PRODUCTION PERFORMANCE OF AUSTRA-WHITE AND RHODE-WHITE LAYERS ON LITTER FLOOR

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "**PRODUCTION PERFORMANCE OF AUSTRA-WHITE AND RHODE-WHITE LAYERS ON LITTER FLOOR**" is a bonafide record of research work done by me during the course of research and that this thesis had not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other university or society.

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CERTIFICATE

Certified that this thesis entitled "**PRODUCTION PERFORMANCE OF AUSTRA-WHITE AND RHODE-WHITE LAYERS ON LITTER FLOOR**" is a record of research work done independently by **Sri. E. SRIDHARAN** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to him.

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Dedicated to my Guide

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Introduction

1. INTRODUCTION

Poultry industry registered a phenomenal growth in India during the past three decades making use of new innovations in technology. The commercial hybrid layers have made remarkable contribution in the total egg output in the country. The crossbred layers as well as the desi flocks available in the country have a vital role in boosting egg production. India ranked sixth in the world in egg production with an annual estimate of 24800 million eggs in the year 1993(Anon, 1997). The GDP value of egg out put was Rs. 1736 crores during the year 1991 - 92. The poultry population during the year 1987 was 275.29 million consisting of 62.71 per cent desi and 22.31 per cent improved chicken varieties.

Among the states, Andhra Pradesh ranked first in egg production with annual egg yield of 5557 million eggs contributing 21.31 per cent of the total egg production in the country. Kerala ranked fifth in poultry population and twelth in egg production. The estimated annual egg production in the state was 2150 million in the year 1997-98. In Kerala, 89.72 per cent of chicken were desi type and only 3.14 per cent was of improved varieties (Anon, 1997). The poultry population in Kerala according to 1996 Livestock census was 26.95 million out of which chicken population was 25.65 million and the duck population was 1.19 million and other poultry were 0.11 million (Anon, 1998). In order to achieve a significant increase in egg out put, the popularity of cross bred layers under rural poultry production programme is inevitable.

The backyard farming is getting popular among the farmers in several states and breed crosses are being widely accepted by the farming community for small scale egg production in villages. The elite strains of white Leghorn available in different agro-climatic regions are used as the female parental lines for evolving breed crosses suitable for egg production in rural areas.

Poultry rearing system in Kerala is unique and most of the layer chicken population are distributed under backyard in rural homesteads. Almost all households in villages maintain few birds since the maintenance of layer flocks on commercial line is a major constrain. Therefore egg production by 'masses' using cross bred layers will be the appropriate technology for this region rather than 'massive' egg production by industrial methods. The rural poultry production programmes help the poor to improve their socio-economic status in villages in several ways. Thus it has become necessary to introduce various breed crosses that perform better under backyard conditions.

Inspite of the implementation of various extension education programmes, the consumer preference for tinted eggs do exist among the public. The tinted eggs also fetch a premium price over the white shelled eggs. Hence cross-bred layers that produce tinted eggs will be more acceptable for the rural farming community especially among the small, marginal and landless labourers. Such birds also clean the surroundings by consuming the decayed materials at the time of scavenging.

Cross breeding in poultry plays an important role in the overall increase of egg production. Most of the breeds of today were cross-breds of one type or other in the ancient times. At present, emphasis given for generating new models by two-way and three-way crosses using stocks that are acclimatised

under local conditions necessarily improve the livability to great extent. Such practices have gained momentum in developing countries and have been identified as thrust areas for research.

The varieties of chicken that are primarily hardy with reasonable egg production rate and high livability are the factors for consideration by scientists and farmers. Birds with a spectrum of plumage colours are being preferred in rural areas. The eradication of malnutrition, poverty alleviation and health care of women and children among the weaker sections of the society are the major objectives envisaged under rural poultry production programmes. The crossbreds generally considered superior in livability in association with certain traits received from the male parental line can be utilised advantageously. The commercial hybrids developed at temperate zones may not show similar performance at other climatic zones and hence the adaptability of stocks and their heterotic effect have to be ascertained at different agro-climatic profile for future exploitation.

Considering the above aspects, the present study was undertaken to evaluate and compare the production performance of Austra-white and Rhode-white layers on litter floor.

Review of Literature

2. REVIEW OF LITERATURE

Meteorological Profile

Somanathan (1980) reported that the highest mean maximum and minimum temperature was 32.35 and 25.27 ^{0} C respectively during May and the months of February to April was hot and dry season in Mannuthy region since the ambient temperature was above 32 ^{0} C.

North and Bell (1990) observed that as the ambient temperature increased, the feed in take, bird weight, egg production, egg weight, egg shell quality, shell thickness and interior egg quality decreased.

Body weight

Kolstad and Lien (1970) reported that the body weight at sexual maturity was 100 g more in pure White Leghorn than that of the cross between Norwegian White Leghorns and imported hybrid hens and found that the difference in BW was significant.

Appelman and Bonhof (1971) reported that the live weight in RIR X WL was 1397 g at 18 weeks and 2132 g at 16 months of age whereas the respective BW in pure White Leghorn was 1234 g and 1874 g. Singh and Singh (1971) also found higher body weight at maturity in crossbreds when compared to pure White Leghorn and RIR pullets. Plessis and Erasmus (1972) observed close relationship between body weight at sexual maturity and egg production in White Leghorn, but this relationship was not existing in black Australorp and opined that the ideal body weight for White Leghorn was 2040 g at maturity.

Jain and Sharma (1977) stated that the body weight in crossbreds of White Leghorn x Rhode Island Red was 1444 g and that in RIR X WL was 1454 g at five month of age. Kumar (1978) observed a higher growth rate in a cross of Desi x White Leghorn than that of pure Desi, White Leghorn and RIR. Naik (1978) found higher body weight in WL x Australorp cross than other genetic group. Yoo et al. (1979) studied the cross breeding performance of White Leghorn and Australorp and observed 4 to 5 per cent heterosis for body weight. Varma and Chaudhary (1981) concluded that the average body weight at sexual maturity was 1633.34 g in purebreds and 1725.09 g in three - way crosses and higher average body weight at sexual maturity by 4.77 per cent in three - way crosses.

Radhakrishnan and Ramakrishnan (1982) recorded body weight of ALP x WL as 1142 g and in RIR x WL as 1134 g at 20 weeks of age whereas 1570 and 1472 g at 40 weeks of age in the crosses respectively under back yard system of rearing. In a study by Howlider and Ahmed (1982), the body weight at 12 weeks of age in ALP x NH was 953.91 g and Aseel x ALP was 1006.42 g and the difference between crosses was non-significant. The body weight at 20 weeks of age was 1390 g in WL,1530 g in RIR and 1450 g in the cross between RIR X WL (Khan and Krishna, 1983).

Nair and Bhattacharyya (1984) found that the body weight of WL x Australorp cross averaged 1250 g at 20 week and 1650 g at 40 week in an experiment under backyard system. Balnave (1984) concluded that the body weight at 21 week varied between 1300 and 1800 g in White Leghorn x Australorp pullets. Jain and Chaudhary (1985) stated that the average body weight of Rhode Island Red x White Leghorn was 1440.5 $\pm$ 12.7 g at five month of age.

Dey et al ., (1987) made a cross of White Lehorn male line L - 55 x RIR female line, BW at 20 week was 1087.83 g and at 40 week was 1499.33 g and found higher body weight in breed cross in comparison with strain cross WL L - 55 X L - 33 birds.

Babu et al ., (1988) opined that the body weight was as high as 1456.2 g at 20 week whereas 1626.4 g at 40 week of age in Austro-white pullets (Australorp x White Leghorn) in cages. Goswami and Shukla (1989) could observe that the body weight was 1339.5 $\pm$ 16.5 g at 20 week of age in White Leghorn strain crosses under deep litter system of housing.

Wang and Pirchner (1991) studied the cross breeding performance of Rhode Island Red and Light Sussex and observed 4.3 to 5.0 per cent heterosis for body weight in a cross between two lines.

The mean body weight at 20 weeks of age observed by Jayanthy (1992) for Desi x Austra-white cross was 1007.29 g and the body weight at 40 weeks of age was 1445.36g. Sharma et al ., (1992) concluded that the body weight of RIR x IWH cross was 1332.38 g at 20 week and 1616.23 g at 40 week of age. Amin et al ., (1992) observed that the body weight was averaged 1650 g in RIR x Fayoumi cross while it was only 1000 g in indigenous fowls.

Asiedu and Weever (1993) found that the growth rate of Creole X RIR and RIR X Creole birds were higher than the pure Creole birds. Nayak (1994) studied the cross breeding performance between RIR and local phulbani birds and observed 40 per cent average heterosis for body weight in F1 birds. In a study by Saikia et al ., (1994), the body weight was 1890 g at 40 weeks of age in RIR in an experiment involving 157 half-sib RIR pullets.

Beena (1995) stated that the body weight was 944.05 g at 20 weeks of age and 1346.67 g at 40 weeks of age in 'F' strain of White Leghorn. In a study conducted by Pratihar et al., (1996), the mean body weights at 8, 16 and 20 weeks were higher in Australorp x WL cross than the reciprocal cross WL x Australorp.

Sexual Maturity

Kolstad and Lien (1970) reported that the crossbred birds reached sexual maturity at significantly early age than the purebreeds in an experiment involving crossing between Norwegian White Leghorns and imported hybrid hens.

In a cross breeding experiment involving Rhode Island Red, White Wyandotte, White Leghorn, Brown Leghorn, New Hampshire and Barred Plymouth Rock, the cross bred birds came to lay early than the purebreeds (Lund 1971).

The data obtained from RIR, Desi x RIR and RIR x Desi hens were compared by Acharya and Kumar (1971) and observed that the age at first egg was 218, 216 and 202 days in RIR, Desi x RIR and RIR x Desi hens respectively. The number of birds used in the above crosses were 253, 246 and 151 respectively.

Dev et al., (1971) found that the age at sexual maturity averaged 182.6, 178.6 and 181.0 days respectively in pure White Leghorn, White Leghorn x Rhode Island Red and Rhode Island Red x White Leghorn and the number of birds tested in the study were 112, 123 and 140 respectively.

Lal and Chhabra (1975) observed that the age at first egg averaged 182, 168, 187, 180, 185, 174, and 185 days in Australorps, Australorps x New Hampshires, Australorps x White Cornish, New Hampshires x Australorps, New Hampshires, White Cornish x Australorps and White Cornish respectively.

Sharma (1978) reported sexual maturity at 217 and 221 days of age in the Rhode Island Red and White Leghorn pullets respectively in an experiment on genetic studies of some economic traits in White Leghorn and Rhode Island Red chickens.

Radhakrishnan and Ramakrishnan (1982) observed that the overall mean age at first egg were 161.0 and 161.2 days for ALP x WL cross and RIR x WL cross respectively and age at 50 per cent production averaged 171.0 and 177.2 days for ALP x WL and RIR x WL respectively in an experiment with White Leghorn, Black Australorp, Rhode Island Red and their reciprocal breed crosses under backyard conditions.

Khan and Krishna (1983) concluded that the age at sexual maturity averaged 174,196 and 188 days in White Leghorn, Rhode Island Red and Rhode - White hens (RW) respectively. Nair and Bhattacharyya (1984) observed that the age at first egg averaged 147.6 days and age at 50 per cent production averaged 175 days in ALP x WL cross under backyard system. Costantini and Panella (1985) stated that the age at first egg was 155.3 days in White Leghorn while 187.6 days in RIR.

Dey et al., (1987) observed that the age at sexual maturity averaged 157.13 days in L-55 x RIR cross in an experiment with White Leghorn strain L-55 x RIR breed cross. Babu et al., (1988) stated that the age at sexual

maturity average 167.7 days in Austra- white pullets under cage system and the age at 5 and 50 per cent production were 146 and 173 days respectively.

Jayanthy (1992) found that the mean age at sexual maturity measured as age at 50 per cent production was 189 days in Desi xAustra - white hens. Herrera and Garcia (1992) found that the age at first egg averaged 149.9 days in 370 Rhode Island Red hens from 78 sire families. Sharma et al ., (1992) conducted a 3 x 3 diallel experiment using one strain of WL, IWH and two strains of RIR viz., RIR and RIW and concluded that the IWH x RIR and IWH x RIW crosses showed early sexual maturity and the earliest age at sexual maturity averaged 148.53 $\pm$ 0.90 days in RIR x IWH cross.

Saikia et al ., (1994) recorded that age at first egg averaged 161.8 days in 157, half -sib Rhode Island Red pullets. Beena (1995) obtained the average age at first egg as 174.67 days in 'F' strain of White Leghorn reared in cages at Mannuthy whereas Mishra (1996) observed the age at sexual maturity at 122 days in Kalinga brown (RIR x White Leghorn) at Bhubaneshwar. Pratihar et al ., (1996) observed that the age at sexual maturity did not differ significantly between the Australorp x White Leghorn and WL x Australorp crosses.

Egg Production

Tijen and Kuit (1970) conducted experiment on cross breeding using White Leghorn and Rhode Island Red and compared their egg production with that of pure strains. The average egg production to 72 weeks of age was 220,227,258,240 in White - Leghorn, Rhode Island Red, White Leghorn x Rhode Island Red and Rhode Island Red x White Leghorn respectively. Choi (1970) observed that the hen-day per cent was 56 to 62, 59 and 65 per cent and hen-housed egg production was 182 to 204, 179 and 213 upto 500 days of age in

White Leghorn, White Leghorn line cross and New Hampshire x White Leghorn respectively.

Dev et al ., (1971) found egg production on hen-day basis from 28 to 40 weeks of age averaged 70.1, 71.6 and 63.8 in White Leghorn, WL x RIR and RIR x WL respectively. Singh and Singh (1971) concluded that strain crosses produced the highest number of eggs when compared to the top crosses, crossbreds and purebreds. Kumar et al ., (1971) studied the egg production in Desi, Rhode Island Red, Rhode Island Red x Desi and Desi x Rhode Island Red pullets aged six months for 10 weeks. The hen-day egg production averaged 19.18 ± 1.41, 47.60 ± 1.40, 29.11 ± 1.50 and 36.50 ± 1.50 per cent respectively.

Lund (1971) in a study on cross breeding experiments involving 722 cross bred and 557 pure bred hens of Rhode Island Red, White Wyandotte, White Leghorn, Brown Leghorn, New Hampshire and Barred plymouth Rock. Found that the rate of laying was better in cross breds in the first laying year. Acharya and Kumar (1971) stated that the annual hen-housed egg number averaged 69, 64, 55 and 45 and hen-day percentage averaged 35, 31, 29 and 21 in Rhode Island Red, Desi x RIR, RIR x Desi and Desi birds respectively.

Sergeev and Sergeeva (1971) studied the performance of line - cross hybrids and found that the Russian White (RW) sire line 108 and the RW dam line 106 had an average 12 months egg production of 204 and 194 respectively. Mool (1971) stated that the WL lines yearly egg production averaged 262-277 eggs and the best results were obtained with WL x Australorp cross wherein the yearly egg production was higher than the parent lines by approximately 40 eggs.

Appleman and Bonhof (1971) opined that the overall laying percentage was 55.0 in RIR x WL cross and the egg production per hen was 196 in RIR x WL hens reared in open houses and according to Marais (1971) the egg production to 500 days was varied from 217.5 (0.9 ft^2 / bird) to 229.1 (0.4 ft^2 / bird) with a mean of 222.7 eggs in Autralorp x White Leghorn.

Swart (1977) compared the performance of White Leghorn and Black Australorp x White Leghorn and found very little difference in egg production between two types. Sheridan and Randall (1977) could obtain substantial hybrid vigour for hen-housed and hen-day egg production in F1 crossbred populations in an experiment involving Australorp, White Leghorn and their crosses.

Kumar (1978) studied the performance of Desi, White Leghorn, Rhode Island Red, Desi x White Leghorn and Desi x Rhode island Red and found that Desi x White Leghorn showed a higher egg production than pure breeds. Sharma (1978) reported that the egg production in the first 100 days averaged 48 eggs in Rhode Island Red pullets.

