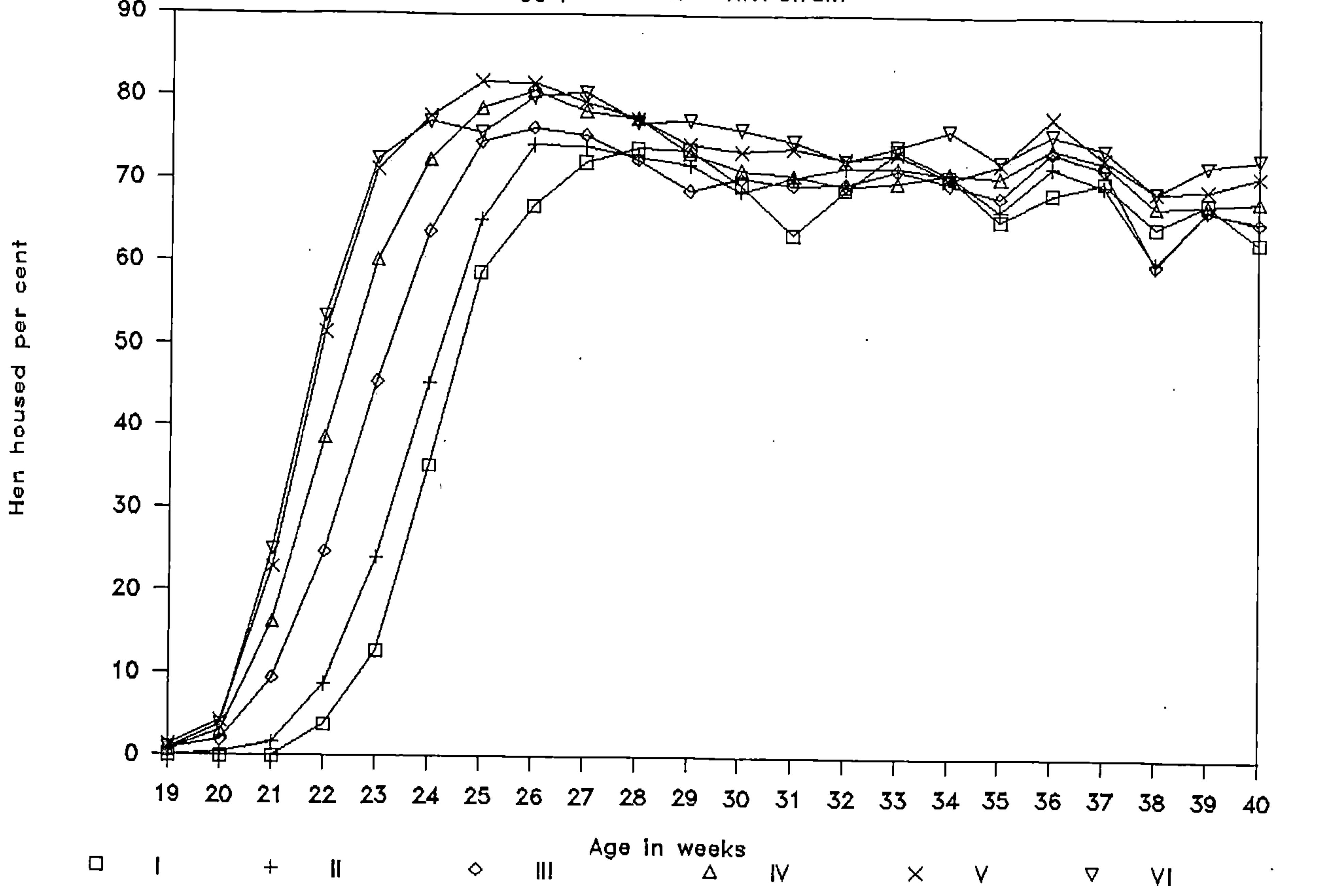


Table 6. Weekly hen housed per cent egg production up to 40 weeks of age in different body weight classes in IWN strain of White Leghorn

Group	Pullet body weight classes (g)	Age in weeks																					
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
I	1000-1100	0	0	0	3.80	12.7	35.3	58.8	66.9	72.2	73.9	73.7	69.5	63.5	69.0	73.7	70.7	65.4	68.6	70.1	64.6	67.5	62.8
II	1101-1200	0.1	0.4	1.6	8.7	24.1	45.3	65.2	74.2	74.0	72.9	71.9	68.7	70.5	71.6	71.6	70.8	66.5	71.8	69.6	60.3	66.7	65.4
III	1201-1300	0.9	1.9	9.4	24.8	45.5	63.7	74.6	76.3	75.5	72.5	68.8	70.3	69.5	69.6	71.4	69.8	68.2	73.6	71.7	60.0	66.7	65.2
IV	1301-1400	0.7	3.0	16.2	38.7	60.2	72.4	78.6	80.7	78.3	77.5	73.3	71.3	70.7	69.4	69.9	70.9	70.6	74.0	72.4	67.1	67.4	67.8
V	1401-1500	1.3	4.2	22.9	51.4	71.2	77.6	81.8	81.6	79.4	77.4	74.4	73.5	73.9	72.6	73.3	70.3	72.1	77.7	72.9	68.9	69.1	70.8
VI	Above 1500	0.9	3.7	25.1	53.4	72.5	77.0	75.7	80.0	80.5	77.0	77.2	76.1	74.8	72.5	74.2	76.1	72.5	75.7	74.0	68.8	72.0	72.9

Fig.IX(b) Weekly Hen housed per cent

egg production – IWN strain



respectively (70.5 and 71.8 per cent). The difference between these two classes was statistically non significant. However classes V and VI had significantly higher egg production than all other classes. Birds in classes III and IV showed intermediate level of production.

The results indicated that egg production was lower in birds with pullet body weight less than 1200 g in IWN strain. The data pertaining to egg production revealed that for every 100 g increase in class interval, the increase in mean egg production was 3.6, 5.3, 5.0, 5.0 and 1.7 in classes II, III, IV, V and VI respectively. The quantum of increase in egg production was not uniform among the classes. It was higher in body weight classes III, IV and V. The overall mean egg number up to 40 weeks of age was 91.1 and per cent production was 65.1.

IWP strain

The data on hen housed egg number and per cent are presented in Table 5 and represented graphically in Fig. X (a). The weekly hen housed per cent egg production is depicted in Table 7 and illustrated in Fig. x (b).