Yoo et al . (1979) studied the cross breeding performance of White Leghorn and Australorp and observed 21 to 34 per cent heterosis for egg production. In breed crosses, Radhakrishnan (1981) concluded that the per cent hen-day was averaged 54.28 in AW and 40. 07 in RW and the per cent hen-housed production averaged 52.97 in ALP x WL (AW) and 34.57 in RIR x WL (RW) cross breds respectively in an experiment involving White Leghorn, Australorp, Rhode Island Red and their reciprocal crosses upto 40 weeks of age.

Chowdhury et al. (1983) reported that the egg production per month per hen averaged 8.7, 9.6 15.60, 13.3 and 11.1 in WL X RIR, WL X RIR,

RIR X WL, WL and RIR respectively 13.3 in WL and 11.1 in pure RIR and in their reciprocal crosses 8.7 and 9.6 eggs in an experiment involving White Leghorn, Rode Island Red and their crosses under local condition. Khan and Krishna (1983) found that the egg production upto 400 days of age averaged 124.84, 122.80 and 135.00 in White Leghorn, Rhode - Island Red and Rhode Island Red X White Leghorn (RW) respectively.

Yoo et al (1984) observed that the White Leghorn x Australorp cross was 13 to 15 per cent higher for egg number and this cross laid more of smaller eggs than the commercial strains. Nair and Bhattacharyya (1984) reported the average annual egg production range from 180 to 216 eggs with an overall average of 195 eggs per hen per year in an experiment involving White Leghorn x Australorp cross under backyard system.

Costantini and panella (1985) studied the productivity in purebreds, crossbreds and commercial hybrids and found that annual egg production was ranged from 207 to 253 eggs in pure breeds and 205 and 209 eggs in cross breds of BPR X RIR and WPR X RIR and 255 to 269 eggs in commercial hybrids.

Tanabe et al . (1985) studied the performance of White Leghorn, Rhode Island Red and WL x RIR and found that the egg production from 151 days to 61 week was 79.9, 71.7 and 83.4 per cent in an experiment involving 151 White Leghorn (WL), 313 Rhode Island Red (RIR) and 40 WL x RIR birds.

Sheridan (1986) studied the cross breeding performance of Australorp and White Leghorn fowls and observed substantial heterosis for egg production variables in F1 cross derived from cross between Australorp and White Leghorn.

Dey et al. (1987) reported egg number upto 280 days of age as 84.13 in L-55 x RIR cross and the annual egg number in the breed cross was also found to have significant and negative correlation with age at sexual maturity. In cage rearing, Babu et al. (1988) found that the hen-housed production was 46.57, hen-housed per cent was 33.02 and the HD production was 65.82 per cent in Austra-White pullets from 21 to 40 weeks of age. Under deep litter system of rearing, Goswami and Shukla (1989) reported overall hen-housed egg production upto 40 weeks as 88.21 ± 1.70 in White Leghorn strain crosses.

The progenies from Austra - white hens on crossing with naked neck desi males produced 47.81 eggs per bird during 21 to 40 weeks of age (Jayanthy, 1992). When two strains of RIR hens were crossed with WL males, the egg production from their progenies were almost same and it was 94.86 eggs and 89.37 in RW per bird upto 40 weeks of age (Sharma et al., 1992).

The egg production from RIR breed was 83.36 eggs in a study by Saikia et al., (1994) and from 'F' strain of WL it was 56.73 eggs on HH basis from 21 to 40 weeks of age in a study conducted by Beena (1995). The annual egg yield from Kalinga brown, a cross between RIR X WL was reported as 272 eggs per bird by Mishra (1996).

Feed consumption and Feed efficiency

Lund (1971) found no significant differences between crossbreds and purebreeds in food utilisation while Kumar et al ., (1971) reported that the feed consumption per Kg egg was 20.07 ± 2.10 Kg in Desi hens and it was 6.39 ± 0.20, 11.20 ± 1.14 and 8.43 ± 0.46 Kg in Rhode Island Red (RIR), RIR x Desi and Desi x RIR fowls respectively. Sergeev and Sergeeva (1971) also stated that

the food conversion for egg production was significantly better for Russian White (RW) x NH cross breds in comparison to their parental lines.

Lal and Chhabra (1976) found that the food conversion for egg production was more efficient in crossbreds (2.42 - 3.76 Kg) than purebreeds (3.18 - 3.69 Kg) in an experiment involving Australorp, New Hampshire and White Cornish fowls and their reciprocal crosses. Sheridan and Randall (1977) noticed substantial hybrid vigour for efficiency of food conversion in the F1 cross bred population but it was lost in the F2 and F3 crossbred populations in an experiment involving Australorp and White Leghorn crosses. Swart (1977) compared the performance of White Leghorn (WL) strain cross and Black Australorp (BA) x WL cross and found that the WL consumed 5.06 Kg less feed per bird than the BA x WL cross.

Jain et al., (1978) stated that the feed efficiency per dozen eggs was 2.48 Kg in RW cross and feed consumption per Kg egg mass was 3.99 Kg in RW cross in an experiment involving Desi, exotic and their crosses.

Howlider and Ahmed (1982) found that the feed conversion ratio was 2.76 for Australorp x New Hampshire and 2.80 for Aseel x Australorp fowls. Yoo et al., (1984) concluded that the White Leghorn x Australorp cross was 2 to 7 per cent better in efficiency of food utilization.

Dey et al., (1987) compared the production traits between the WL strain cross and WL x RIR breed cross and stated that the annual feed consumption per day did not differ much between crosses. Since the average feed consumption per day was 117.85 g. In Austra - white pullets in cages, Babu et al., (1988) reported that the feed consumption per bird per day was

142.04 g and the feed efficiency per dozen eggs was 5.09 while feed efficiency per Kg egg mass was 9.31.

Goswami and Shukla (1989) found that the feed consumption per dozen eggs upto 40 week was 1656.4 ± 19.0 g and that upto 56 week was 1692.8 ± 26.3 g and feed consumption per Kilo egg was 2649.8 ± 36.8 g and 2631.1 ± 40.7 g upto 40 and 56 week respectively in WL strain cross.

Jayanthy (1992) recorded the mean daily feed consumption of 106.61 and 104.95 g in Desi x New Rock and Desi x Austra-white crosses respectively during 21 - 40 weeks and Beena (1995) recorded average feed consumption of 93.83 g/bird/day with an overall feed efficiency of 2.47 per dozen egg from 25 to 40 weeks of age in 'F' strain of White Leghorn.

Mishra (1996) stated that the feed efficiency per dozen egg was 1.985 Kg in Kalinga brown (RIR x WL) layer and Bhatti et al., (1997) concluded that the crossbred birds of Aseel x RIR showed significantly better feed consumption when compared to pure Aseel birds upto 20 weeks of age.

Egg weight

The mean egg weight at 36 week of age in WL X RIR cross was 55.48 g and in RIR X WL cross it was 55.56 g in a study conducted by Dev et al., (1971). In six month old cross bred pullets, the mean egg weight reported by Kumar et al., (1971) was 48.47 ± 0.37 g in RIR X Desi cross and in reciprocal Desi X RIR cross it was 47.96 ± 0.40 g. In he above study the mean egg weight in RIR was 51.96 g and in Desi birds the mean egg weight was only 44.9 g.

Iype (1979) found that the egg weight averaged 50 g for daughters and 51 g for dams at 230 to 240 days of age in a study on egg weight of 988 progenies from 288 dams and 43 sires of the Forsgate strain of White Leghorn at Central Hatchery, Kerala. According to Radhakrishnan (1981) the mean egg weight was 48.8 g in ALP X WL cross and in RIR X WL cross it was 47.40 g at 40 weeks of age. Chowdhury et al. (1983) studied the egg weight White Leghorn, Rhode Island Red and their crosses and found that the average egg weights were 46.8 g in WL X RIR cross. In pure WL the mean EW was 45.6 g and in pure RIR, it was 46.7 g.

Khan and Krishna (1983) stated that the egg weight were 52.5, 53.7 and 51.8 g in White Leghorn, Rhode Island Red and Rhode - white (RW) respectively at 400 days of age. Nair and Bhattacharya (1984) reported the average egg weight 52 g with range of 40 to 60 g at 40 weeks of age in WL X Australorp cross under backyard system.

Dey et al. (1987) concluded that the annual egg weight did not differ much between the WL strain cross and WL X RIR breed cross and observed an egg weight of 50.16 g at 40 week of age in L - 55 X RIR cross. Babu et al. (1988) found the average egg weight of 43.81 g at period I and 45.62 g at 40 weeks of age in Austro-White pullets in cages.

Salahuddin and Howlider (1991) reported that the egg weight was high in White Leghorn intermediate in Rhode Island Red and lowest in Fayoumi birds in an experiment involving White Leghorn, Rhode Island Red and Fayoumi layers and recorded an egg weight of 52.5 g in RIR at 40 weeks of age. Jayanthy (1992) observed that the initial egg weight at 21-24 weeks of age was 36.25 g while the egg weight at 37-40 weeks of age was and 44.88 g in Desi X Austra-

white crossbred layers. Sharma et al. (1992) stated that the egg weight at 32 weeks was 48.57 g in RIR X WL cross.

In RIR hens, Herrera and Garcia (1992) stated that the mean egg weight was 50.3 g at 28 weeks and 53.4 g at 36 weeks of age. In RIR X Fayoumi cross, Amin et al., (1992) observed mean egg weight of 56 g. Saikia et al., (1994) stated that the EW was 47.9 g in RIR pullets a 40 weeks of age. In F strain of WL, the mean EW reported by Beena (1995) was 50.13 g. In RIR X WL cross named Kalinga Brown, developed at Bubaneswar, Mishra (1996) reported an average egg weight of 50 g.

Egg Mass

The mean egg mass upto 500 days of age was 11.99 Kg in WL and 12.34 kg in RIR (Gintovt et al. 1981). Dey et al. (1987) concluded that the egg mass at 40 weeks of age was 4218.45 $\pm$ 67.21 g in L-55 X RIR cross.

Egg quality Traits

Kolstad and Lien (1970) found that there was no significant difference between crossbreds and purebreds in shell quality but the crossbreds had significantly low albumen height. Tijen and Kuit (1970) reported that the shell quality as 15.4, 18.4, 16.8 and 15.6 μ in WL, RIR,WLX RIR and RIR X WL respectively .

Lund (1971) stated that there were no significant difference between crossbreds and purebreds in egg shell quality in an experiment involving 722 crossbred and 557 purebred Rhode Island Red, White Wyandotte, White Leghorn, Brown Leghorn, New Hampshire and Barred plymouth Rock

birds. Kotaiah et al. (1976) found average shell thickness of 0.31 mm at 300 days of age in Australorp eggs. Stino et al. (1977) observed average per cent shell of 12.95, yolk of 31.7 and albumen of 55.8 in RIR eggs. Mohapatra et al. (1985) stated that the average shell thickness was 0.32 mm in RIR eggs.

Khan et al., (1989) studied the physical quality characters in White Leghorn eggs in three successive stages of laying viz., at start, at first and second months of production. He reported the average per cent albumen, yolk and shell were 60.02, 29.04 and 10.94 respectively and shell thickness was 0.37 mm.

In RIR eggs, Simeonovova et al. (1989) observed 63 per cent albumen, 28.5 per cent yolk, 8.5 per cent shell and 0.35 mm as shell thickness. Kumararaj et al. (1991) measured the egg quality traits in Forsgate strain of White Leghorn eggs laid between 38 and 40 weeks of age and observed average shell thickness of 0.36 mm. Salahuddin and Howlider (1991) studied the effect of breed and season on egg quality traits and stated that shape index was highest in RIR, intermediate in White Leghorn. Shell thickness was highest in White Leghorn and Rhode Island Red.

Jayanthy (1992) studied the egg quality traits in terms of shape index, Albumen index, yolk index and shell thickness and the respective mean values noted were 75.38, 0.113, 0.485 and 0.396 in Desi X New Rock (DNR) and 76.47. 0.103, 0.476 and 0.403 in Desi X Austra-white (DAW) cross bred layers.

Sakuntala Devi et al. (1998) reported that the age at first egg was in positive correlation and significant with shape index and shell thickness in an experiment involving IWD, IWF and IWK strains of White Leghorn. Padhi et al. (1988) observed negative correlation between percentage yolk and egg weight

and positive correlation between egg weight and per cent albumen in White Leghorn.

Livability

Acharya and Kumar (1971) pointed out the possibility of improving the survivability of Rhode Island Red by introducing into them desi inheritance in a study of laying house mortality in Desi, RIR and their crosses. Sergeev and Sergeeva (1971) found that the survival rate of adult hybrids exceeded that of the two parent lines by 21.5 and 9.5 per cent. Lund (1971) observed in a cross breeding experiment that mortality of crossbreds were 13.7 per cent in the first year and 32.5 per cent in the second year of laying and the mortality in pure breeds were 18.3 and 36.4 per cent respectively for similar periods. Appelman and Bonhof (1971) observed that the mortality was 43.5 per cent in White Leghorn and 52.8 per cent in RIR X WL in open houses.

Lowe and Garvood (1976) studied the sex difference in mortality rates of Leghorn - Red reciprocal crosses. He concluded that the mortality rate among progeny of White Leghorn males exceeded that of the progeny of Rhode Island Red males in both pure line and cross breds. White leghorn X RIR cross bred progeny had the highest mortality rate and the rate of loss was significantly lower in males than in females but did not differ between crosses. They came to a conclusion that sex linkage is major factor in differential mortality rates between progeny of White Leghorn X heavy breed reciprocal crosses.

Swart (1977) found that the percentage mortality was high among the heavy type than the light type birds in an experiment involving White Leghorn (WL) strain cross and Black Australorp (BA) X WL heavy type cross. Kumar (1978) studied the performance of Desi, White Leghorn, RIR,

Desi X White Leghorn and Desi X RIR fowls and found Desi X White Leghorn had better survival rate than pure breds.

Radhakrishnan (1981) stated that the livability percentage upto 40 weeks of age was 96 in ALP X WL while in RIR X WL cross it was 76 per cent under backyard condition. Howlider and Ahmed (1982) concluded that the mortality was 14.28 per cent in Australorp X New Hampshire and 19.04 per cent in Aseel X Australorp cross.

Chowdhury et al. (1983) reported that the mortality per cent to 7 months of age was 11.1, 53.8 and 25.0 in WL + RIR and RIR respectively. Nair and Bhattacharyya (1984) found that the mortality to 40 weeks of age was 3.4 per cent with the range of 2 to 5 per cent in WL X Australorp cross, under backyard system.

Costantini and Panella (1985) stated that the mortality in Rhode Island Red was 9.5 per cent and it was 10.0 per cent in White Leghorn. Babu et al. (1988) stated that the livability percentage to 40 weeks of age was 95.74 in Austra - white pullets in cages. Amin et al. (1992) observed that the mortality was 55 per cent in RIR X Fayoumi cross bred fowls and 29 per cent in indigenous fowls. Jayanthy (1992) recorded the per cent mortality of 37.5 per cent from 21-40 weeks of age in Desi X Austra - white cross.

Asiedu and Weever (1993) reported low mortality for the cross breds in an experiment involving Creole X RIR birds. Beena ((1995) reported that the over all per cent livability was 95.50 in 'F' strain of White Leghorn from 21 to 40 weeks of age. Mishra (1996) concluded that the survivability was 95 per cent in Kalinga brown (RIR X White Leghorn) cross developed at, Bhubaneshwar.

Materials & Methods

3. MATERIALS AND METHODS

An experiment was conducted at the Kerala Agricultural University Poultry Farm, Mannuthy to evaluate the production performance of two cross bred layers, i.e. Austra - white and Rhode - white. The Australorp and Rhode Island Red male lines were used for producing the crosses. The 'F' strain of White Leghorn formed the female parental line in both the crosses. The chicks required for the present study were hatched at the University Poultry Farm, Mannuthy. They were reared on litter floor under standard managemental conditions until 18 weeks of age. The objective of the present study was to compare the production performance of Austra-white and Rhode-white hens from 21 to 44 weeks of age under deep litter system of rearing.

One hundred and twenty (120) pullets each of Austra-white and Rhode-white at the age of 18 weeks were housed on litter floor in identical pens in eight replicates each at the rate of 15 birds per replicate at random in a well ventilated house. They were provided with a floor space of 1800 cm^2 per bird. The body weights were recorded individually at the age of 20 weeks. The standard managemental practices for layers were followed through out the experiment. The production performance were tested for six periods of 28-days each from 21 to 44 weeks of age. The standard layer mash as per BIS (1993) were fed *ad libitum*. The composition of the layer mash is presented in Table 1. The proximate composition of the ration was estimated according to the procedure described in AOAC(1990). The per cent chemical composition of nutrients in the layer mash on dry matter basis is projected in Table 2.

Table 1. Per cent Composition of feed ingredients in the layer mash fed to the experimental birds

Sl. No.	Ingredients	Per cent
1	Yellow maize	47.00
2	Ground nut cake	16.00
3	Gingelly oil cake	5.00
4	Dried unsalted fish	5.00
5	Rice polish	23.00
6	Shell grit	2.00
7	Mineral mixture *	1.75
8	Salt	0.25

Added per 100 kg vitamin premix 10 g. Indomix ($AB_2 D_3$); Vitamin A 40,000 IU, Vitamin B_2 20 mg., Vitamin D_3 5000 IU per gram.

* Mineral mixture: Moisture (Max.) 3 %, Calcium 32 %, Phosphorus 6 %, Manganese 0.27 %, Iodine 0.01 %, Zinc 0.26 %, Fluorine (Max.) 0.03 %, Iron 1000 ppm, Copper 100 ppm.

Table 2. Per cent chemical composition of the nutrients in the layer mash on dry matter basis.

Sl. No.	Nutrients	Per cent
1	Dry matter	90.38
2	Moisture	9.62
3	Crude protein	17.61
4	Crude fibre	5.23
5	Ether extract	4.08
6	Nitrogen free extract	51.00
7	Total ash	12.46
8	Acid insoluble ash	4.70
9	Calcium	2.90
10	Phosphorus	0.76
Calculated value		
11	Metabolizable energy (Kcal/kg)	2631.00

The following observations were recorded during the course of the experiment.

1. Body weight at 20 and 44 weeks of age.
2. Age at first egg in each replicate.
3. Age at 10 and 50 percent production.
4. Weekly egg production , HH and HD.
5. Period wise egg production, HH and HD.
6. Mean daily feed consumption.
7. Mean feed efficiency.
8. Mean egg weight.
9. Mean egg mass
10. Egg quality in terms of per cent shell, albumen and yolk.
11. Shell thickness.
12. Livability and
13. Economics over feed cost.

Body weight

The body weight of birds at 20 and 44 weeks of age were recorded individually to the nearest 10 g accuracy.

Sexual Maturity

The age at first egg was recorded in each replicate .The ages at 10 and 50 percent production were recorded replicate wise. From these data, the age at sexual maturity in Austra-white and Rhode-white birds were determined.

Weekly Egg Production

Hen-housed and Hen-day egg production in number and percentage were estimated on weekly basis. The level and duration of peak production were also determined. The age from which both groups of Austra-white and Rhode-white commenced laying was used for statistical analysis.

Period-wise Egg Production

Hen -housed and Hen-day egg number and its per cent production were estimated on period basis. The age from which both groups of Austra-white and Rhode-white commenced laying was only used for statistical analysis.

Feed Consumption

Ad-libitum feed was issued in each replicate daily and the balance feed available in the feeders and feed bins at the end of each period were recorded. From this, period-wise mean daily feed consumption per bird per replicate was worked out.

Feed Efficiency

Feed efficiency was calculated period-wise in each replicate as kilogram of feed consumed to produce dozen eggs. For statistical analysis, feed efficiency values from 25 weeks of age were used at the end of each period.

Egg Weight

All eggs from each replicate during three consecutive days towards the end of 24,28,32,36,40 and 44 weeks of age were weighed individually to the accuracy of 0.01 g and the mean egg weight was arrived at for Austra-white and Rhode-white at different ages. These mean values were also considered as the means for that particular period.

Egg Mass

Egg mass was worked out replicate-wise based on the total weight of eggs recorded during the three days towards the end of 24,28,32,36,40 and 44 weeks of age. Thus, altogether total egg mass for 18 days were recorded in each group and the mean egg mass per day was determined.

Egg Quality

Five eggs in each replicate for three consecutive days towards the end of each period were broken and the weights of shell, albumen and yolk were recorded and expressed as percentage of egg weight. The shell thickness was measured using the shell thickness gauge.

Livability

The week-wise per cent livability were recorded based on the number of birds died in each week.

Economics Over Feed Cost

The economics of egg production over feed cost was calculated taking into account the cost of feed ingredients prevailing at the local market.

The data were subjected to statistical analysis as per methods described by Snedecor and Cochran, (1985) in order to draw conclusions.

Results

4. RESULTS

The results obtained in the study on 'Production Performance of Austra - white and Rhode-white layers on litter floor' are presented in this chapter.

Meteorological Observations

The macroclimate prevailed at Mannuthy region during the experimental periods I to VI from December 1997 to June 1998 are presented in Table 3. The mean maximum temperature during periods II to V were significantly higher than that of periods I and VI. In period I, it was 32.34 ^{0}C and it increased significantly to 34.54 ^{0} C in period II and it was statistically comparable till period V then decreased significantly to 31.59 ^{0}C in period VI.

Whereas, the minimum temperature in periods I to III were significantly lower than those in periods IV to VI. The relative humidity (R.H) in periods I to III were also significantly lower than periods IV to VI in the fore noon. In the after noon, the R.H. percentage was significantly lower in periods II to V in comparison to periods I and VI (61 and 63 per cent). The mean sun shine hours were the same in periods I and VI (7.5 and 7.6 h) and these values were significantly lower than the values in periods II to VI which ranged from 9 to 10 hours per day. The mean daily rainfall was 66.7 mm in period I and there was no rainfall during periods II and III and it was very low in period IV (11 mm) and further increased to 61.4 mm in period V and to 203 mm in period VI. The wind speed in the initial three periods were in the range of 4.9 to 5.5 Kmph and these values were significantly higher than the values that ranged from 3.3 to 3.8 in periods IV to VI.

Table 3. Mean daily meteorological data outside the poultry house for the period from December 1997 to June 1998 at Mannuthy region

mean	Experimental periods / age of birds in weeks/months						Overall
	I/21-24 Dec-Jan 1997-98	II/25-28 Jan-Feb	III/29-32 Feb-Mar	IV/33-36 Mar-Apr	V/37-40 Apr-May	VI/41-44 May-Jun	
1. Temperature (° C)							
a) Max	32.34 ± 0.17[a]	34.54 ± 0.26[b]	35.24 ± 0.18[b]	36.87 ± 0.22[b]	35.71 ± 0.25[b]	31.59 ± 0.28[a]	34.38 ± 0.24
b) Min	23.25 ± 0.16[a]	23.84 ± 0.25[a]	23.85 ± 0.24[a]	24.56 ± 0.18[b]	25.38 ± 0.25[b]	24.77 ± 0.23[b]	24.28 ± 0.21
2. Per cent Relative humidity							
a) Forenoon	83 ± 1.15[a]	78 ± 1.50[a]	77 ± 1.92[a]	86 ± 1.37[b]	86 ± 1.00[b]	90 ± 0.85[c]	83.33 ± 0.72
b) Afternoon	61 ± 1.35[a]	49 ± 0.93[b]	51 ± 1.64[b]	47 ± 1.86[c]	50 ± 1.7[b]	63 ± 1.57[a]	53.50 ± 1.61
3. Rainfall (mm)	66.7	0.0	0.0	11.0	61.4	203.0	57.02
4. Sunshine hours	7.5 ± 1.20[a]	9.3 ± 0.41[b]	9.6 ± 0.42[b]	10.0 ± 0.43[b]	9.0 ± 0.21[b]	7.6 ± 0.22[a]	8.83 ± 0.20
5. Wind speed (Kmph)	5.1 ± 0.21[a]	5.5 ± 0.18[a]	4.9 ± 1.21[a]	3.8 ± 0.14[b]	3.4 ± 0.13[b]	3.3 ± 0.04[b]	4.33 ± 0.05

Means carrying the same superscript within a row did not differ significantly ($P < 0.05$)

Body Weight

The mean body weight in Austra-white (AW) and Rhode-white (RW) at 20 and 44 weeks are presented in Table 4. The overall mean body weights of pullets at 20 week were 1181.50 ± 9.15 g in Austra - white and 1178.75 ± 8.91 g in Rhode -white which were comparable. The mean body weight at 44 weeks of age was significantly higher in RW (1539.79 g) than that recorded in AW (1477.45 g).

Sexual Maturity

The sexual maturity traits measured in terms of age at first egg and ages at 10 and 50 per cent production are presented in Table 5. The age at first egg (AFE) averaged 161.63 ± 1.20 days in AW and 159.75 ± 1.63 days in RW. The range of values were 157 to 166 in the former and 152 to 168 days in the latter. This indicated that the first egg in the flock in RW was at 152 days of age. The mean age at 10 per cent production was 166.25 days in AW and 163.00 days in RW with the range of values from 161 to 169 in AW and 158 to 169 days in RW. The overall mean age at 50 per cent production was 179.13 days in AW and 176.75 days in RW with a variation from 172 to 184 days in AW and 175 to 180 days in RW.

Weekly Egg Production

The weekly egg production from 23 to 44 weeks of age in AW and RW are presented on hen-housed basis in Table 6 and on hen-day basis in Table 7.

Table 4. Mean body weight (g) at 20 and 44 weeks of age in Austra-white (AW) and Rhode-white (RW) pullets.

	Replicates								Overall
	1	2	3	4	5	6	7	8	Mean
Body weight at 20 weeks									
Austra-white	1204.67 ±16.04	1210.67 ±35.68	1207.33 ±31.12	1156.00 ±20.53	1192.00 ±26.26	1173.33 ±27.10	1172.00 ±21.11	1136.00 ±23.40	1181.50[a] ± 9.15
Rhode-white	1229.00 ±31.04	1200.00 ±26.39	1178.67 ±25.20	1195.33 ±23.13	1128.00 ±16.08	1172.00 ±22.61	1136.33 ±25.27	1190.67 ±24.75	1178.75[a] ±8.91
Body weight at 44 weeks									
Austra-white	1492.50 ±30.86	1401.15 ±41.07	1560.83 ±59.44	1483.57 ±37.56	1520.71 ±56.93	1409.58 ±38.02	1469.23 ±37.41	1482.00 ±44.82	1477.45[b] ±16.59
Rhode white	1641.43 ±36.36	1585.33 ±53.88	1573.57 ±39.24	1530.67 ±26.54	1465.39 ±46.40	1509.29 ±47.64	1484.67 ±41.78	1528.00 ±38.68	1539.79[a] ±15.21

The overall means bearing the same superscript between AW and RW did not differ significantly ($P < 0.01$)

Table 5. Age at sexual maturity (days) in Austra - white and Rhode- white hens reared on litter floor

	Replicate Number								Overall Mean
	1	2	3	4	5	6	7	8	
				Age at first egg (AFE)					
Austra-white	162	164	159	157	160	159	166	166	161.63 ±1.20[a]
Rhode-white	162	158	160	162	168	158	158	152	159.75 ±1.63[a]
				Age at 10 Per cent Production					
Austra-white	164	168	166	169	161	168	168	166	166.25 ±0.95[a]
Rhode-white	162	159	164	166	169	163	163	158	163.00 ±1.24[a]
				Age at 50 Per cent Production					
Austra-white	172	175	184	178	177	181	182	184	179.13 ±1.55[a]
Rhode-white	176	176	178	173	180	179	177	175	176.75 ±0.81[a]

The overall mean bearing the same superscript between AW and RW did not differ significantly ($P < 0.05$).

Hen-housed number and per cent

The weekly hen-housed number (HHN) and the HH per cent production in AW and RW are presented in Table 6 and the comparison between weeks are shown under the HHN column and the comparison between AW and RW are given under the HH per cent column. Table 6 revealed that the HHN was very low at 23 and 24 weeks of age in Austra-white birds. There was significant increase in egg number from 25th week onwards till 28 weeks. From 28 to 35 weeks, HHN was statistically comparable. During this period the highest mean weekly HHN registered was 5.64 at 32nd week of age and it gradually reduced to 4.37 eggs per bird at 36th week. From this, a significant reduction in egg number to 3.28 egg was observed at 37th week. The weekly production declined markedly to 2.81 eggs at 42nd week and further reduced and it was very poor at 43rd week with 2.11 eggs. From this level a significant increase to 3.51 eggs was also noticed at 44 weeks of age.

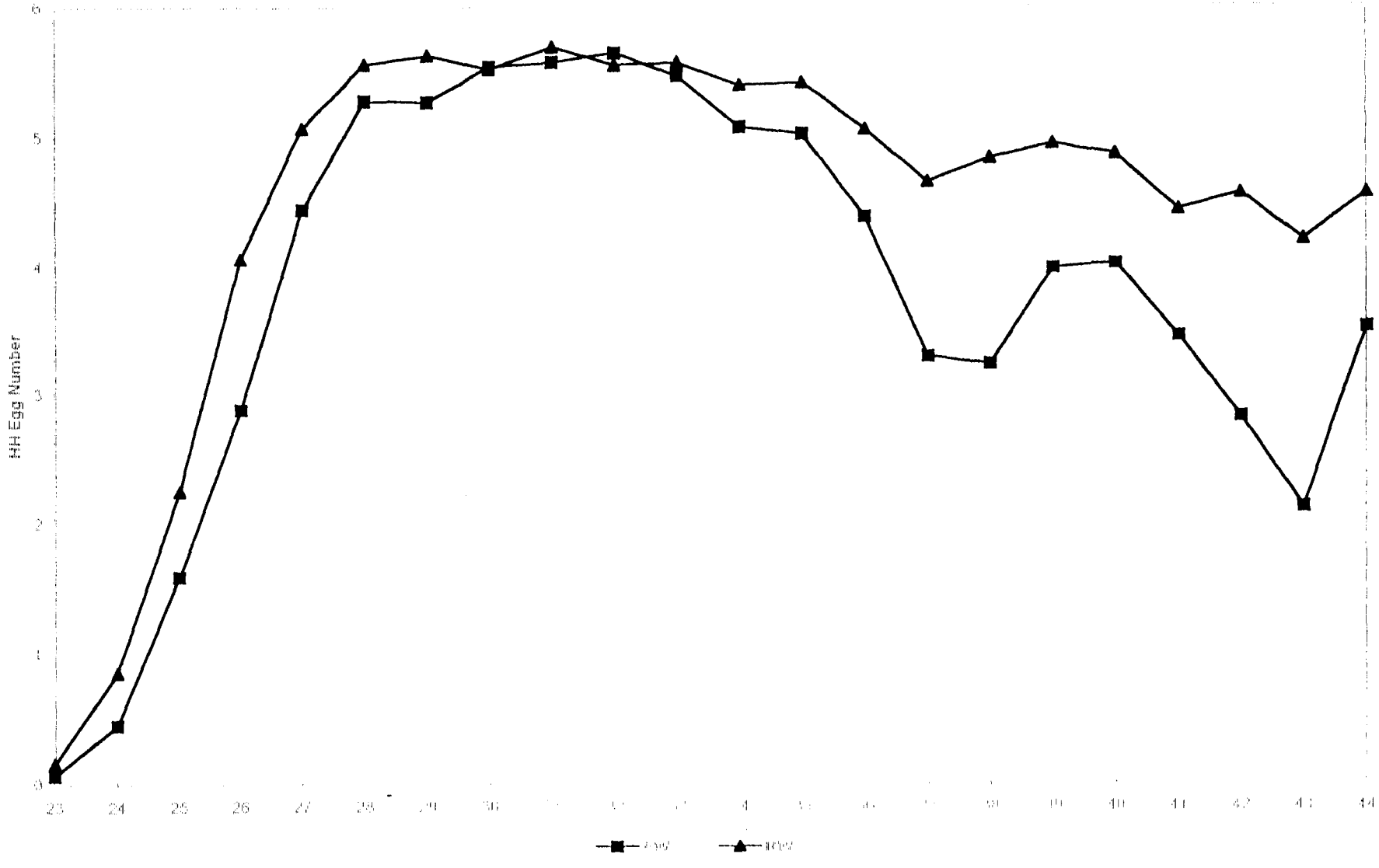
The hen-housed production percentages in AW (Table 6) at the above ages revealed that it was only 0.94 per cent at 23rd week and 6.44 per cent at 24th week. It increased significantly to 22.73 per cent at 25th week and further increased progressively until it reached 75.36 per cent at 28th week. Further increase was non significant during 28 to 35 weeks. The peak production was 80.57 per cent at 32nd week. After peak production, it declined gradually to 71.66 per cent at 35th week and to 62.37 per cent at 36th week. The percentages showed further decline to the tune of 46.90 and 45.94 per cent at 37th and 38th weeks and improved to 56.69 and 57.24 per cent at 39 and 40 weeks. Further reduction to 49.16 per cent was noticed at 41st week and 40.13 per cent at 42nd week. Still further reduction to 30.11 per cent was noticed at 43rd week. From this level, a significant rise in production to 50.10 per cent was evident at 44 weeks of age (Table 6).