The mean egg number in class I, II and III were 72.7, 87.5 and 91.8 eggs respectively and corresponding percentages were 51.9, 62.5 and 65.6. For classes I, II and

Fig. Xa Egg number upto 40 weeks of age - IWP strain

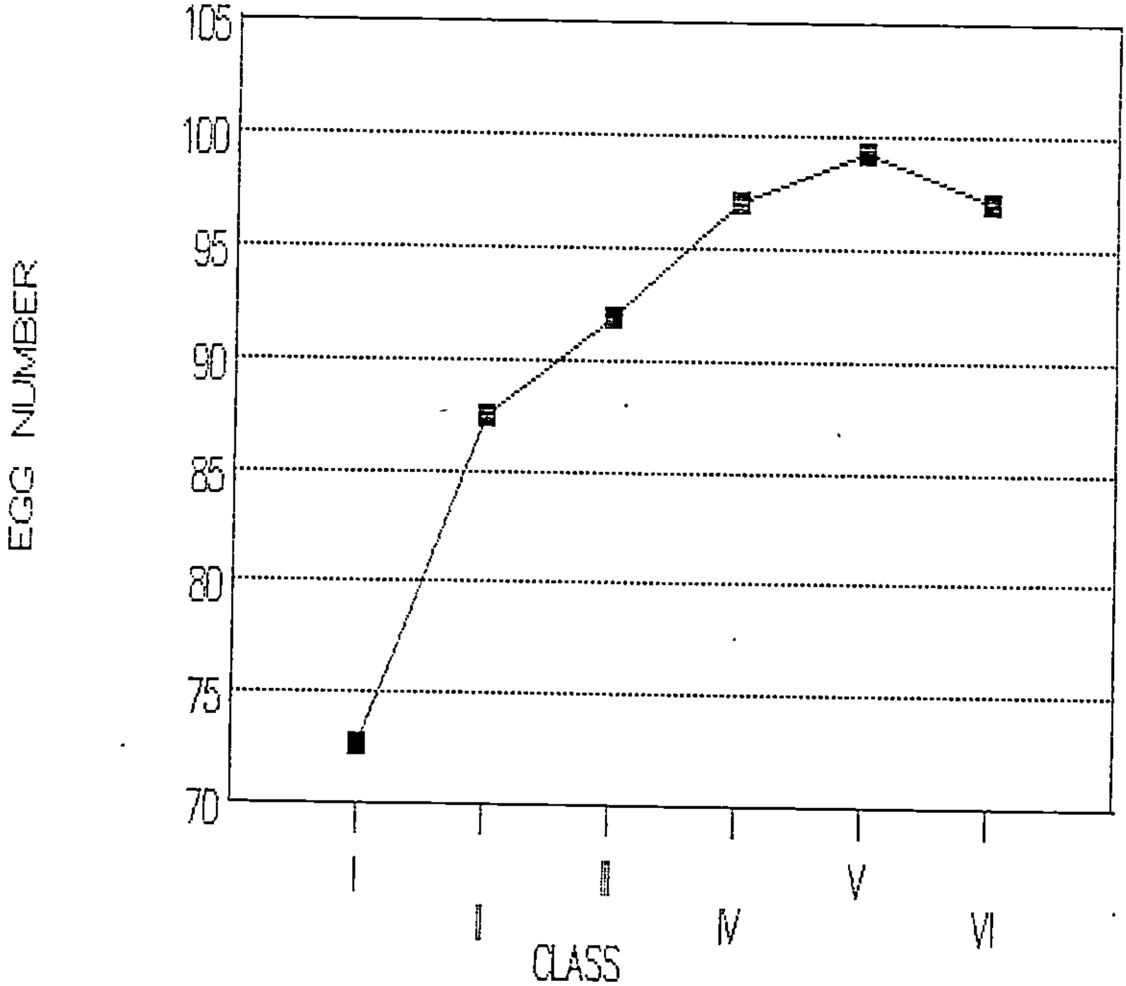


Table 7. Weekly hen housed per cent egg production up to 40 weeks of age in different body weight classes in IWP strain of White Leghorn

Group	Pullet body weight classes (g)	Age in weeks																					
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
I	1000-1100	1.2	1.9	1.9	6.9	20.0	36.2	43.2	60.2	62.1	62.1	67.1	64.4	71.8	65.2	61.3	61.3	59.0	59.0	56.7	56.7	61.7	58.3
II	1101-1200	1.6	3.3	7.1	18.4	34.3	55.4	60.4	72.7	74.8	77.3	76.0	75.4	75.7	73.0	69.1	68.7	68.2	69.9	63.9	66.4	65.8	70.6
III	1201-1300	3.9	6.2	18.2	34.7	50.6	63.3	68.9	77.9	75.7	74.6	74.2	75.4	73.0	73.0	68.9	70.4	71.2	69.7	65.8	67.6	67.7	68.2
IV	1301-1400	5.2	10.3	33.7	54.9	66.9	74.1	70.9	77.5	75.3	74.6	74.2	75.2	74.4	71.1	71.0	74.3	73.1	71.9	69.3	67.9	67.8	67.3
V	1401-1500	3.1	9.0	38.9	64.6	74.7	77.8	73.0	79.1	76.5	75.9	77.9	78.9	75.4	72.6	72.2	71.6	72.5	68.8	69.8	68.3	67.0	66.3
VI	Above 1500	3.9	11.7	51.5	74.9	73.3	74.7	68.9	73.7	74.4	70.9	71.6	71.8	68.2	68.6	70.4	73.2	70.3	66.9	66.9	67.3	66.1	67.3