Table 6. Weekly mean hen - housed number and hen - housed per cent in Austra - white and Rhode-white hens from 23 to 44 weeks of age

Periods	Age in weeks	HH Number		HH Per cent	
		Austra-white	Rhode-white	Austra-white	Rhode-white
I	23	0.07 ± 0.03^{i}	0.16 ± 0.05^{i}	0.94^{a}	2.26^{a}
	24	0.45 ± 0.11^{i}	0.85 ± 0.14^{h}	6.44^{b}	12.14^{a}
II	25	1.59 ± 0.30^{h}	2.25 ± 0.24^{g}	22.73^{a}	32.09^{a}
	26	2.88 ± 0.31^{fg}	4.06 ± 0.30^{f}	41.07^{b}	57.97^{a}
	27	4.44 ± 0.28^{bc}	5.07 ± 0.15^{abcd}	63.43^{a}	72.36^{a}
	28	5.28 ± 0.16^{a}	5.56 ± 0.19^{ab}	75.36^{a}	79.37^{a}
III	29	5.27 ± 0.10^{a}	5.63 ± 0.18^{a}	75.23^{a}	80.49^{a}
	30	5.54± 0.14^{a}	5.52 ± 0.23^{ab}	79.19^{a}	78.80^{a}
	31	5.57 ± 0.09^{a}	5.69 ± 0.20^{a}	79.50^{a}	81.21^{a}
	32	5.64 ± 0.12^{a}	5.55 ± 0.20^{ab}	80.57^{a}	79.29^{a}
IV	33	5.47 ± 0.15^{a}	5.57 ± 0.27^{ab}	78.11^{a}	79.52^{a}
	34	5.07 ± 0.23^{a}	5.40 ± 0.30^{abc}	72.49^{a}	77.16^{a}
	35	5.02 ± 0.22^{ab}	5.42 ± 0.28^{abc}	71.66^{a}	77.37^{a}
	36	4.37 ± 0.22^{a}	5.05 ± 0.28^{abcd}	62.37^{a}	72.14^{a}
V	37	3.28 ± 0.40^{def}	4.65 ± 0.24^{abc}	46.90^{b}	66.41^{a}
	38	3.22 ± 0.45^{def}	4.83 ± 0.24^{abc}	45.94^{b}	69.06^{a}
	39	3.97 ± 0.32^{cde}	4.94 ± 0.19^{bcd}	56.69^{b}	70.57^{a}
	40	4.01 ± 0.31^{cd}	4.86 ± 0.23^{cd}	57.24^{b}	69.41^{a}
VI	41	3.44 ± 0.39^{def}	4.43 ± 0.20^{def}	49.16^{b}	63.33^{a}
	42	2.81 ± 0.40^{fg}	4.56 ± 0.26^{def}	40.13^{b}	65.10^{a}
	43	2.11 ± 0.48^{gh}	4.20 ± 0.20^{ef}	30.11^{b}	60.01^{a}
	44	3.51 ± 0.31^{def}	4.56 ± 0.20^{def}	50.10^{b}	65.11^{a}
Overall	23-44	82.98 ± 3.39^{b}	98.80± 3.00^{a}	49.39^{b}	58.81^{a}

HHN carrying the same superscript between weeks did not differ significantly ($P< 0.05$) under AW and RW.HH per cent carrying the same superscripts between AW and RW did not differ significantly ($p<0.05$). The overall means carrying the same superscript under HHN and HH per cent between AW and RW did not differ significantly ($P < 0.05$).

Fig. 1: WEEK-WISE MEAN HEN-HOUSED EGG NUMBER FROM 23 TO 44 WEEKS OF AGE IN AUSTRA-WHITE AND RHODE-WHITE BIRDS.



The RW birds although commenced laying at 22nd week at a rate of 0.29 eggs per week, this figure was not included in statistical analysis and hence it was not shown in Table 6. Progressive and significant increase in HHN was recorded till 27th week and thereafter it was comparable statistically from 27 to 36 week. The HHN during 27 to 36 weeks was more than 5 eggs per bird per week. The numerical reduction noticed from 37 to 44 weeks were very low and the mean values from 41 to 44 weeks were 4.43, 4.56. 4.20 and 4.56 eggs respectively.

The weekly HH percentages in RW (Table 6) revealed that it was increased significantly from 23rd week onwards and reached a percentage of 72.36 at 27th week and recorded a peak percentage of 81.21 at 31st week and declined to 72.14 per cent at 36th week and further reduced to 66.41 at 37th week and to a level of 60.01 per cent at 43rd week which increased to 65.11 per cent at 44th week.

The overall comparison between Austra - white and Rhode-white revealed that the HHN and percentages were significantly higher in RW at 24, 26 and at all weeks from 37 to 44 . The overall HHN and per cent recorded in RW was significantly higher than AW birds ($P < 0.05$). The overall mean values were 98.80 in RW and 82.98 in AW with 58.81 and 49.39 per cent respectively. The magnitude of variations in weekly egg production are represented in figure 1.

Hen - day number and per cent

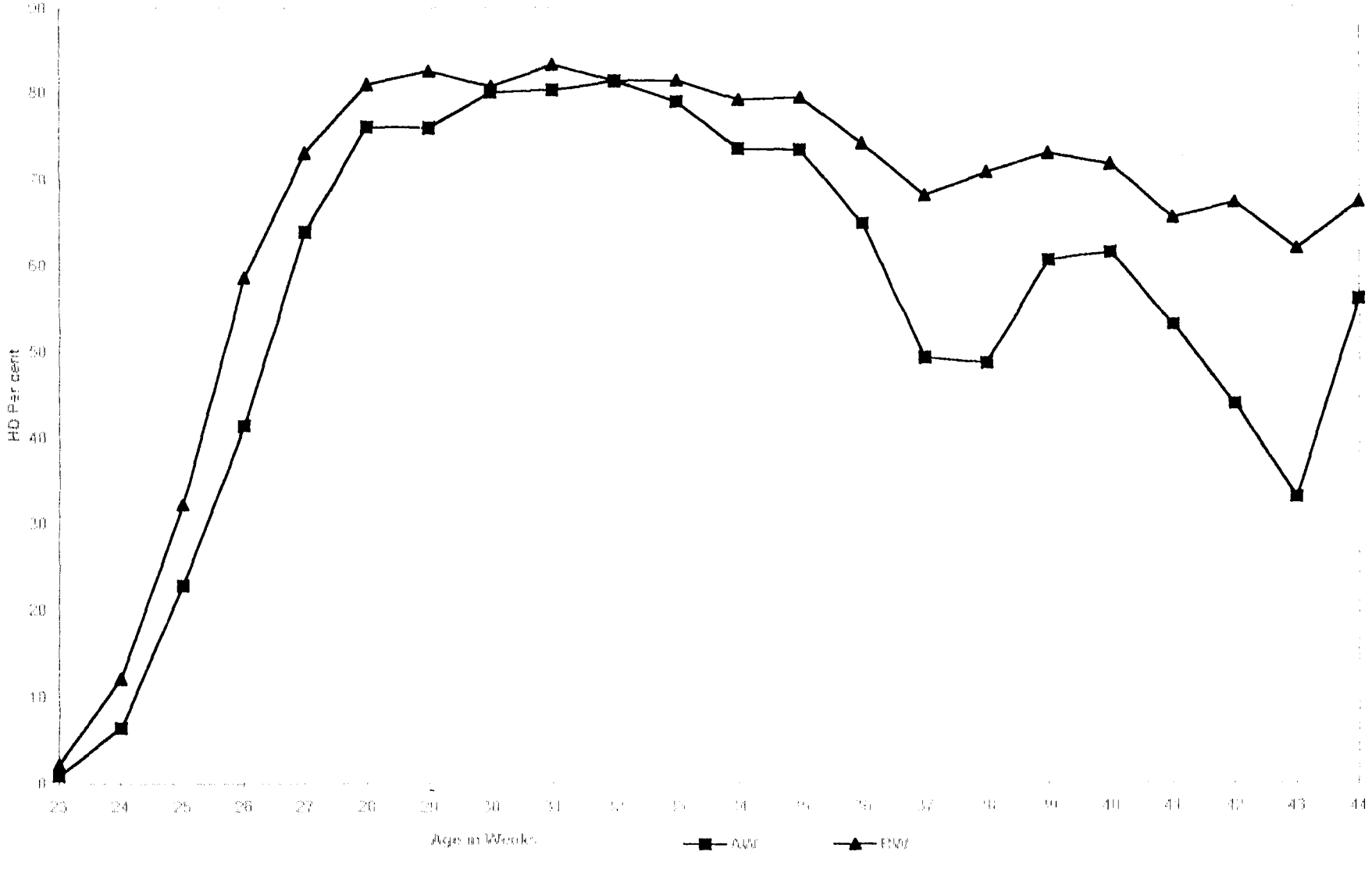
The data pertaining to weekly hen-day number and the HD per cent production in AW and RW are presented in Table 7 and the comparison between weeks within the group are shown under the HDN column and the comparison between AW and RW are given under the HD per cent column.

Table 7. Weekly mean hen-day number and hen - day per cent in Austra - white and Rhode - white from 23-44 weeks of age.

Periods	Age in weeks	HD Number		HD Per cent	
		Austra-white	Rhode-white	Austra-white	Rhode-white
I	23	0.07 ± 0.03^{j}	1.06 ± 0.05^{m}	0.94^{a}	2.26^{a}
	24	0.45 ± 0.11^{j}	0.85 ± 0.14^{i}	6.44^{b}	12.14^{a}
II	25	1.60 ± 0.30^{i}	2.26 ± 0.24^{k}	22.84^{a}	32.29^{a}
	26	2.90 ± 0.30^{gh}	4.10 ± 0.31^{j}	41.36^{b}	58.56^{a}
	27	4.48 ± 0.27^{bcd}	5.11 ± 0.20^{cdefgh}	63.94^{a}	73.04^{a}
	28	5.32 ± 0.17^{a}	5.66 ± 0.17^{abcd}	76.01^{a}	80.91^{a}
III	29	5.32 ± 0.12^{a}	5.77 ± 0.13^{ab}	75.93^{b}	82.49^{a}
	30	5.59 ± 0.15^{a}	5.64 ± 0.16^{abcd}	79.90^{a}	80.60^{a}
	31	5.62 ± 0.12^{a}	5.08 ± 0.14^{a}	80.23^{a}	83.20^{a}
	32	5.69 ± 0.11^{a}	5.69 ± 0.15^{abcd}	81.23^{a}	81.23^{a}
IV	33	5.52 ± 0.18^{a}	5.70 ± 0.22^{abc}	78.86^{a}	81.39^{a}
	34	5.14 ± 0.25^{ab}	5.53 ± 0.28^{abcdef}	73.44^{a}	79.01^{a}
	35	5.14 ± 0.22^{ab}	5.55 ± 0.30^{abcde}	73.36^{a}	79.30^{a}
	36	4.54 ± 0.20^{bc}	5.19 ± 0.29^{abcdefg}	64.84^{a}	74.09^{a}
V	37	3.44 ± 0.40^{efg}	4.76 ± 0.20^{ghi}	49.14^{b}	68.01^{a}
	38	3.40 ± 0.46^{efg}	4.95 ± 0.22^{fgh}	48.50^{b}	70.77^{a}
	39	4.24 ± 0.30^{cd}	5.10 ± 0.17^{defgh}	60.50^{b}	72.87^{a}
	40	4.30 ± 0.27^{cd}	5.02 ± 0.20^{efgh}	61.41^{b}	71.73^{a}
VI	41	3.71 ± 0.36^{def}	4.58 ± 0.16^{hij}	52.99^{b}	65.37^{a}
	42	3.07 ± 0.38^{fgh}	4.70 ± 0.23^{ghi}	43.84^{b}	67.19^{a}
	43	2.30 ± 0.49^{hi}	4.34 ± 0.32^{ij}	32.91^{b}	61.93^{a}
	44	3.92 ± 0.31^{cde}	4.71 ± 0.14^{ghi}	56.01^{b}	67.23^{a}
Overall	23-44	85.72 ± 3.06^{b}	101.21 ± 1.83^{a}	51.02^{b}	60.24^{a}

HD number carrying the same superscript between weeks did not differ significantly ($P< 0.05$) under AW and RW. HD per cent carrying the same superscripts between AW and RW did not differ significantly ($p<0.05$). The overall means carrying the same superscript under HDN and HD per cent between AW and RW did not differ significantly ($P < 0.05$).

Fig.2: WEEK-WISE MEAN PERCENT HEN-DAY PRODUCTION FROM 23 TO 44 WEEKS OF AGE IN AUSTRA-WHITE AND RHODE-WHITE BIRDS



The hen-day number (HDN) and the HD per cent at 23 and 24 weeks were the same as that of HHN and HH per cent since there was no mortality at these ages in both AW and RW groups. The HDN and its percentages in AW increased significantly up to 28 weeks and from 28 to 35 weeks the figures were comparable. The highest HDN value was 5.69 at 32 weeks and it was reduced to 4.54 at 36 weeks .The HDN decreased significantly to 3.44 at 37 week and to 3.40 at 38 week and from this level it showed a significant increase to 4.24 at 39 week and to 4.30 at 40 weeks. The HD per cent which was 22.84 at 25 weeks increased to 76.01 at 28 weeks and 64.84 at 36 weeks. It declined to 48.50 per cent at 38 weeks and then increased significantly to 60.50 per cent at 39 weeks and declined significantly to 32.91 per cent at 43 weeks and again registered a significant rise to 56.01 per cent at 44 weeks of age.

The Weekly HDN increased significantly until 28 weeks and the peak was 5.82 at 31 weeks of age (Table 7). It declined significantly to 4.76 at 37 weeks and it was comparable until 40 weeks and also in a homogenous group from 37 to 44 weeks of age.

On a comparison between AW and RW, the HDN and HD per cent were significantly higher in RW at 24, 26,29 and also at all weeks from 37 to 44. The overall HDN was 101.21 eggs in RW and 85.72 eggs in AW with 60.24 and 51.02 per cent respectively . The magnitude of variations in weekly HD per cent are represented in figure 2.

Period wise Egg Production

The weekly egg productions from 21 to 44 weeks were pooled in 28 - day periods (periods I to VI) for easy and meaningful interpretation of the results. Since egg production commenced late, the first period consisted egg

Table 8.Period - wise mean hen - housed number and hen - housed per cent production in Austra - white and Rhode- white from 23 to 44o weeks of age

Periods	Age in weeks	HH Number		HH Per cent	
		Austra-white	Rhode-white	Austra-white	Rhode-white
I	23-24	0.52 ± 0.13^{c}	1.02 ± 0.17^{e}	1.85^{b}	3.66^{e}
II	25-28	14.18 ± 0.99^{d}	16.93 ± 0.83^{df}	50.66^{d}	60.46^{df}
III	29-32	22.00 ± 0.35^{a}	22.39 ± 0.76^{a}	78.62^{a}	79.95^{a}
IV	33-36	19.92 ± 0.73^{a}	21.44 ± 1.07^{ab}	71.16^{a}	76.55^{ab}
V	37-40	14.47 ± 1.42^{d}	19.28 ± 0.75^{bc}	51.69^{d}	68.86^{bc}
VI	41-44	11.87 ± 1.52^{d}	17.75 ± 0.87^{cf}	42.38^{d}	63.39^{cf}
Overall	23-44	13.83 ± 3.39^{b}	16.47 ± 3.00^{a}	49.39^{b}	58.81^{a}

Period wise means carrying the same superscript under HHN and HH per cent within as well as between AW and RW did not differ significantly ($P< 0.05$).