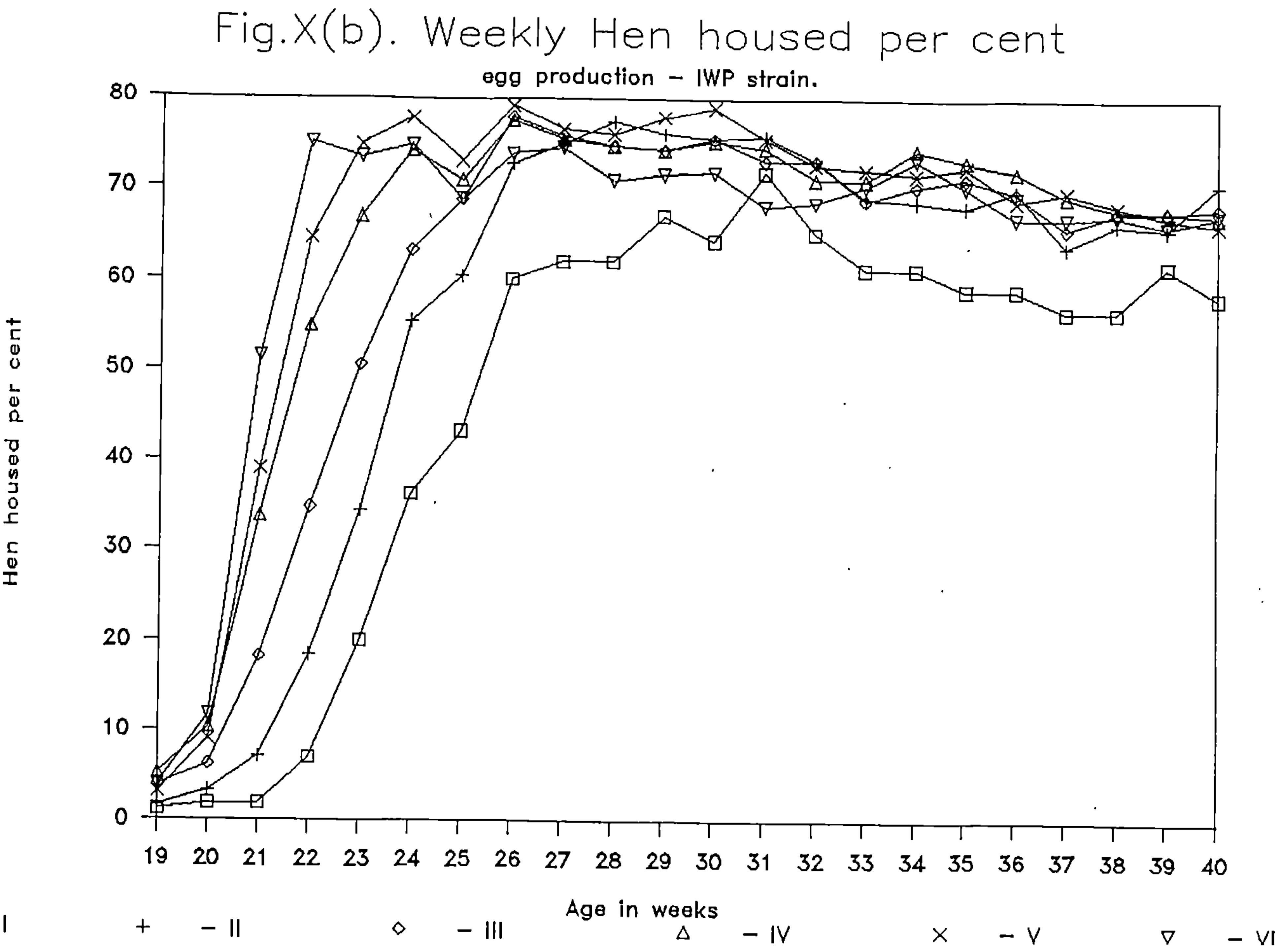


Fig.X(b). Weekly Hen housed per cent
egg production - IWP strain.
Hen housed per cent
0
10
20
30
40
50
60
70
80
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
Age in weeks
I
+ - II
◇ - III
△ - IV
× - V
▽ - VI

III, the peak production were 71.8, 77.3 and 77.9 per cent and were obtained at 31, 28 and 26 weeks of age respectively.

The mean egg number in classes IV, V and VI were 97.0, 99.3 and 97.0 eggs, respectively and the corresponding percentages were 69.3, 70.9 and 69.3. These mean values were statistically non-significant. In classes IV, V and VI, peak production of 77.5, 79.1 and 74.4 per cent were obtained at 26, 26 and 27 weeks of age respectively. These egg numbers were superior when compared to classes I, II and III. Thus birds weighing more than 1300 g formed a similar group with higher egg production.

The results revealed that for every 100 g increase in class interval the increase in egg number was not uniform and values were 4.8, 4.3, 5.2, 2.3 and 2.3 between two successive classes. The increase in egg number was high in weight class IV when compared to class III. The over all mean egg number up to 40 weeks of age was 94.2 eggs i.e. 67.3 per cent.

Egg Weight

Egg weight at 32 weeks of age

Mean egg weight recorded at 32 weeks of age in different weight classes of IWN and IWP strains are presented in Table 8. The graphical representation of egg weight pattern is given in Fig. XI and XII.

IWN strain

Results revealed that mean egg weight at 32 weeks of age was not significantly influenced by any of the body weight classes. The lowest mean egg weight of 51.5±0.3 g was recorded in class I and the highest mean egg weight of 52.1±0.3 g in class VI. In classes II, III, IV and V the mean egg weights were 51.9±0.2, 51.8±0.2, 51.8±0.2 and 51.9±0.2 g respectively. The overall mean egg weight at 32 weeks of age was 51.8±0.1 g.

IWP Strain

Egg weight at 32 week of age in IWP strain showed difference among certain classes in contrast to IWN strain (Table 8).

The lowest egg weight of 49.4±0.5 g was recorded in class I. It was comparable with the mean values of 50.1±0.2 g recorded in class II and 50.4±0.2 g recorded in class IV. The egg weight in birds of class III was significantly higher than that of class I but was comparable with classes II and IV. Thus classes II, III and IV formed a similar group. The mean egg weights in classes V and VI were 50.9±0.2 and 51.5±0.3 g respectively.

Table 8. Mean egg weight (g) at 32 weeks of age in different body weight classes in two strains of White Leghorn (Mean ±SE).

Weight classes	Egg weight at 32 weeks (g)	
	IWN strain	IWP strain
I	51.5±0.3[a]	49.4±0.5[a]
II	51.9±0.2[a]	50.1±0.2[ab]
III	51.8±0.2[a]	50.6±0.2[bc]
IV	51.8±0.2[a]	50.4±0.2[ab]
V	51.9±0.2[a]	50.9±0.2[cd]
VI	52.1±0.3[a]	51.5±0.3[d]
Overall mean	51.8±0.1	50.6±0.1

Means bearing same superscript within a strain do not differ significantly ($P < 0.05$)

However the egg weight in class VI was significantly higher than those in other classes except class V. The highest egg weight was recorded in class VI. The overall mean egg weight in IWP strain was 50.6±0.1 g.

Egg weight at 40 weeks of age

The mean egg weights at 40 weeks of age in different body weight classes are presented in Table 9 and represented graphically in Fig. XI and XII. Statistical analysis of data revealed that different body weight classes significantly influenced the egg weight at 40 week of age in both IWN and IWP strains.

IWN strain

The lowest mean egg weight of 52.3±0.3 was recorded in class I. The mean values of egg weight in classes II and III were 52.7±0.2 and 52.8±0.2 g respectively. The egg weight in the first three classes were statisticaly comparable among each other. The mean egg weight of classes IV, V and VI were 53.4±0.2, 53.3±0.2 and 53.8±0.4 g respectively and were comparable. However, these mean values were significantly higher than that observed in class I. But the egg weight in class V was statistically comparable with those of classes II and III.

Table 9. Mean egg weight (g) at 40 weeks of age in different body weight classes in two strains of White Leghorn (Mean ±SE).

Weight classes	Egg weight at 40 weeks (g)	
	IWN strain	IWP strain
I	52.3 ± 0.3^{a}	50.7 ± 0.6^{a}
II	52.7 ± 0.2^{ab}	51.5 ± 0.3^{a}
III	52.8 ± 0.2^{ab}	51.8 ± 0.2^{ab}
IV	53.4 ± 0.2^{c}	52.1 ± 0.2^{bc}
V	53.3 ± 0.2^{bc}	52.6 ± 0.2^{cd}
VI	53.8 ± 0.4^{c}	53.1 ± 0.3^{d}
Overall Mean	53.1 ± 0.1	52.1 ± 0.1

Means bearing same superscript within a strain do not differ significantly ($P < 0.05$)

IWP Strain

The mean egg weight in class I was the lowest with a value of 50.7±0.6 g. It was comparable with the mean value recorded in class II (51.5±0.3 g) and class III (51.8±0.2 g).

The mean egg weight in classes I and II were significantly lower than all other classes except class III. Average egg weight in classes IV, V and VI were 52.1±0.2, 52.6±0.2 and 53.1±0.3 g respectively. The egg weight in class IV was comparable with class V. The egg weight in class VI differed significantly from other classes except class V. As the body weight increased the mean egg weight also showed an increasing trend. The overall mean egg weight in IWP strain was 52.1±0.1 g.

Egg weight gain

IWN Strain

Results obtained revealed that there was an increase of 0.8 g in egg weight from 32 to 40 weeks of age in class I and in class II the gain in egg weight was also 0.8 g (Tables 8 and 9). In classes III, IV, V and VI the gain in egg weights were 1.0, 1.6, 1.4 and 1.7 g respectively. This showed that the rate of egg weight gain was not uniform and higher weight gain was observed in higher body weight classes.

Fig. XI Egg weight pattern at

32 and 40 weeks of age — IWN strain

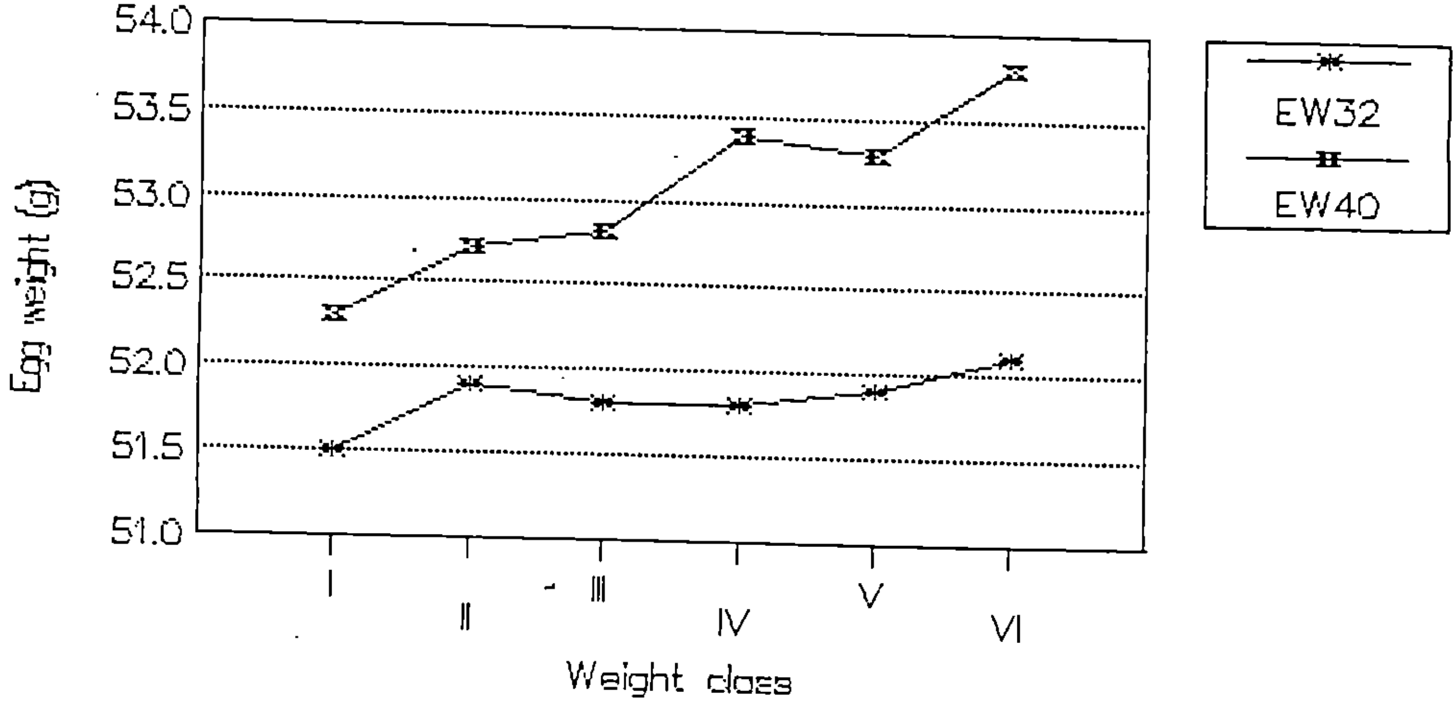
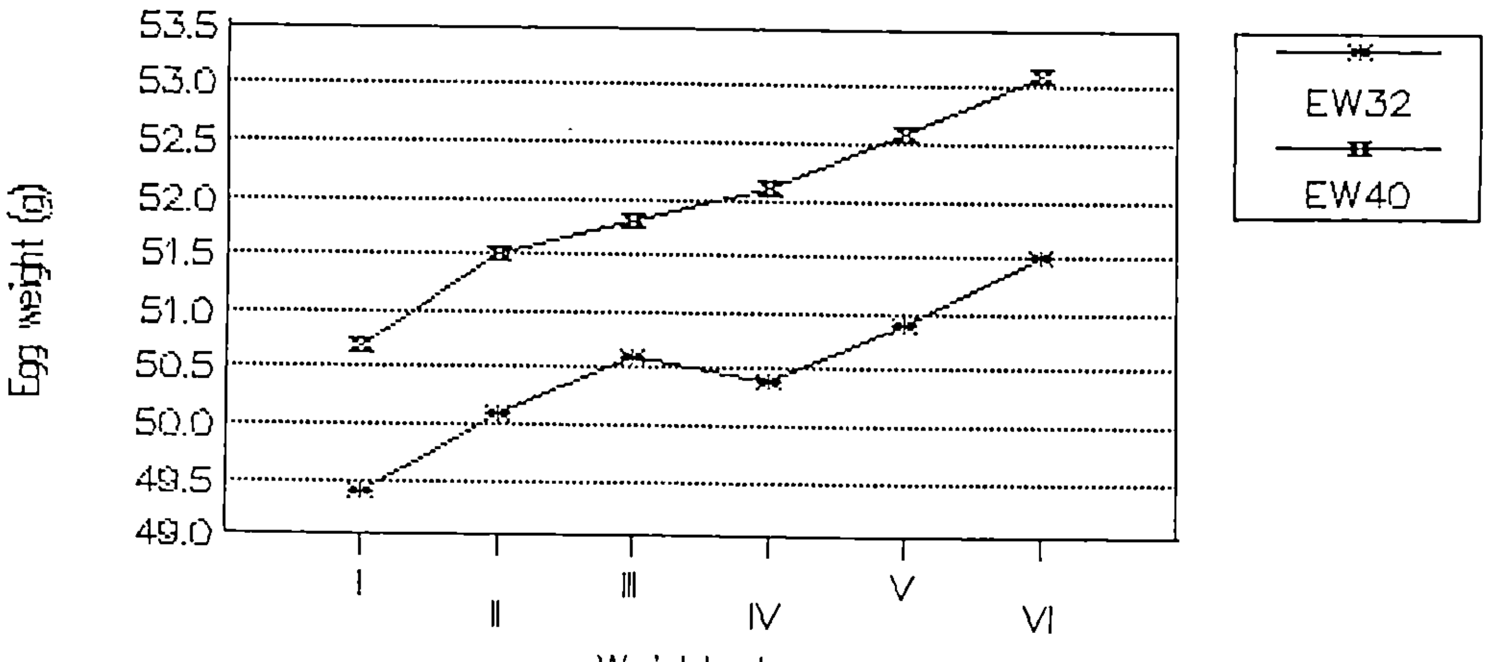


Fig. XII Egg weight pattern at

32 and 40 weeks of age — IWP strain



IWP Strain

The egg weight gain from 32 to 40 week of age were 1.3, 1.4, 1.2, 1.7, 1.7 and 1.6 g for classes I, II, III, IV, V and VI respectively (Tables 8 and 9). Lowest weight gain was recorded in class III and highest in class IV and V. In IWP strain also higher gain in egg weight was recorded in higher body weight classes.

Livability

Per cent livability from 20 to 40 weeks of age in IWN and IWP strains as influenced by different body weight classes are presented in Table 10.

IWN Strain

Livabilities recorded in IWN strain were 87.3, 92.5, 91.2, 92.9, 95.5 and 92.4 per cent respectively from classes I to VI. The lowest livability was recorded in body weight class I and the highest livability in class V. The overall mean livability upto 40 weeks of age was 92.4 per cent in IWN strain.