The overall means carrying the same superscript under HHN and HH per cent between AW and RW did not differ significantly ($P < 0.05$).

Fig. 3 PERIODWISE [illegible] WHITE AND RHODE WHITE BIRDS

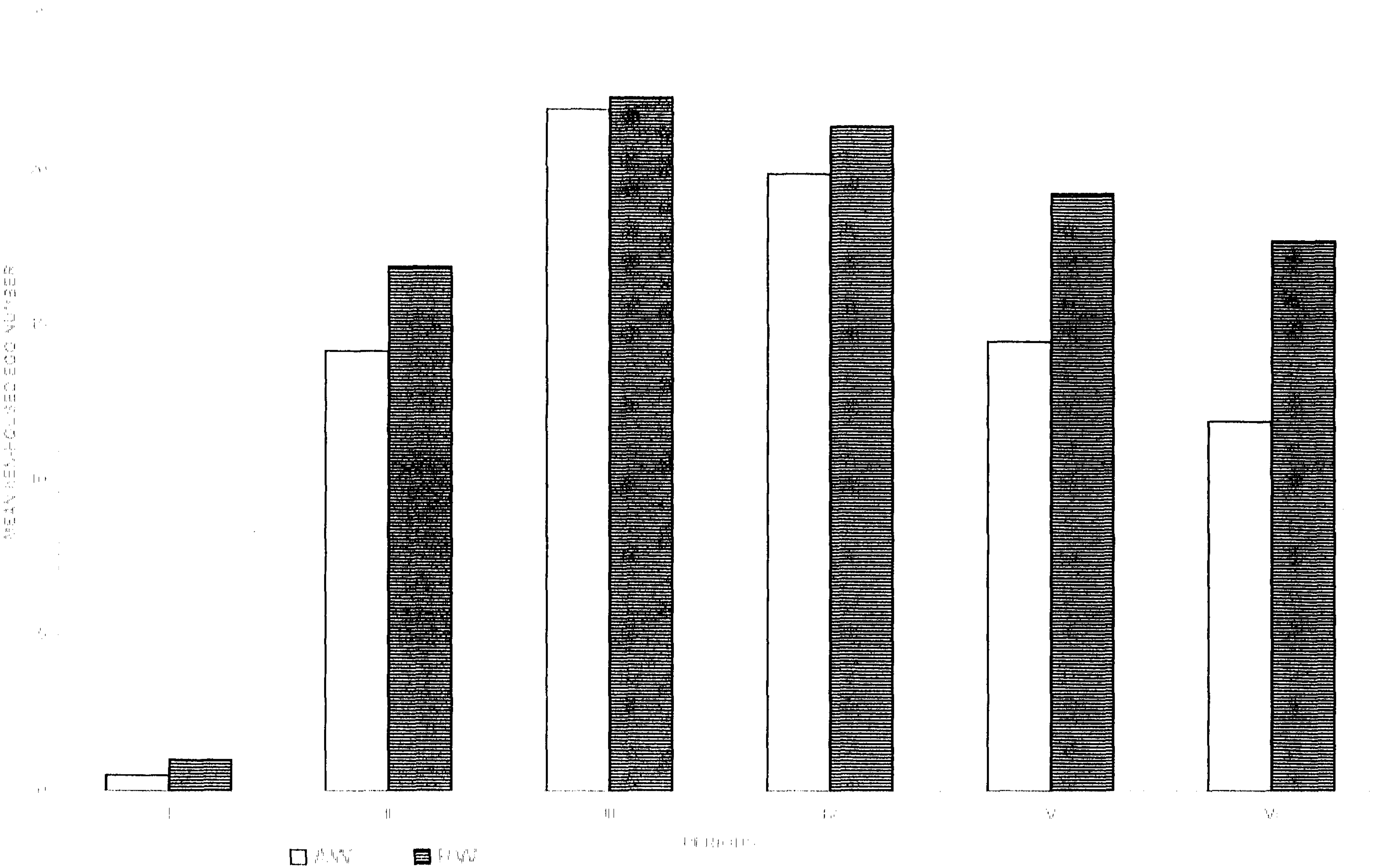
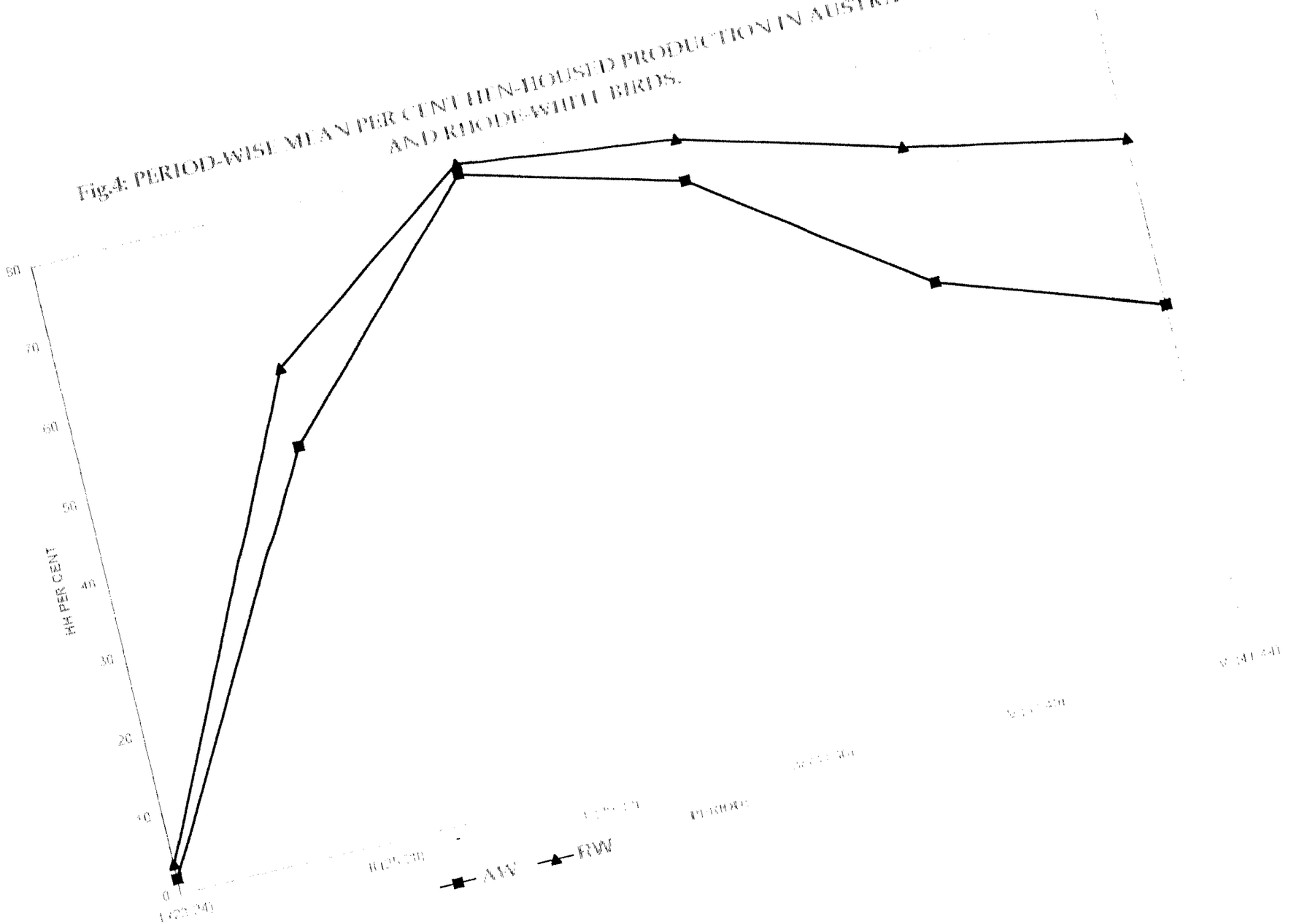


Fig.4: PERIOD-WISE MEAN PER CENT HEN-HOUSED PRODUCTION IN AUSTRA-WHITE AND RHODE-WHITE BIRDS.



production for 23 and 24 weeks and in all subsequent periods, the egg production for four weeks duration were pooled and set out on hen-housed basis in Table 8 and on hen-day basis in Table 9.

Hen-housed number and per cent

The period-wise data presented in Table 8 revealed that the HHN in period I was only 0.52 in Austra-white and it increased significantly to 14.18 in period II and to 22.01 in period III. Thereafter it reduced to 19.92 in period IV. The mean values in periods V and VI were (14.47 and 11.87) significantly lower than the previous periods III and IV. The percentages in the above periods showed that it was 1.85 per cent in period I and increased significantly to 50.66 and 78.62 per cent in periods II and III. Thereafter it reduced to 71.16, 51.69 and further to 42.38 per cent in periods IV,V and VI. The overall mean was 49.39 per cent.

In Rhode-white birds, the period- wise performance presented in Table 8 showed a different trend in magnitude and period-wise variations. The HHN in period I which was 1.02 increased significantly to 16.93 in period II and 22.39 in period III and then reduced numerically to 21.44 in period IV and 19.28 in period V and 17.75 in period VI. The percentages were 3.66,60.46,79.95,76.55, 68.86 and 63.39 respectively with an overall mean of 58.81 per cent. The period-wise HHN and per cent were significantly higher in RW birds at periods I, V and VI. The overall period - wise mean was also significantly higher in RW birds. The period wise HHN and HH per cent are shown in figures 3 and 4 respectively.

Hen-day number and per cent

The period - wise data presented in Table 9 revealed that HD number in AW was 0.52 in period I and it increased significantly to 14.28,22.21 in periods II and III respectively. The HDN was reduced to 20.34, 15.37 and 13.00 in periods IV,V and VI respectively. The corresponding percentages were 1.85, 51.01,79.32, 72.63, 54.89 and 46.44 with an overall mean of 51.02.

The period-wise HD number in RW was 1.02 in period I. It significantly increased to 17.14, 22.93 in periods II and III respectively. Thereafter reduced numerically to 21.97 in period IV. Further reduction was significant to 19.84 in period V and to 18.32 in period VI. The HD per cent were 3.66, 61.20, 81.88,78.45, 70.85 and 65.43 in periods I to VI respectively with an overall mean per cent of 60.24.

On a comparison of period-wise data between AW and RW it was observed that the hen-day production was significantly higher in RW in periods I,II,V and VI. The overall mean period wise HDN was 16.87 eggs in Rhode-white as against 14.29 in Austra-white. The Hen-day percentage were 60.24 in RW as against 51.02 per cent in AW. The magnitude of period - wise variations in hen - day number and the hen - day per cent production are set out in figures 5 and 6 respectively.

Table 9. Period-wise mean hen-day number and hen-day per cent in Austra-white and Rhode-white from 23-44 weeks of age.

Periods	Age in weeks	HD Number		HD Per cent	
		Austra-white	Rhode-white	Austra-white	Rhode-white
I	23-24	0.52 ± 0.13 ^{c}	1.02 ± 0.17 ^{d}	1.85 ^{c}	3.66 ^{d}
II	25-28	14.28 ± 0.96 ^{b}	17.14 ± 0.85 ^{c}	51.01 ^{b}	61.20 ^{c}
III	29-32	22.21 ± 0.41 ^{a}	22.93 ± 0.49 ^{a}	79.32 ^{a}	81.88 ^{a}
IV	33-36	20.34 ± 0.73 ^{a}	21.97 ± 0.99 ^{a}	72.63 ^{a}	78.45 ^{a}
V	37-40	15.37 ± 1.35 ^{b}	19.84 ± 0.63 ^{f}	54.89 ^{b}	70.85 ^{f}
VI	41-44	13.00 ± 1.45 ^{b}	18.32 ± 0.69 ^{fc}	46.44 ^{b}	65.43 ^{fc}
Overall	23-44	14.29 ± 3.06 ^{b}	16.87 ± 1.83 ^{a}	51.02 ^{b}	60.24 ^{a}

Period wise means carrying the same superscript under HDN and HD per cent within as well as between AW and RW did not differ significantly ($P<0.05$).

The overall means carrying the same superscript under HDN and HD per cent between AW and RW did not differ significantly ($P< 0.05$).