IWP Strain

In IWP strain the livability per cent in classes I to VI were 91.9, 91.0, 92.5, 93.9, 95.2 and 91.2 respectively. The lowest livability was recorded in class II (91.0 per

Table 10. Per cent livability from 20 to 40 weeks of age in different body weight classes in two strains of White Leghorn.

Weight classes	Livability (%)	
	IWN strain	IWP strain
I	87.3	91.9
II	92.5	91.0
III	91.2	92.5
IV	92.9	93.9
V	95.5	95.2
VI	92.4	91.2
Overall Mean	92.4	93.2

cent) and highest in class V (95.2 per cent). The overall livability upto 40 week of age was 93.2 per cent.

Egg quality parameters

The egg quality traits studied at 40 weeks of age in different body weight classes are presented in Tables 11 and 12. Statistical analysis of data revealed that there was no significant difference for different body weight classes for any of the traits studied.

IWN Strain

The shape indices of eggs were 73.2±1, 72.7±0.6, 73.1±0.9, 72.9±0.8, 72.6±1.0 and 73.3±0.7 for classes I to VI respectively and differences were not statistically significant. The albumin indices of weight classes were 0.11±0.002, 0.11±0.002, 0.12±0.002, 0.11±0.001, 0.11±0.002 and 0.12±0.002 for classes I to VI respectively. The yolk indices of different weight classes in IWN strain were 0.44±0.02, 0.44±0.02, 0.43±0.01, 0.44±0.01, 0.44±0.01 and 0.43±0.02 for classes I to VI respectively. The shell thickness obtained for different body weight classes were 0.37±0.01, 0.38±0.01, 0.38±0.01, 0.37±0.01, 0.38±0.01 and 0.38±0.02 mm for classes I to VI respectively. Haugh unit recorded for different body weight classes were 86.6±3, 86.4±2, 86.6±2, 86.8±2, 85.4±2 and 85.8±3 for body weight classes I to VI respectively.

Table 11. Egg quality traits at 40 weeks of age in IWN strain of White Leghorn in different body weight classes (Mean ±SE)

Group	Pullet body weight classes (g)	Shape index	Albumin index	Yolk index	Shell thickness (mm)	Haugh unit score
I	1000-1100	73.2±1.0^{a}	0.11±0.002^{b}	0.44±0.02^{c}	0.37±0.01^{d}	86.6±3^{e}
II	1101-1200	72.7±0.6^{a}	0.11±0.002^{b}	0.44±0.02^{c}	0.38±0.01^{d}	86.4±2^{e}
III	1201-1300	73.1±0.9^{a}	0.12±0.001^{b}	0.43±0.01^{c}	0.38±0.01^{d}	86.6±2^{e}
IV	1301-1400	72.9±0.8^{a}	0.11±0.001^{b}	0.44±0.01^{c}	0.37±0.01^{d}	86.8±2^{e}
V	1401-1500	72.6±1.0^{a}	0.11±0.002^{b}	0.44±0.01^{c}	0.38±0.01^{d}	85.4±2^{e}
VI	Above 1500	73.3±0.7^{a}	0.12±0.002^{b}	0.43±0.02^{c}	0.38±0.02^{d}	85.8±3^{e}

Means bearing same superscript with in a trait do not differ significantly ($P<0.05$)

IWP Strain

The shape indices of eggs were 73.6 ± 1, 73.2 ± 0.7, 73.1 ± 0.7, 74.1 ± 0.8, 74.0 ± 0.9 and 73.3 ± 1 for classes 1 to 6 respectively and the differences were statistically non significant. The albumin indices for weight classes I to VI were 0.10 ± 0.002, 0.11 ± 0.002, 0.11 ± 0.001, 0.11 ± 0.001, 0.10 ± 0.002 and 0.12 ± 0.002 respectively. The yolk indices of eggs obtained were 0.47 ± 0.02, 0.46 ± 0.02, 0.46 ± 0.02, 0.48 ± 0.01, 0.47 ± 0.01, 0.46 ± 0.02 for classes I to VI respectively. The shell thickness were 0.38 ± 0.02, 0.38 ± 0.02, 0.37 ± 0.02, 0.37 ± 0.01, 0.39 ± 0.01 and 0.39 ± 0.02 mm for classes I to VI respectively and there was no significant difference among different body weight classes. The haugh unit recorded for different body weight classes were 86.2 ± 3, 86.4 ± 2, 86.0 ± 2, 86.4 ± 2, 85.7 ± 2 and 84.8 ± 3 for body weight classes I to VI respectively.

Meteorological observations

The data pertaining to micro climate inside the experimental house in respect of ambient temperature and relative humidity recorded during the experimental period are presented in Table 13. The mean minimum temperature inside the experimental house varied from 26.0°C to 26.8°C and the mean maximum temperature from 30.2°C to 34.0°C. The lowest per cent relative humidity recorded was 65 and the highest was 78.

Table 12. Egg quality traits at 40 weeks of age in IWP strain of White Leghorn in different body weight classes (Mean ±SE)

Group	Pullet body weight classes (g)	Shape index	Albumin index	Yolk index	Shell thickness(mm)	Haugh unit score
I	1000-1100	73.6±1 ^{a}	0.10±0.002 ^{b}	0.47±0.02 ^{c}	0.38±0.02 ^{d}	86.2±3 ^{e}
II	1101-1200	73.2±0.7 ^{a}	0.11±0.002 ^{b}	0.46±0.02 ^{c}	0.38±0.02 ^{d}	86.4±2 ^{e}
III	1201-1300	73.1±0.7 ^{a}	0.11±0.001 ^{b}	0.46±0.01 ^{c}	0.37±0.02 ^{d}	86.0±2 ^{e}
IV	1301-1400	74.1±0.8 ^{a}	0.11±0.001 ^{b}	0.48±0.01 ^{c}	0.37±0.01 ^{d}	86.4±2 ^{e}
V	1401-1500	74.0±0.9 ^{a}	0.1±0.002 ^{b}	0.47±0.01 ^{c}	0.39±0.01 ^{d}	85.7±2 ^{e}
VI	Above 1500	73.3±1 ^{a}	0.12±0.002 ^{b}	0.46±0.02 ^{c}	0.39±0.02 ^{d}	84.8±3 ^{e}

Mean bearing same superscript with in a trait do not differ significantly ($P < 0.05$)

Table 13. Mean values of meteorological observations inside the experimental house

Period	Temperature (C°)		Per cent Relative humidity.
	Minimum	Maxmimum	
July	26.2	30.4	65
August	26.8	30.4	72
September	26.4	32.4	73
October	26.6	33.8	78
November	26.6	34.0	68
December	26.0	34.0	65

Overall performance

IWN Strain

The summary of production performance from 20 to 40 weeks of age in different body weight classes are presented in Table 14. The mean pullet body weight ranged from 1054.8 ± 14 g to 1576.5±6 g for body weight classess I to VI. The overall mean pullet body weight was 1304.7 ± 4 g. The mean 40 week body weight ranged from 1396.5±19 g to 1720.4±36 g for body weight classes I to VI and the overall mean 40 week body weight was 1533.3±5 g. The mean age at first egg ranged from 163.5±1 to 146.2±0.9 days and overall mean age at first egg was 153.4±0.3 days. Egg number varied from 79.9 to 100.5 for body weight classes I to VI. The mean 32 week egg weight ranged from 51.5±0.3 to 52.1±0.3 g. The overall mean 32 week egg weight was 51.8 ±0.1 g.