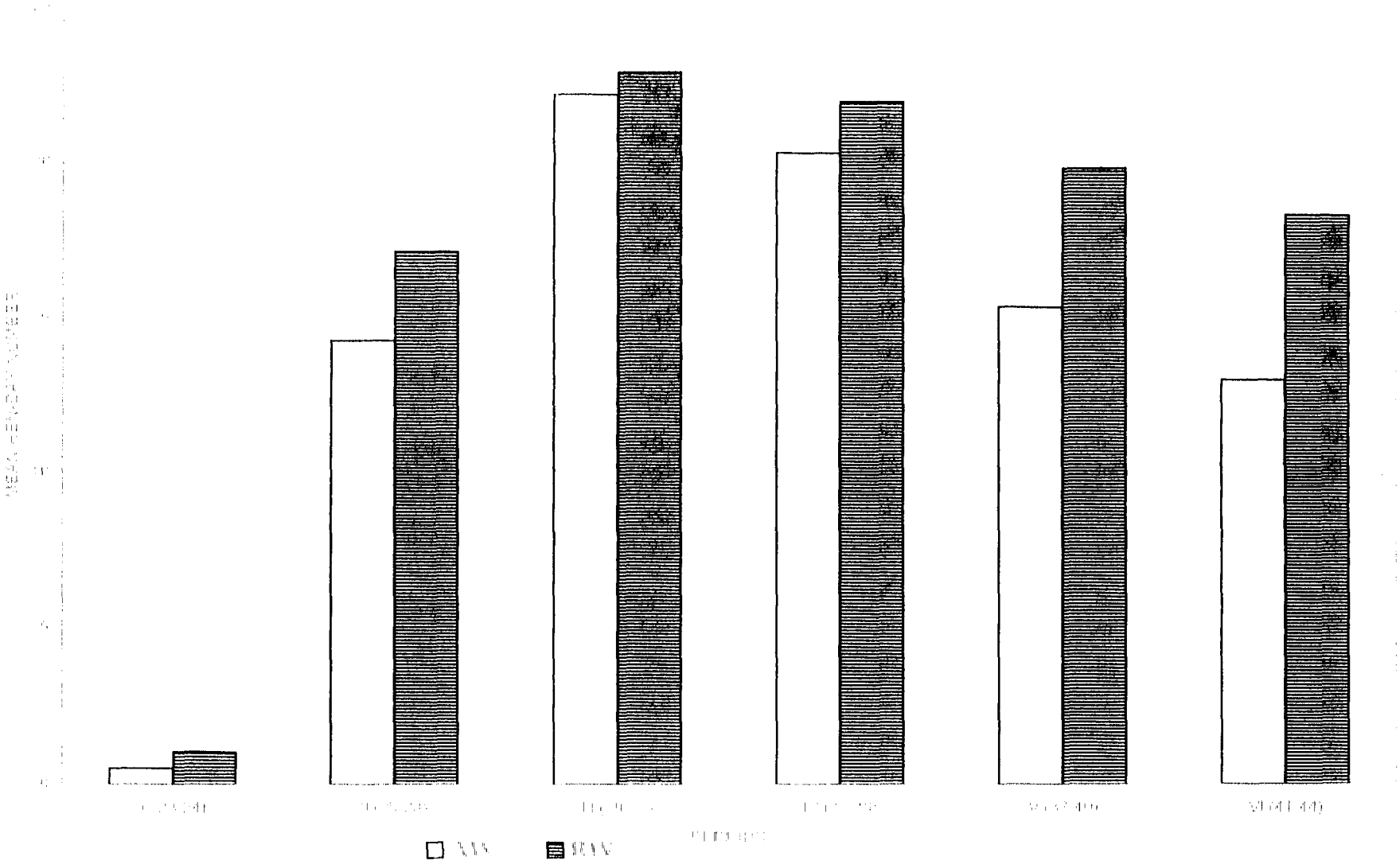
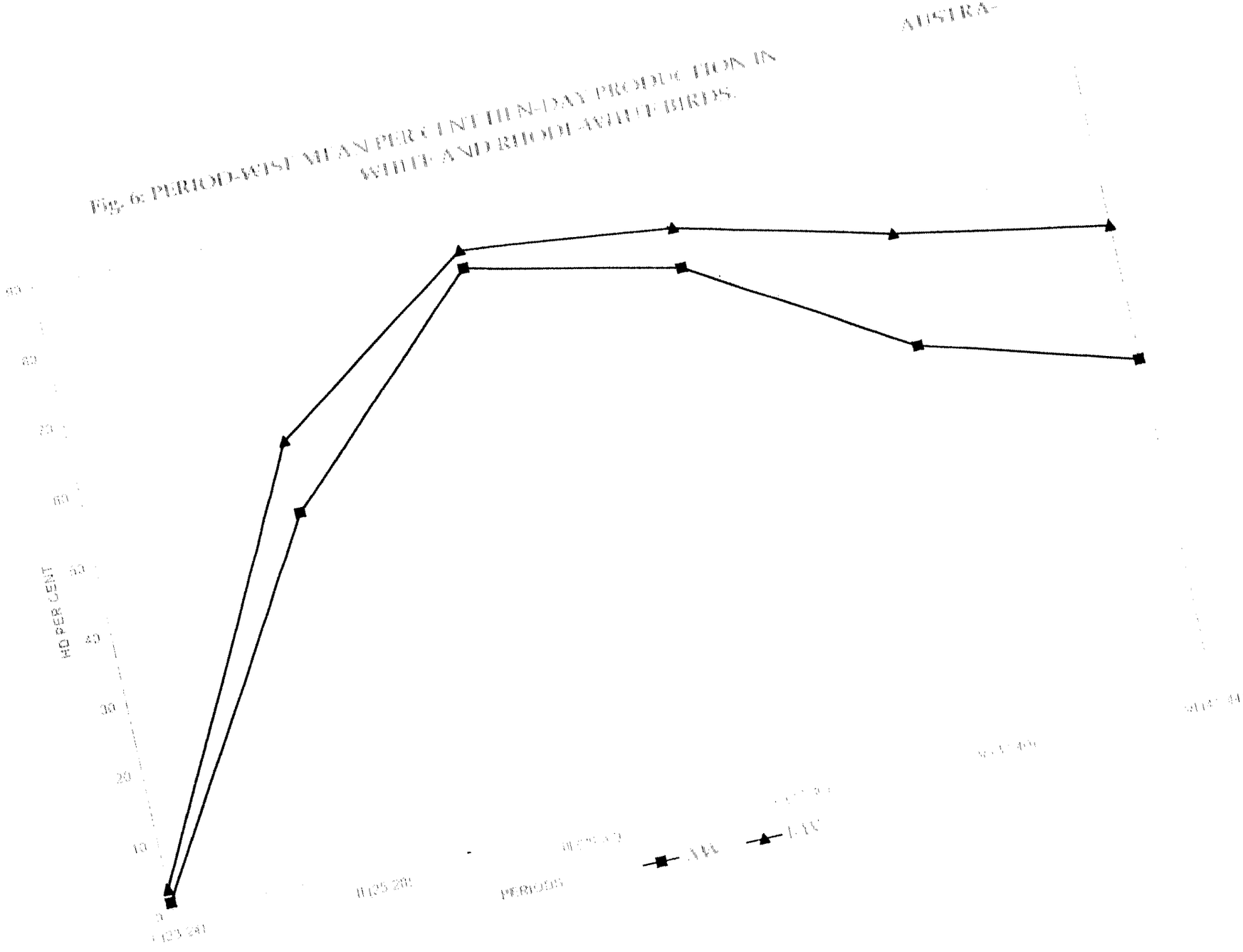


Fig. 6. PERIOD-WISE MEAN PER CENT EGG-LAY PRODUCTION IN WHITE AND BROWN LAYING BIRDS.



Feed Consumption

The mean daily feed consumption (g) in Austra - white and Rhode - white birds at different periods from I to VI are presented in Table 10.

In AW, the mean feed consumption during period I, that is from 21 to 24 weeks was 83.48 g per bird per day. The mean daily feed consumption showed significant increase to 106.62g in period II and to 117.36 g in period III. In period IV, the feed consumption was 115.82g and it was statistically comparable with the mean value recorded during period III. The feed consumption during periods V and VI (127.79 and 128.26 g) were almost same and were significantly higher ($P < 0.05$) than all the previous periods. The overall mean daily feed consumption from 21 to 44 week of age was 113.22 g in AW birds.

In RW, the mean feed consumption during period I, that is from 21 to 24 weeks of age was 84.65 g per bird per day and showed a significant increase($P < 0.05$) during periods II (107.58 g) and III (112.72 g) as in the case of AW. At period IV the mean daily feed consumption was 118.81 g and it was statistically comparable with the mean value recorded during period III. The feed consumption during periods V (125.42 g) and VI (122.79 g) were comparable and the former significantly higher ($P < 0.05$) than that of period III and the latter was higher than periods I and II only is a deviation from AW birds. However, the feed consumption recorded during periods V and VI in RW were numerically lesser than the corresponding values recorded in AW.

On a comparison between AW and RW, the period wise mean values did not differ significantly between Austra - white and Rhode white at any period during 21 to 44 weeks of age. The overall mean daily feed intake were

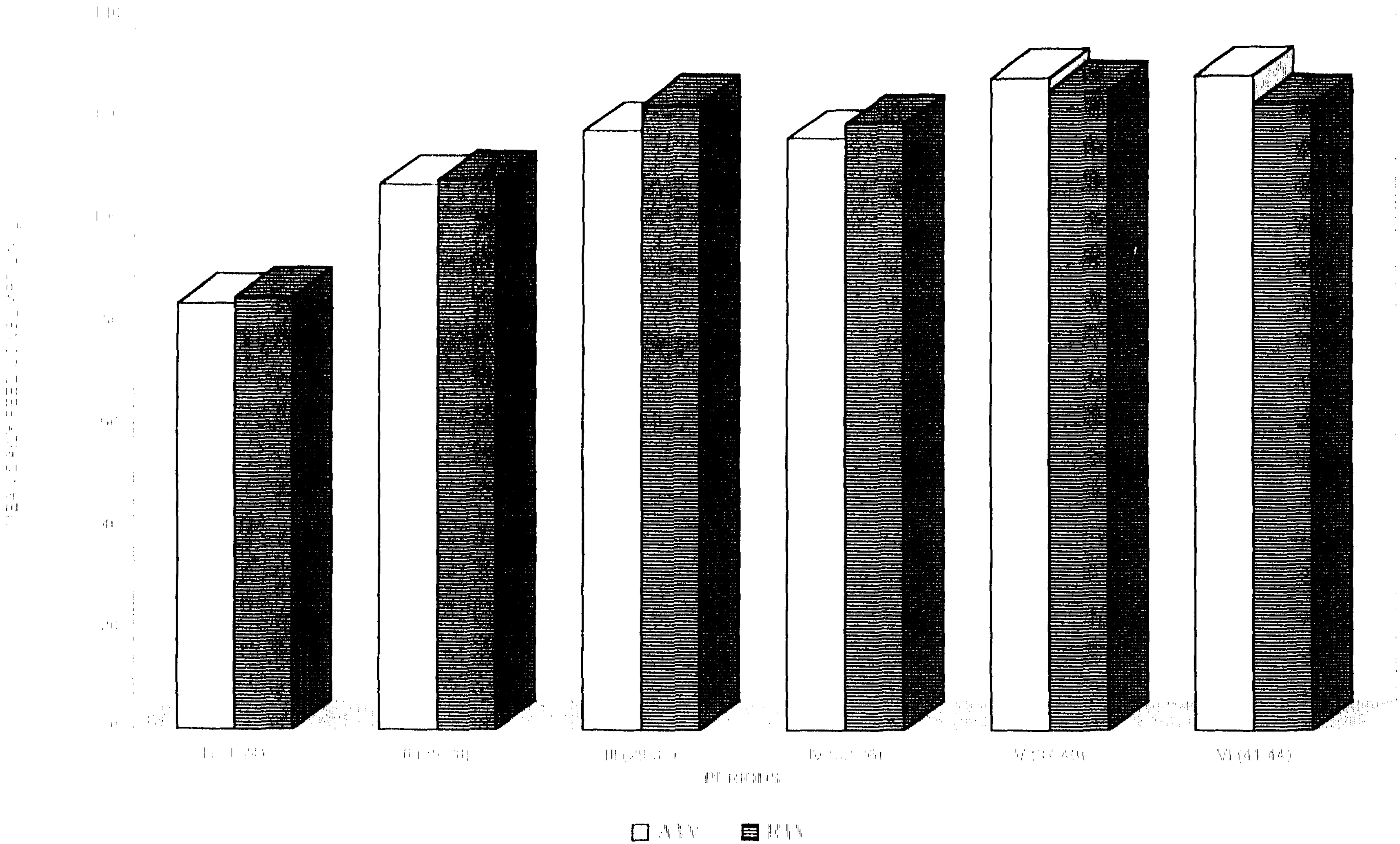
Table 10. Mean daily feed consumption (g) in Austra-white and Rhode-white birds at different periods

Periods	Age in weeks	Austra-white	Rhode-white
I	21-24	83.48 ± 0.96 [d]	84.65 ± 0.67 [d]
II	25-28	106.62 ± 0.99 [c]	107.58 ± 1.01 [c]
III	29-32	117.36 ± 1.75 [b]	122.72 ± 2.58 [ab]
IV	33-36	115.82 ± 0.85 [b]	118.81 ± 2.41 [b]
V	37-40	127.79 ± 2.34 [a]	125.42 ± 2.57 [a]
VI	41-44	128.26 ± 2.76 [a]	122.79 ± 2.51 [ab]
Overall		113.22 ± 2.32 [a]	113.66 ± 2.23 [a]

Period wise means carrying the same superscript within as well as between AW and RW did not differ significantly ($P< 0.05$).

The overall means carrying the same superscript between AW and RW did not differ significantly ($P< 0.05$).

Fig.7: MEAN DAILY FEED CONSUMPTION (g) IN AUSTRA WHITE AND RHODE-WHITE BIRDS AT DIFFERENT PERIODS



similar in AW and RW and the values were 113.22 g in Austra - white and 113.66g in Rhode- white. The period-wise variations in daily feed intake are plotted in figure 7.

Feed Efficiency

The mean feed efficiency per dozen eggs in AW and RW for periods II to VI are presented in Table 11. Since the egg production was very low during period I, i.e. from 21-24 week, the feed efficiency value in AW and RW were not taken into consideration for statistical analysis and hence not shown in Table 11.

In AW, the mean feed efficiency during periods II,III and IV were 2.58, 1.78 and 1.93 respectively and were statistically comparable among each other. The feed efficiency in period V (2.99) and VI (3.70) were significantly inferior than those in periods III and IV. The overall mean feed efficiency from 25 to 44 week of age was 2.60 in AW birds.

The mean feed efficiency in RW during II period was 2.15 and it was significantly better in periods III (1.81) and IV (1.85)as against comparable values in AW. At period V, the feed efficiency was 2.14 and during period VI it was 2.28. This value was statistically comparable with that of period II and to this extent it varies from AW birds. The overall mean feed efficiency in Rhode white was 2.05 against the value of 2.60 in AW.

On a comparison between Austra-white and Rhode - white, it was observed that the mean feed efficiency values were better significantly ($P < 0.05$) in Rhode - white birds during periods II, V and VI. Hence, the overall mean feed efficiency was also significantly better in Rhode-white birds (2.05). The period - wise variations in mean feed efficiency per dozen eggs are represented as histogram in figure 8.

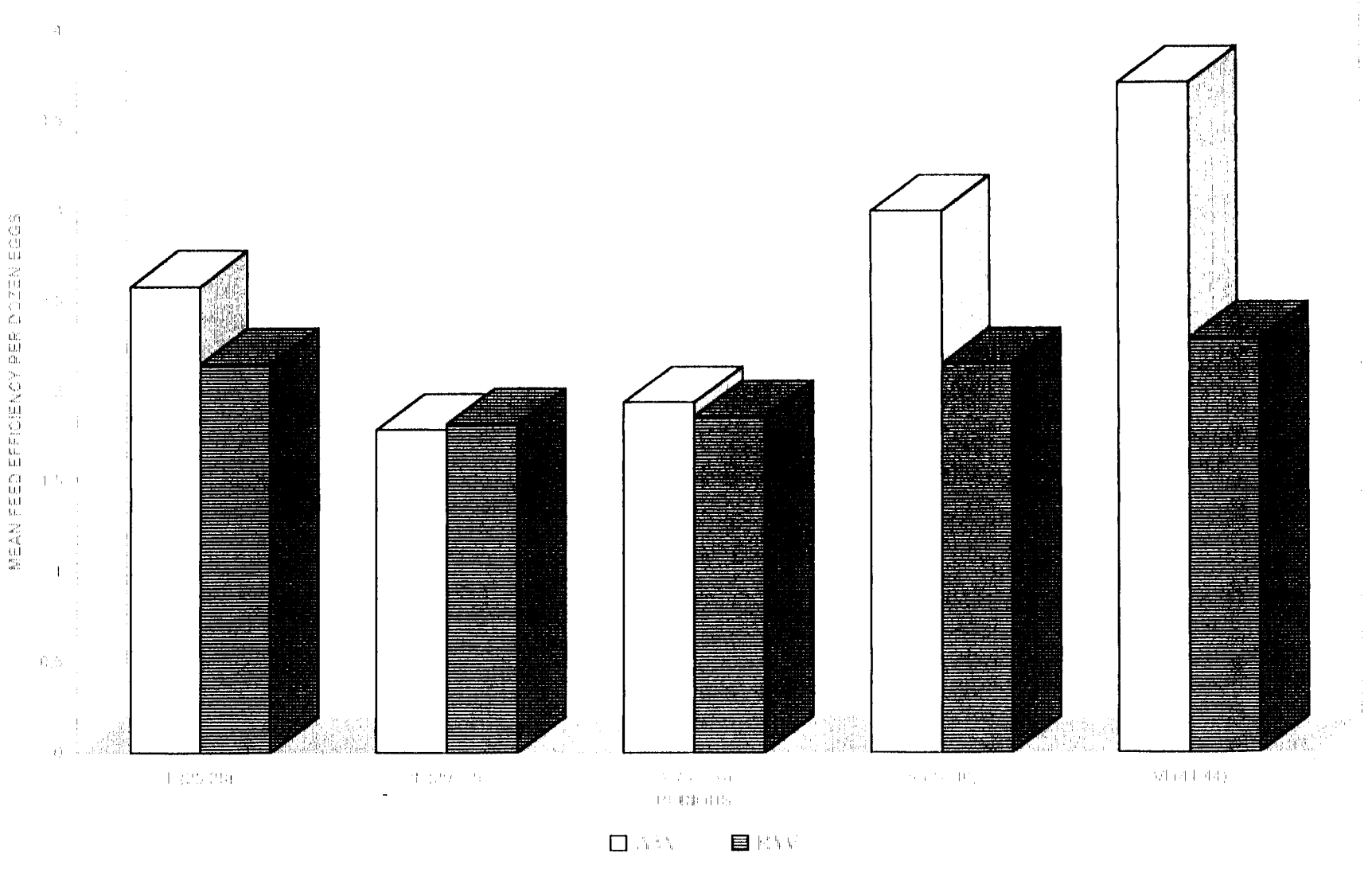
Table 11. Mean feed efficiency per dozen eggs in Austra-white and Rhode-white birds at different periods.

Periods	Age in weeks	Austra-white	Rhode-white
II	25-28	2.58 ± 0.16 [bc]	2.15 ± 0.11 [f]
III	29-32	1.78 ± 0.03 [c]	1.81 ± 0.07 [e]
IV	33-36	1.93 ± 0.06 [c]	1.85 ± 0.11 [de]
V	37-40	2.99 ± 0.33 [ab]	2.14 ± 0.09 [fd]
VI	41-44	3.70 ± 0.54 [a]	2.28 ± 0.12 [e]
Overall		2.60 ± 0.17[b]	2.05 ± 0.05[a]

Period wise means carrying the same superscript within as well as between AW and RW did not differ significantly ($P< 0.05$).