The egg weight at 40 weeks of age ranged from 52.3 ±0.3 to 53.8±0.4 for classes I to VI and the overall mean was 53.1±0.1 g. Livability per cent ranged from 87.3 to 95.5. The lowest livability per cent was observed for class I (87.3 %) and the highest for class V (95.5 %). Egg quality parameters were similar in different body weight classes.

Table 14. Summary of production performance from 20 to 40 weeks of age in different body weight classes in IWN strain of White Leghorn (Mean ± SE)

Group	Pullet body weight classes	Mean 20 week body weight(g)	Mean 40 week body weight(g)	Average age at first egg(days)	Hen housed egg number	Egg weight at 32 weeks(g)	Egg weight at 40 weeks(g)	Liva-bility (%)
I	1000-1100	1054.8±14	1396.5±19	163.5±1.0	79.9	51.5±0.3	52.3±0.3	87.3
II	1101-1200	1162.2±2	1467.9±8	161.1±0.6	83.5	51.9±0.2	52.7±0.2	92.5
III	1201-1300	1256.1±2	1502.7±10	154.5±0.5	88.8	51.8±0.2	52.8±0.2	91.2
IV	1301-1400	1350.6±2	1540.3±9	150.2±0.5	93.8	51.8±0.2	53.4±0.2	92.9
V	1401-1500	1450.0±2	1617.8±10	147.8±0.6	98.8	51.9±0.2	53.3±0.2	95.5
VI	Above 1500	1576.5±6	1720.4±36	146.2±0.9	100.5	52.1±0.3	53.8±0.4	92.4
Overall mean		1304.7±4	1533.3±5	153.4±0.3	91.1	51.8±0.1	53.1±0.1	92.4

IWP Strain

The summary of production performance from 20 to 40 weeks of age in different body weight classes are presented in Table 15.

The mean pullet body weight ranged from 1078.4±4 to 1581.2±4 g for weight classes I to VI. The overall mean pullet body weight was 1335.2±3.5 g. The mean 40 week body weight ranged from 1425.9± 29 to 1740.2±15 g for classes I to VI and overall mean 40 week body weight was 1562.6 ± 5 g. The average age at first egg ranged from 164.1 ± 3 to 141.4 ±0.7 days for weight classes I to VI and overall mean age at first egg was 148.7±0.4 days. [illegible]gg number varied from 72.7 to 99.3 for weight classes I to V and the egg number for weight class VI was 97.0. The overall mean egg number was 94.2. The mean 32 week egg weight ranged from 49.4 g to 51.5 g for weight classes I to VI and the overall mean was 50.6±0.1 g. [illegible]gg weight at 40 weeks of age ranged from 50.7±0.6 to 53.1±0.3 g for weight classes I to VI and overall mean 40 week egg weight was 52.1±0.1 g. The livability ranged from 91.0 to 95.2 per cent. Lowest livability was observed for class II and highest for class V. In IWP strain also the egg quality parameters were similar in different body weight classes.

Table 15. Summary of production performance from 20 to 40 weeks of age in different body weight classes in IWP strain of White Leghorn (Mean ±SE).

Group	Pullet body weight classes	Mean 20 week body weight(g)	Mean 40 week body weight(g)	Average age at first egg(days)	Hen housed egg number	Egg weight at 32 weeks (g)	Egg weight at 40 weeks (g)	Livability (%)
I	1000-1100	1078.4±4	1425.9±29	164.1±3.0	72.7	49.4±0.5	50.7±0.6	91.9
II	1101-1200	1160.1±2	1461.2±10	157.1±1.0	87.5	50.1±0.2	51.5±0.3	91.0
III	1201-1300	1255.2±2	1517.6±8	152.3±0.7	91.8	50.6±0.2	51.8±0.2	92.5
IV	1301-1400	1353.2±1	1564.5±8	146.1±0.6	97.0	50.4±0.2	52.1±0.2	93.9
V	1401-1500	1450.1±2	1621.6±10	143.9±0.5	99.3	50.9±0.2	52.6±0.2	95.2
VI	Above 1500	1581.2±4	1740.2±15	141.4±0.7	97.0	51.5±0.3	53.1±0.3	91.2
Overall mean		1335.2±3.5	1562.6±0.5	148.7±0.4	94.2	50.6±0.1	52.1±0.1	93.2

Discussion

DISCUSSION

Variation in pullet body weight

The mean pullet body weight (PBW) of 1304.7±4 g with a coefficient of variation 10.1 per cent revealed considerable amount of variation for this trait in IWN strain. The frequency distribution of body weight (Table 1) indicated a near normal distribution for this trait (Fig. 1). The results also revealed that 55.17 per cent i.e. more than half of birds in IWN strain was constituted by the two weight classes III and IV, ranging from 1201 to 1400 g. The overall mean body weight also fell within this range.

In IWP strain, PBW averaged 1335.2±3.5 g with a coefficient of variation 9.5 per cent which indicated considerable amount of variation for this trait. The frequency distribution also tended towards normality (Fig. II). The two weight classes III and IV ranging from 1201 to 1400 g amounted to 56.19 per cent of total birds. The overall mean PBW also fell in this range.

Johari et al. (1977) also observed similar distribution in the mid way classes in White Leghorn pullets. This is in agreement with the results of the present study.

Pullet body weight

The class means registered an increasing trend from the lower to higher weight class as expected (Table 2 and Fig. III). Their mean values were close to the mid value of each class except class VI in IWN strain which indicated a fair distribution among the class members. In class VI, all the birds above 1500 g were included and this might have caused a shift in the mean value. The standard error estimates from classes II to V were low compared to classes I and VI which was also indicative of a lower variation within the former classes.

In IWP strain also the class means showed a linear trend from class I to VI (Table 2 and Fig. IV). The mean values were close to mid value in all the classes except I and VI. In these classes, mean values were higher than the respective mid values indicating the presence of more number of heavy birds. Therefore a proportionate increase in PBW could be expected when the birds are classified based on this trait.

Body weight at 40 weeks

The mean body weight at 40 weeks of age in IWN and IWP strain (Table 3 and Fig. V) showed a linear trend from class I to VI in both the strains. Data indicated that birds heavier at 20 weeks of age would also be heavier at 40 week of age. In IWN strain classes II to V showed variation with similar standard error associated with the mean values where as classes I and VI showed a greater amount of variation a situation similar to PBW. It could also be noticed that though birds of class V and VI were heavy even at 20 weeks of age their body weight did not increase proportionately at 40 weeks of age compared to lower weight classes.

In IWP strain, the mean 40 week body weight in different classes showed a linear trend from class II to VI (Table 3 and Fig. VI). In this strain also, class II to class V had a comparable variation among its members as indicated by a similar standard error. The large variation in class I and VI in PBW also continued to exist in 40 week body weight. The heavier PBW class continued to be heavier at 40 weeks of age. But, members of higher weight classes did not put up weight exorbitantly at 40 weeks of age.