The overall means carrying the same superscript between AW and RW did not differ significantly ($P< 0.05$).

Fig.8: MEAN FEED EFFICIENCY PER DOZEN EGGS IN AUSTRA WHITE AND RHODE-WHITE BIRDS AT DIFFERENT PERIODS.



Egg Weight

The mean values based on individual egg weights recorded for three days in each period in AW and RW are presented in Table 12.

At 24 weeks of age, the mean egg weight (EW) was 43.33 g in AW. The mean egg weight showed significant increase at 28 (46.99 g) and 32 (49.22 g) weeks of age. There was numerical decline in egg weight to 48.15 g at 36 weeks of age but it was comparable to that of egg weights recorded at 32 and 40 weeks of age. The mean egg weights recorded at 40 and 44 weeks of age were (49.59 and 50.82 g) statistically comparable each other. The overall mean egg weight from 24 to 44 weeks of age was 48.02 g in Austra - white group.

The mean egg weight (EW) recorded in RW birds were numerically lower than that of AW. At 24 weeks of age, the mean egg weight was 42.67 g in RW. The mean egg weight showed significant increase to 44.93 g at 28 weeks and to 47.44 g at 32 weeks of age. The mean egg weights at 36 and 40 weeks of age were 46.73 and 47.71 g. These values were statistically comparable to that of 32 week of age. The mean egg weight at 44 week of age was only 49.50 g and it was significantly higher ($P < 0.05$) than all the egg weights recorded during the previous ages.

On a comparison between Austra - white and Rhode-white, it was observed that the EW at 28,32 and 40 weeks of age were significantly high ($P < 0.05$) in Austra -white than the respective values recorded in Rhode -white. The overall mean egg weight from 24 to 44 weeks of age was also significantly higher in Austra - white than that in Rhode - white ($P < 0.05$). The magnitude of variations in mean egg weight recorded at different ages are plotted in figure 9.

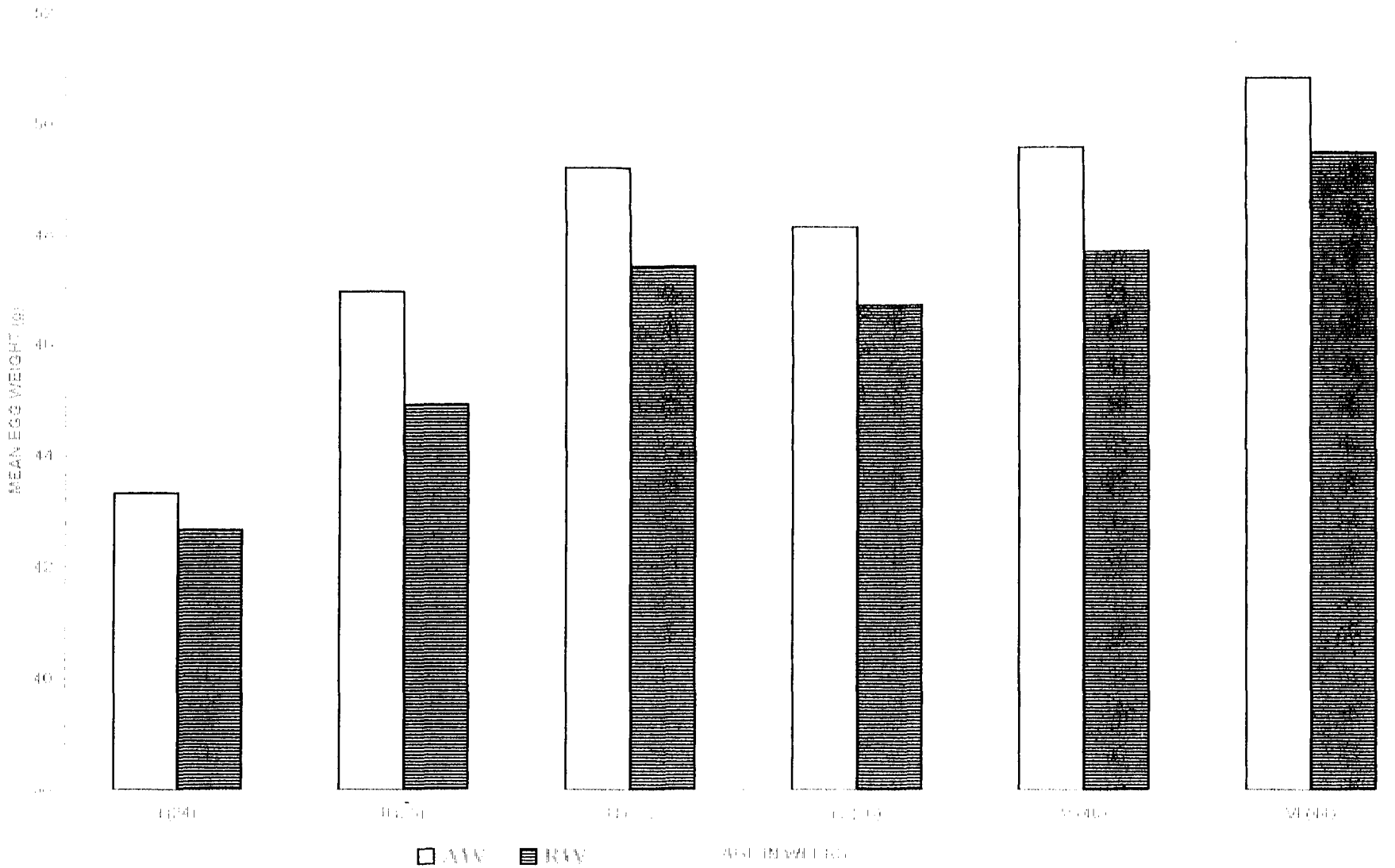
Table 12. Mean egg weight(g) in Austra-white and Rhode-white at different ages

Periods	Age in weeks	Austra-white	Rhode-white
I	24	43.33 ± 0.72 ^{d}	42.67 ± 0.71 ^{d}
II	28	46.99 ± 0.45 ^{c}	44.93 ± 0.34 ^{f}
III	32	49.22 ± 0.50 ^{ab}	47.44 ± 0.22 ^{c}
IV	36	48.15 ± 0.61 ^{bc}	46.73 ± 0.31 ^{c}
V	40	49.59 ± 0.58 ^{ab}	47.71 ± 0.59 ^{c}
VI	44	50.82 ± 0.53 ^{a}	49.50 ± 0.54 ^{a}
Overall		48.02 ± 0.41 ^{a}	46.50 ± 0.37 ^{b}

Period wise means carrying the same superscript within as well as between AW and RW did not differ significantly ($P< 0.05$).

The overall means carrying the same superscript between AW and RW did not differ significantly ($P< 0.05$).

Fig.9: MEAN EGG WEIGHT (g) IN ACCRA-WHITE AND RHODE ISLAND WHITE AT DIFFERENT AGES.



Egg Mass

The mean egg mass (Kg) per day recorded at interim ages in Austra-white and Rhode - white birds are presented in Table 13. These mean values were arrived on the basis of total egg mass recorded for three days each at an interval of four weeks commencing from 24 weeks.

The mean egg mass (EM) per day during period I i.e. at the end of 24 weeks of age was 0.53 Kg and it increased significantly to 4.46 Kg towards the end of 28 weeks i.e. in period II . The mean egg mass at the end of 32 weeks (Period III) was 4.74 Kg and it was statistically comparable to that of period II. The mean egg mass during periods IV ,V and VI were 3.32, 3.36 and 3.51 Kg respectively and was comparable statistically among each other. These mean values were significantly lower than those values recorded in periods II and III. The overall mean egg mass per day in Austra - white was 3.32 Kg based on the 18 days total egg mass recorded in the entire period of experiment.

In RW birds, the mean egg mass per day during period I at the end of 24 weeks of age was 0.81 Kg and it increased significantly to 4.34 Kg towards the end of 28 weeks in period II. The mean egg mass at the end of 32 weeks (period III) was 4.52 Kg and it was statistically comparable to that of period II as was seen in AW birds. The mean egg mass during periods IV, V and VI were 3.91, 3.83 and 3.94 Kg respectively and were comparable statistically among each other. These mean values were significantly lower than the value 4.52 Kg recorded in period III. All these values were comparable to that of period II. The overall mean value of egg mass per day in Rhode - white birds was 3.56 Kg based on the 18 days total egg mass record to representing the entire VI periods of the experiment. The variations in egg mass are depicted in figure 10.

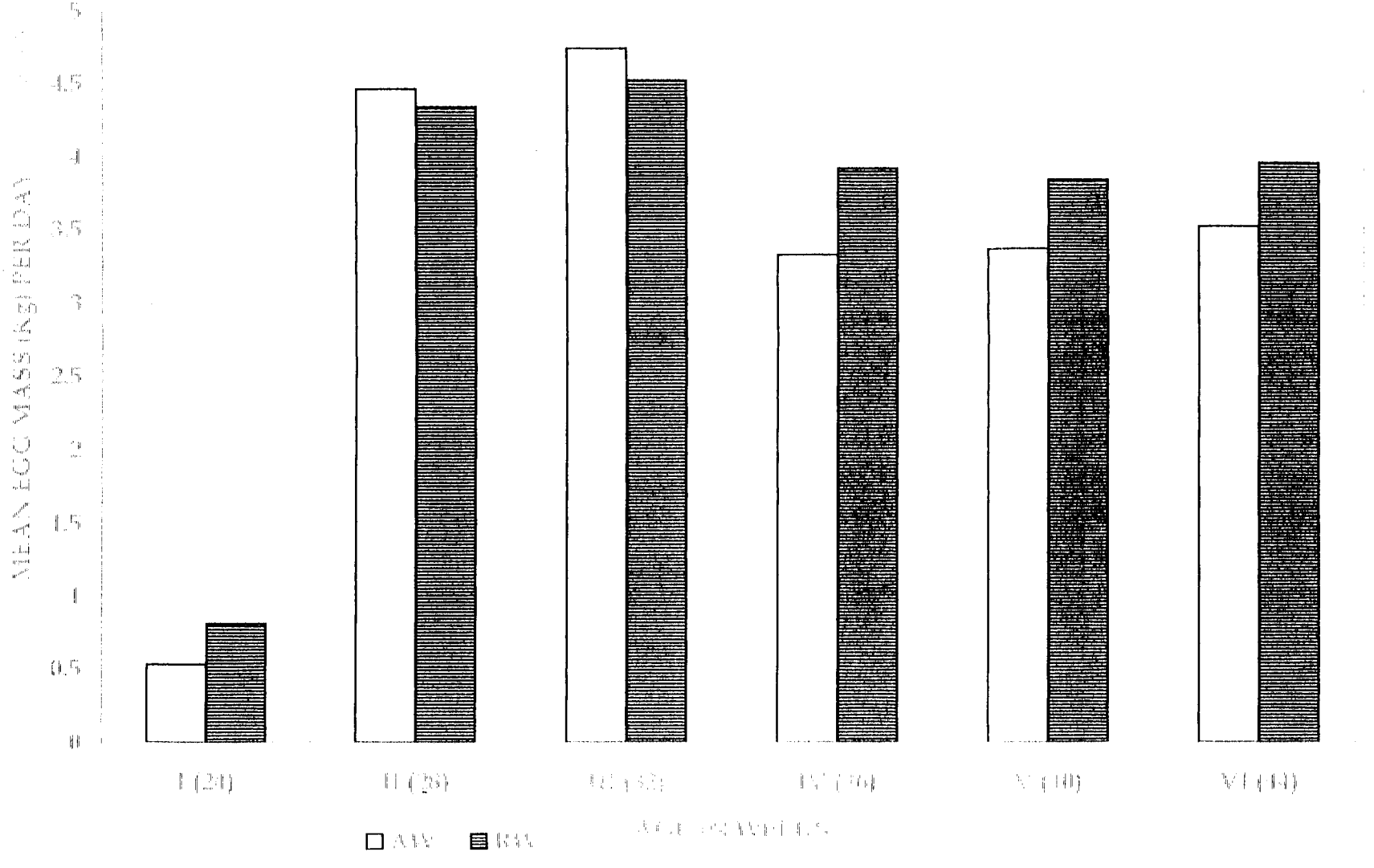
Table 13. Mean egg mass (kg) per day in Austra-white and Rhode-white at different ages.

Periods	Age in weeks	Austra-white	Rhode-white
I	24	0.53 [c]	0.81 [c]
II	28	4.46 [a]	4.34 [ab]
III	32	4.74 [a]	4.52 [a]
IV	36	3.32 [b]	3.91 [b]
V	40	3.36 [b]	3.83 [b]
VI	44	3.51 [b]	3.94 [b]
Overall		3.32[a]	3.56[a]

Period wise means carrying the same superscript within as well as between AW and RW did not differ significantly ($P< 0.05$).

The overall means carrying the same superscript between AW and RW did not differ significantly ($P< 0.05$).

Fig.10: MEAN E.C.G MASS(gm) PER DAY IN AUSTRA WHITE AND RHODE-WHITE AT DIFFERENT AGES.



On a comparison between Austra - white and Rhode white, it was revealed that the variation in the mean daily egg mass between Austra - white and Rhode- white was statistically non-significant. However the numerical values were higher in Rhode - white eggs at all periods except periods II and III where in it was high in AW. The overall mean egg mass per day also showed a higher numerical value in Rhode - white (3.56 Kg) than that of Austra - white (3.32 Kg).

Egg Quality Traits

Per cent Shell

The mean values of per cent shell in eggs from Austra - white and Rhode-white are presented in Table 14. The mean per cent shell in Austra-white at the end of 24 weeks of age was 11.86 per cent . It reduced significantly to 10.98 per cent at 28 weeks of age and it again increased significantly to 11.87 per cent at the end of 32 weeks. The mean value recorded at the end of 36 weeks of age was comparable to 24 and 32 weeks of age. The per cent shell showed a significant decline at 40 weeks of age and the mean value recorded at this age was 7.52 per cent. It significantly increased to 10.86 per cent at 44 weeks of age. The overall mean per cent shell during 24 to 44 weeks of age was 10.86 in eggs from Austra - white birds.

The mean per cent shell in eggs from Rhode - white birds were 11.62, 11.23 and 11.29 at 24,28,32 weeks of age respectively. These mean values were statistically comparable among each other. The mean value recorded at 40 weeks of age was significantly lower in comparison to all other periods. Per cent shell increased at 44 weeks of age and was statistically comparable with those mean values recorded during periods II to IV. The overall mean value recorded in eggs from Rhode-white birds was 11.10 per cent.

Table 14. Mean per cent shell in Austra-white and Rhode-white eggs at different ages

Periods	Age in weeks	Austra-white	Rhode-white
I	24	11.86 ± 0.14^{b}	11.62 ± 0.10^{ab}
II	28	10.98 ± 0.19^{c}	11.23 ± 0.14^{bc}
III	32	11.87 ± 0.20^{b}	11.29 ± 0.22^{bc}
IV	36	12.09 ± 0.12^{b}	11.29 ± 0.10^{bc}
V	40	7.52 ± 0.12^{f}	9.74 ± 0.33^{d}
VI	44	10.86 ± 0.18^{c}	10.82 ± 0.06^{c}
Overall		10.86 ± 0.24^{a}	11.10 ± 0.12^{a}

Period wise means carrying the same superscript within as well as between AW and RW did not differ significantly ($P< 0.05$).

The overall means carrying the same superscript between AW and RW did not differ significantly ($P< 0.05$).

On a comparison between Austra-white and Rhode-white, it was observed that the per cent shell was significantly higher ($P< 0.05$) in eggs from Rhode-white birds at 40 weeks of age only. However, the difference between overall mean values were not significant.

Shell Thickness

The mean shell thickness (mm) in Austra-white and Rhode-white eggs at different periods are presented in Table 15. The results revealed that shell thickness at 24 and 28 weeks of age was same in AW (0.49 mm) and the mean values recorded during 32,36,40 and 44 weeks of age were statistically comparable among each other (0.39,0.39,0.36 and 0.37 mm) and these mean values were significantly lower than those recorded at 24 and 28 week of age. The overall mean shell thickness in Austra-white eggs was 0.42 mm.