Body weight gain

The body weight gain data revealed that the weight gain showed a declining trend from class I to class VI (Tables 2 and 3). The fact that lower body weight classes had higher weight gain than higher body weight classes indicated that a compensatory growth occured in the lower body weight birds. This is further testified by the fact that the difference in 40 week body weight of extreme classes was only 323.9 g where as the same was 521.7g in the case of PBW in IWN strain. In IWP strain corresponding figures were 314.3 g and 502.8 g respectively. These results also point to the fact that a higher pullet body weight need not necessarily lead to very high 40 week body eight in these strains. As the trend shown by both the strains are similar in this regard, it is advisable to provide optimum conditions during growing period to enable the chicks to attain higher pullet body weight.

Summers and Leeson (1983) also observed higher weight gain for the lower body weight classes. Renden et al. (1984) also observed higher weight gain from 20 to 40 weeks of age in low body weight classes and a control line. The results of the present study are in agreement with these reports.

Age at first egg

The data on mean age at first egg (Table 4) revealed the marked influence of pullet body weight on this trait. A definite declining trend in the age at sexual maturity with an increase in the average pullet body weight was observed in both the strains. The influence appeared to be stronger in IWP strain. As the ASM is instrumental in deciding the number of eggs laid by the bird up to a fixed age, any technique which can lower the ASM will be acceptable commercially. The results revealed that by selecting higher body weight classes i.e. 1200 g and above, one can significantly reduce the ASM to the tune of nine days in IWN strain and 12 days in IWP strain which may be calculated as equivalent for seven and nine eggs, respectively for IWN and IWP strains.

A similar decreasing trend in ASM was also reported by Johari et al. 1977, Singh (1982), Benoff and Renden (1983), Richter et al. (1986) and Zhuvavlev et al. (1986). But Summers and Leeson (1983) did not observe major difference in ASM in contrast to the result of the present study.

Egg production

IWN Strain

The hen housed and per cent egg production in IWN strain (Table 5 and Fig. IX (a)) revealed a considerable difference among the weight classes. A sharp ascending trend was noticed from class I to class VI. The magnitude of increase was more pronounced from class I to other classes. These results suggested that birds heavier at 20 weeks of age laid more eggs compared to lighter birds. This trend was advantageous commercially in that a well maintained flock having good pullet body weight can be expected to lay more during their production period.

The weight classes III and IV which constituted a large percentage of the population had egg number statistically higher than those of classes I and II.

Although weight class V and VI also registered higher egg production, it is likely that the feed requirement may be higher and may offset profit margin. These results suggest that selecting birds with pullet body weight more than 1200 g is likely to result in higher intensity of egg production.

The weekly hen housed per cent (HHP) in IWN strain in various classes (Table 6 and Fig. IX (b)) illustrate clearly the influence of body weight classes on the egg production pattern. The body weight classes V and VI had a distinct advantage over classes III and IV which in turn performed better than classes I and II. Birds of classes V and VI attained HPP of 70, three to four weeks earlier compared to birds of classes I and II. The lowest weight classes (1000 to 1200 g) were clearly at a disadvantage in terms of start of lay, attainment of peak production and in the intensity of lay. But the profound influence of body weight groupings was found only upto 27 weeks of age and thereafter the HHP were maintained almost similar till the end of test period. These results suggested that pullet body weight has to be optimal at 20 weeks of age to exploit this full potential of the bird. A lower body weight is of disadvantageous due to delayed sexual maturity and concomitantly lower egg production. But the fact that these birds also caught up with birds of higher body weight classes in HHP at a later age at 27 weeks indicated a high genetic potential in these birds. As the classification was based on phenotype, it is likely that birds with a genotype for higher body weight might have come under lower weight classes for want of adequate grower requirements.

IWP Strain

The influence of pullet body weight on egg number was very well indicated by the sharp increase in egg number from class I to heavier classes in IWP strain also (Table 5 and Fig.X (a)). This is of advantage to breeder/farmer in that he may keep only heavier birds at 20 weeks of age. In this strain also members of classes I and II appeared to be poor for this trait, laying less than 90 eggs. Birds weighing 1200 g or above may be considered for testing/laying performance.

The weekly HHP of IWP strain (Table 7 and Fig.X (b)) illustrated a similar pattern to that of IWN strain. The birds of classes I and II were poor both in peak and intensity similar to that of IWN strain. During the initial part of the laying period, the higher weight classes showed a distinct advantage over the lower weight classes. But this phenomenon existed only upto 26 weeks of age. Thereafter birds in classes II to VI showed a similar trend in production. It is evident from the graph that the difference in egg number among weight groups has been contributed by early laying period - the variation in the onset of laying and attainment of peak production. These factors contributed for the poor performance of members of classes I and II. Therefore these weight classes may be discarded at housing time or at 20 weeks of age. This will yield a better egg production performance in this trait.

The strains used in the present study (IWN and IWP) were maintained as parent lines and are subjected to selection for egg number. As the goal of selection programme is maximum improvement per generation, the finding of this study can be very well applied in this direction. Member of classes I and II are distinctly poor in egg number and ASM. Therefore birds below 1200 g can be discarded from the testing population at the pullet stage itself. This is likely to result in a better selection gain and simultaneous saving of feed and space.

The result of this study is in conformation with those reported by Johari _et al_. (1977), Richter _et al_. (1981), Johari _et al_. (1982), Brister (1986) and Summers and Leeson (1983). However, Bish _et al_. (1985) and Leeson and Summers (1987) did not observe significant effect of body weight grouping on egg production.

Egg weight at 32 weeks of age

The egg weight at 32 weeks set out in Table 8 depicts a totally different pattern in IWN and IWP strain. Although pullet body weights varied significantly in different weight classes, a similar significant variation could not be observed in the 32 week egg weight, which was more or less uniform in IWN strain. Although egg weight is positivelly correlated with body weight, it is surprising that PBW did not exert any influence in 32 week egg weight. A higher egg weight at this age will be an indication of higher egg weight at later ages. But as the pullet body weight doesn't show any clear influence on this trait, improving PBW is unlikely to enhance egg weight in this strain at 32 weeks of age. Though some difference were observed among weight classes in IWP strain, the difference between extreme classes was 2.1 g.

Egg weight at 40 weeks of age

The data on 40 week egg weight in IWN strain (Table 9) revealed marked difference between weight classes. Although the heavier weight classes recorded better egg weight the magnitude of differences were low (52.3 g in Class I and 53.8 g in Class VI). The data did not reflect the amount of variation exhibited by the weight classes for pullet body weight. Therefore selecting birds at 20 week of age may not result in higher flock average for this trait in this strain. In IWP strain the magnitude of variation was more profound. The weight classes I and II had the lowest egg weight. Discarding these groups may contribute to a better flock average for this trait. As the heavier weight classes had significantly higher egg weight, selecting heavier birds at 20 weeks of age may result in a higher flock average in this strain. A similar result was observed by Renden et al. (1984) and Escalente et al. (1991).

Livability

A perusal of data on livability (Table 10) revealed little difference between weight classes for this trait. It did not show a linear trend for higher weight classes. But the weight class I had the lowest livability. Therefore it may be assumed that weight classifications do not have much difference on livability pattern. A similar result was also observed by Richter et al. (1981).

Egg Quality Parameters

In IWN strain, egg quality traits (Table 11) revealed a similar shape index, albumin index, yolk index, shell thickness and Haugh unit score in all the weight classes. This indicated that weight classification did not influence egg quality traits. A similar situation was also encountered in IWP strain (Table 12). Therefore selecting birds of higher weight classes would neither deteriorate nor improve the internal egg quality traits.

Meteorological observations

The meteorological observations inside the experimental house are presented in Table 13. The mean minimum temperature was in a close range (26.0-26.8°C), whereas the maximum temperature increased from 30.4°C at the start of the experiment to 34.0°C by the end of experiment. The temperature did not show any wide fluctuation indicating a constant environment. The relative humidity which ranged from 65.0 to 78.0 per cent also did not show any wide variation. These observations rec , ded during the course of experiment were similar in trend as reported by Somanathan (1980). Therefore it can be assumed that normal environmental conditions existed during the experiment and variation in performance of birds in both IWN and IWP strains due to environment were minimum.

Overall performance

In IWN strain, birds below 1100 g PBW were consistently poor in ASM, egg number, egg weight and livability and therefore members of these weight class are of distinct disadvantage to consider either commercially or as parent stock (Table 14). Therefore, they may be excluded from the flock before testing or at the time of housing. They accounted for 5.59 per cent of the population.

Performance of second weight class (1101 to 1200 g) was also below average in most of the traits and they accounted for 16.68 per cent of the population. Their ASM (161.1±0.6 days) was well above the over all mean of 153.4±0.3 days. Egg number upto 40 weeks of age was only 83.5 compared to overall mean of 91.1 eggs. But the egg weight and livability were comparable with the next higher weight class. Considering all the aspects, it will be advantageous to exclude this class also from the testing/commercial population. This will help in attaining a better HHP for the flock. In parent stock under selection for egg number, a comparatively better response could be obtained if this practice can be followed in future generations.

In IWP strain, the weight class I amounted for 2.81 per cent of the population. This group registered a mean ASM of 164.1±0.3 days, with a mean egg number of 72.7 eggs (51.9 per cent) which is lesser by 20 eggs than the population average 94.2 eggs. The 32 and 40 week egg weights were also comparatively low. Therefore this weight class need not be considered for testing and could be excluded at the start of the test. The weight class II (1101 to 1200 g) represented 11.84 per cent of the population with a mean PBW of 1160.1±2 g. The performance with regard to ASM, egg number, egg weight and livability also fell short of the overall mean (Table 15). The performance of this group was also poorer compared to higher weight classes and therefore it is safer and of advantage to the breeder and farmer to exclude this group also from the testing and rearing population.

The results clearly indicated that classification of pullets according to PBW has shown a distinct difference between performances of different weight classes in IWN and

IWP strains. The higher body weight classes exhibited a lower age at first egg which resulted in higher egg number. But egg weight at 32 weeks of age did not differ between classes in IWN strain and 40 week egg weight also did not show wide variation. Livability was satisfactory in all classes except in class I of IWN strain. The 40 week body weight did not show a proportionate increase in both strains.

From the results obtained in the study, it is suggested that pullets with body weight at 20 weeks of age above 1200 g may be retained in IWN and IWP strains for further testing/rearing. This would help to obtain better intensity of production without loss in egg weight or livability. The total rejection amounted to 22.3 per cent in IWN strain and 14.6 per cent in IWP strain. Since PBW and ASM are greatly influenced by managemental conditions during the brooding and rearing periods, proper attention should be given to provide optimal conditions in respect of brooder and grower space and feeder space allowances and health management. This would help to attain maximum growth for pullets which inturn will reduce the percentage of rejection.

Summary

SUMMARY

An experiment was carried at All India Co-ordinated Research Project on poultry for eggs, Mannuthy to evaluate the influence pullet body weight on the production performance in two strains of White Leghorn viz., IWN and IWP. The experimental birds consisted of 1271 pullets of IWN strain and 1317 pullets IWP strain. Based on the 20 week body weight, the pullets were classified in to six classes, starting with 1000 g with a class interval of 100 g. Standard and routine managemental practices were followed. The traits considered for evaluation were body weights at 20 and 40 weeks of age, age at first egg, hen housed number and per cent upto 40 weeks of age, egg weight at 32 and 40 weeks of age, livability, egg quality traits and meteorological observations inside the experimental house.

The summary of results obtained in the study are presented below.

1. The frequency distribution (per cent) of birds showed maximum number in class III and IV in IWN and IWP strains.

2. The mean 20 week body weight was 1304.7±4 g in IWN strain and 1335.2±3.5 g in IWP strain with cv of 10.1 and 9.5 per cent, respectively.

3. The birds heavier at 20 weeks of age were also heavier at 40 weeks of age. But the magnitude of increase in body weight was lesser for higher body weight classes.

4. The age at first egg was significantly influenced by different body weight classes in both strains. The ASM was lower for higher body weight classes.

5. The data on egg production showed significant influence for different body weight classes on egg production. As the body weight increased egg production also increased. The influence of body weight on egg production was pronounced upto 27 weeks of age but thereafter egg production per cent was comparable for different body weight classes up to 40 weeks of age.

6. The egg weight at 32 weeks of age did not vary significantly among the body weight classes in IWN strain. In contrast to this, in IWP strain egg weight was higher for higher body weight classes.

7. Egg weight at 40 weeks of age differed significantly in different body weight classes in both strains. As the body weight increased, the mean egg weight also increased. The gain in egg weight from 32 to 40 weeks of age was not linear, but higher gain was observed in higher body weight classes.

8. The data on livability revealed that different body weight classes had a similar livability per cent. But the livability percentage was lower for class I of IWN strain.

9 The egg quality traits studied did not show any significant influence of body weight classes on this trait in both the strains.

From the results obtained in the study it could be observed that pullet body weight exerted a definite influence on the subsequent performance of layers. Lower body weight classes especially class I and class II, with weight class ranging from 1000 to 1200 g. were poorer for most of the traits studied and it would be beneficial if these two classes are eliminated from the flock. This would result in a better egg production performance in IWN and IWP strains.

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THE INFLUENCE OF PULLET BODY WEIGHT ON PRODUCTION TRAITS IN WHITE LEGHORNS

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ABSTRACT OF A THESIS

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ABSTRACT

A study was carried out at All India Co-ordinated Research Project on Poultry for eggs, Mannuthy, to evaluate the influence of pullet body weight on egg production performance in IWN and IWP strains of White Leghorn. The experimental birds consisted of six body weight classes starting from 1000 g with a class interval of 100 g. Body weight at 20 weeks of age was considered as pullet body weight. The observations recorded were body weight at 20 and 40 weeks of age, age at first egg, hen housed number and per cent, egg weight at 32 and 40 weeks of age, livability and egg quality traits.

The mean pullet body weight was 1304.7±4 g in IWN strain and 1335.2±3.5 g in IWP strain. Age at sexual maturity lowered as pullet body weight increased. A higher egg number was observed in heavier body weight classes. The peak production was delayed in lower body weight classes. Though egg weight at 32 weeks of age did not vary significantly among classes, higher egg weight at 40 weeks was recorded in heavier classes. Birds which were heavier at 20 weeks of age were also heavier at 40 weeks of age. But the gain in weight was lesser for higher body weight classes. The classes were similar for livability and egg quality parameters.

The results revealed that an optimum pullet body weight is an important requirement for IWN and IWP strains. Birds with pullet body weight below 1200 g were poor in most of the production traits in both IWN and IWP strains and therefore may be culled. Optimum managemental conditions may be provided during growing period to enable the pullets to attain good pullet body weight.