The mean shell thickness in Rhode-white eggs were 0.48 and 0.46 at 24 and 28 weeks of age and the difference was statistically non-significant. A significant reduction in shell thickness was noticed at 32 weeks of age (0.39 mm) in comparison with 24 and 28 weeks. The shell thickness at 36 weeks of age was 0.42 mm but it was significantly lower than that of 24 weeks of age but comparable to 28 and 32 weeks of age. The mean shell thickness at 40 and 44 week of age was the same (0.36 mm) and it was significantly lower than the earlier ages except 32 weeks. The overall mean shell thickness in Rhode-white eggs was 0.41 mm and the mean shell thickness at none of the above ages differed statistically between Austra-white and Rhode-white eggs.

Table 15. Mean shell thickness (mm) in Austra-white and Rhode-white eggs at different ages.

Periods	Age in weeks	Austra-white	Rhode-white
I	24	0.49 ± 0.01^{a}	0.48 ± 0.01^{a}
II	28	0.49 ± 0.03^{a}	0.46 ± 0.03^{ab}
III	32	0.39 ± 0.01^{bd}	0.39 ± 0.01^{cd}
IV	36	0.39 ± 0.02^{b}	0.42 ± 0.02^{bc}
V	40	0.36 ± 0.00^{bd}	0.36 ± 0.01^{d}
VI	44	0.37 ± 0.01^{bd}	0.36 ± 0.01^{d}
Overall		0.42 ± 0.01^{a}	0.41 ± 0.01^{a}

Period wise means carrying the same superscript within as well as between AW and RW did not differ significantly ($P< 0.05$).

The overall means carrying the same superscript between AW and RW did not differ significantly ($P< 0.05$).

Per cent albumen

The mean per cent albumen in Austra-white and Rhode-white eggs at different ages are presented in Table 16. The mean per cent albumen in Austra-white showed that it was significantly higher at 24 and 40 weeks of age (61.54 and 61.31 per cent) in comparison with other ages and the per cent albumen at 28,32,36 and 44 weeks of age were in a homogenous group with mean values of 59.66, 59.98, 58.79 and 59.37 per cent respectively. At 44 weeks of age, mean value was significantly lower than that of 40 weeks of age. The overall mean value of albumen in Austra - white egg was 60.11 per cent.

In RW eggs, the per cent albumen recorded during 24 to 40 weeks of age was in a homogenous group with mean values of 60.00, 60.25, 59.09, 59.65 and 59.31 per cent at four weekly intervals respectively. The reduction in albumen per cent at 44 weeks of age (58.02 per cent) was significantly lower than the previous ages with an exception that it was comparable to that of 32 week of age. The overall mean value of albumen content in Rhode - white egg was 59.39 per cent .

On a comparison between Austra - white and Rhode - white eggs, the albumen percentage was significantly lower at 40 and 44 weeks of age in Rhode - white eggs and the percentages at all other ages were comparable. Even though the differences in overall mean per cent albumen between Austra - white and Rhode-white were very narrow, it differed statistically indicating significantly lower albumen content in Rhode - white eggs.

Table 16. Mean per cent albumen in Austra-white and Rhode-white eggs at different ages.

Periods	Age in weeks	Austra-white	Rhode-white
I	24	61.54 ± 0.68 [c]	60.00 ± 0.47 [ac]
II	28	59.66 ± 0.30 [a]	60.25 ± 0.28 [a]
III	32	59.98 ± 0.31 [a]	59.09 ± 0.55 [ab]
IV	36	58.79 ± 0.39 [a]	59.65 ± 0.32 [a]
V	40	61.31 ± 0.41 [c]	59.31 ± 0.30 [a]
VI	44	59.37 ± 0.32 [a]	58.02 ± 0.46 [b]
Overall		60.11 ± 0.22 [a]	59.39 ± 0.19 [b]

Period wise means carrying the same superscript within as well as between AW and RW did not differ significantly ($P< 0.05$).

The overall means carrying the same superscript between AW and RW did not differ significantly ($P< 0.05$).

Per cent Yolk

The mean per cent yolk in Austra - white and Rhode - white eggs at different periods are presented in Table 17. In Austra - white eggs, the mean percentages of yolk at 24 and 28 weeks of age was statistically comparable (26.61 and 26.79 per cent). The per cent yolk in eggs from 32 to 44 week of age (29.19, 29.74, 30.00 and 30.19) fall in a homogenous group and was significantly higher ($P < 0.05$) than those recorded at 24 and 28 week of age. The overall mean yolk percentage in Austra - white egg was 28.75 per cent.

In Rhode - white eggs, the per cent yolk was statistically comparable at 24 , 28 and 32 week of age and the mean values were 28.33, 28.47 and 28.88 per cent respectively. The yolk percentages at 36, 40 and 44 week of age were 29.95, 30.38 and 30.82 per cent. Although, these values were statistically comparable among each other, a significant increase in per cent yolk at 40 and 44 week of age was noticed in comparison to 24 to 32 weeks of age. The overall mean per cent yolk was 29.47 per cent in Rhode-white eggs.

On a comparison between Austra- white and Rhode- white eggs, it was observed that only the overall mean per cent yolk was significantly higher ($P < 0.05$) in Rhode- white eggs. However the differences in per cent yolk between Austra-white and Rhode-white eggs were non- significant at all ages from 24 to 44 weeks of age.

Table 17. Mean per cent yolk in Austra-white and Rhode-white eggs at different ages

Periods	Age in weeks	Austra-white	Rhode-white
I	24	26.61 ± 0.65^{c}	28.33 ± 0.52^{c}
II	28	26.79 ± 0.57^{c}	28.47 ± 0.80^{c}
III	32	29.19 ± 0.24^{ab}	28.88 ± 0.29^{bc}
IV	36	29.74 ± 0.24^{ab}	29.95 ± 0.19^{ab}
V	40	30.00 ± 0.13^{ab}	30.38 ± 0.33^{a}
VI	44	30.19 ± 0.21^{ab}	30.82 ± 0.40^{a}
Overall		28.75 ± 0.26^{b}	29.47 ± 0.23^{a}

Period wise means carrying the same superscript within as well as between AW and RW did not differ significantly ($P< 0.05$).

The overall means carrying the same superscript between AW and RW did not differ significantly ($P< 0.05$).

Livability

The per cent livability in Austra - white and Rhode - white birds at different ages from 21 to 44 week of age are presented in Table 18. The results indicated that the overall livability was 89.17 per cent in Austra - white birds and 95.83 per cent in Rhode-white birds. The difference between livability percentages was found to be statistically significant ($P < 0.05$). The total number of birds died was 13 in Austra - white group and five in Rhode - white group from 21 to 44 week of age. But the differences in livability at all age were non-significant between AW and RW from 21 to 44 week of age.

Economics

The economics of egg production over the feed cost from 23 to 44 week of age are set out in Table 19. The total feed consumed was 2054.83 Kg in Austra - white birds and 2095.39 Kg in Rhode - white birds. The feed consumed per egg was 206.35 g in Austra - white and 176.72 g in Rhode - white. The total number of eggs produced during the entire period of experiment was 9958 in Austra - white and 11857 in Rhode - white. The feed cost which worked out to Rs.7.41 per Kg indicated that the cost of feed consumed per egg was 152.91 paise in AW and 130.95 paise in RW.

Table 18. Per cent livability in Austra-white and Rhode-white birds at different ages from 21 to 44 weeks.

Age in weeks	Austra - white		Rhode-white	
	Mortality Number	Per cent livability	Mortality Number	Per cent livability
21	-	100.00	-	100.00
25	1/120	99.17	1/120	99.17
28	-	-	2/119	98.32
34	1/119	99.16	-	-
35	1/118	99.15	-	-
36	3/117	97.44	-	-
37	1/114	99.12	-	-
38	1/113	99.12	-	-
39	-	-	1/117	99.15
40	2/112	98.21	-	-
42	3/110	97.27	-	-
44	-	-	1/116	99.14
Overall	13/120	89.17[b]	5/120	95.83[a]

The overall means bearing same superscript between AW and RW did not differ significantly ($P< 0.05$).

Table 19. Economics of egg production over feed cost from 23 to 44 weeks of age in Austra-white and Rhode-white birds.

Particulars	Austra-white	Rhode-white
Total feed intake (Kg), 23 - 44 weeks	2054.83	2095.39
Total number of eggs produced	9958	11857
Feed consumed per egg (g) 23 - 44 weeks	206.35	176.72
Cost of feed per Kg (Rs.)	7.41	7.41
Cost of feed per egg (paise)	152.91	130.95

Discussion

5. DISCUSSION

The results obtained in the study on "production performance of Austra-white and Rhode-white layers on litter floor " are discussed in this chapter.

Meteorological Observations

The meteorological observations presented in Table 3 revealed that the macro-climate pertaining to the summer season prevailed outside the experimental house during the experimental periods II to V. The maximum temperature showed an increasing trend from January through May 1998 which coincided with the experimental periods II to V which was corresponding to the age of birds from 25 to 40 weeks in the present study. The rainfall was heavy in the final period VI wherein the per cent relative humidity (RH) was significantly high while the mean sun shine hours and wind speed were significantly low in period VI. Significantly high wind speeds were observed in the initial three periods in comparison to the periods IV to VI. Somanathan (1980) also reported that the months of February to April was hot and dry season in Mannuthy region since the ambient temperature was above 32 ^{0}C

Body Weight

The mean body weight (BW) in Austra-white (AW) and Rhode-white (RW) birds presented in Table 4 revealed that the overall mean body weight at 20 week was similar in AW and RW (1181.5 vs. 1178.7 g) while the BW at 44 week was significantly lower in AW than that of RW wherein it was

1477.45 g in AW and 1539.79 g in RW. Radhakrishnan and Ramakrishnan (1982) reported 20 week BW as 1142 g in AW and 1134 g in RW under backyard system of rearing is in agreement with the results obtained in the present study whereas the 40 week BW stated by the above authors was high in AW (1570 g) and low in RW (1472 g). The body weights at 20 weeks in caged pullets in AW (1456 g) and that in RW (1332 g) reviewed respectively by Babu et al (1988) and Sharma et al (1992) were also high. They have also observed higher body weights at 40 week of age in AW (1626 g) and RW (1616 g). These differences in body weights reported by the above authors might be due to the variations in the parental lines, methods of selection employed, rearing conditions and season under which the studies were carried out.

Age at sexual maturity

The age at first egg (AFE) in the flock was 157 day in AW and 152 day in RW indicated commencement of laying at 23 week in AW whereas 22 week in RW birds. Similarly, the ages at 10 and 50 per cent production were also late in AW in relation to RW (Table 5) with the respective mean values of 166.25 and 179.13 days in AW and 163.0 and 176.75 days in RW. Mishra (1996) recorded very early AFE in RW did not agree with the present findings. The mean age at first egg reported by Babu et al (1988) in AW (167.7 days) and the sexual maturity as stated by Nair and Bhattacharyya (1984) in AW (147.6 days) and Sharma et al (1992) in RW (148.5 days) did not specify the exact criteria of their measurement. The age at 50 per cent production in RW observed by Radhakrishnan and Ramakrishnan (1982) is in close agreement with the results obtained in the present study.

Weekly egg production

Hen-housed number and per cent

The weekly egg production data (Table 6) revealed that the hen-housed number (HHN) was low at 23 and 24 weeks in AW and thereafter increased significantly until 28 weeks. In RW there was significant and progressively increasing trend from 23 to 27 weeks. During these weeks the magnitude of variation between AW and RW was significant only at 24 and 26 weeks with high egg production Rhode - white birds. This was due to earlier attainment of sexual maturity in RW as evidenced by Table 5 and thereby significantly higher production in RW birds at the above ages. At 24 weeks, the difference in per cent production between AW and RW was 5.7 while at 26th week it was appreciable in figure 1 and it was 16.9 per cent (Table 6).

In subsequent weeks, the differences within the group as well as between groups were narrow and the weekly production were comparable statistically from 28 to 35 weeks in AW while from 27 to 36 weeks in RW group. High production was maintained uniformly from 30 to 33 weeks in AW. Rhode-white birds showed an extended duration of high egg yield from 28 to 35 weeks. The peak production registered was 80.57 per cent at 32 weeks in AW and 81.21 per cent at 31 weeks in RW indicating peak yield one week earlier than that of AW, The weekly production slowly declined after peak and it reached 62.37 per cent in AW whereas it was 72.14 per cent in RW at 36 weeks of age. The magnitude of variation in weekly production between AW and RW was very wide from 37 week onwards as evidenced in figure 1.

The progressive total of HHN from 21 to 40 weeks of age was worked out to 71.14 in AW and 81.06 in RW. The HHN in AW upto 40 weeks of

age reported by the authors Radhakrishnan and Ramakrishnan (1982) (52.97 eggs) and Babu et al (1988) (46.57 eggs) and Sharma et al (1992) as 89.37 eggs in RW were not in agreement with the results obtained in the present study. The hen-housed per cent was 33.02 in AW birds in a study conducted by Babu et al (1988) from 21 to 40 weeks in cages was lower than the results obtained in the present study. Radhakrishnan (1981) reported HD per cent production of 54.28 in AW and 40.07 per cent in RW upto 40 weeks of age under backyard system of rearing was lower than the results obtained in the present study.

In the present study, the hen-housed production was significantly higher consistently in all weeks from 37 to 44 weeks in Rhode-white birds. There was an inconsistent and low profile of weekly hen-housed production after 36 weeks of age in Austra-white birds. This resulted in significantly higher overall hen-housed yield and it was 98.80 eggs with a percentage of 58.81 in RW as against the egg number of 82.98 with a percentage of 49.39 in AW.

Hen-day number and per cent

The data presented in Table 7 showed that the HDN and percentages were same as that of the respective hen-housed values since there as no mortality from 21 to 24 weeks in AW and RW. The egg production efficiency of survivors as indicated by the weekly hen-day number did show the same trend similar to that observed in HH production (Table 6 and figure 1). Figure 2 indicated significantly higher egg yield in RW at 29 weeks in addition to the significant variations already observed under hen-housed production in AW. This might be due to the differences in mortality rates between AW and RW upto 29 weeks. The overall hen-day number in AW and RW were 85.72 and 101.21 eggs with 51.02 and 60.24 per cent respectively. The hen-day per cent

production reported by Babu et al (1988) in AW in cages from 21 to 40 weeks (65.82) was higher than the present results.

Period-wise Egg Production

Period-wise hen-day production presented in Table 9 revealed that it was significantly lower in AW in all periods except periods III and IV. The hen-day number in periods III and IV were comparable within as well as between AW and RW. The overall hen-housed number recorded in AW in the present study was higher than that reported by Babu et al (1988). Chowdhary et al (1983) reported the average egg number as 15.6 per month in RW under deep litter system which was in agreement with the results obtained in the present study. The average egg production reported by Chowdhary et al (1983) was 15.6 in RW per month per hen was in agreement for the period II in the current study.

Feed consumption

The mean daily feed consumption presented in Table 10 did not show any statistical difference between AW and RW at any period. The over all mean consumption was the same in AW and RW (113.22 and 113.66 g). Significant differences between periods within AW and RW were observed as age advanced. In AW, feed intake increased significantly till period III. Periods III and IV were comparable. Significantly higher feed intake noted in periods V and VI were normal for the age group 36 to 44 weeks. In RW, the feed intake increased significantly till period III and further trend was similar to that observed in AW except that the feed intake in periods III and VI were the same in RW and these mean values were comparable to that in period IV showing numerically lower feed intake in periods V and VI in RW when compared to

AW. Babu et al (1988) observed high feed intake of 142 g per bird per day during the period from 21 to 40 weeks in AW in cages. Beena (1995) recorded average daily feed intake of 93.8g from 21 to 40 weeks in WL; the female parental line of AW and RW used in the present study.

The total feed intake was almost similar in AW and RW (Table 10)but the variation in total egg output was high between the two groups since the egg production was significantly low in AW (Tables 6 to 9). Hence the feed consumption for producing each egg was high in AW. The cost of feed for the production of each egg was worked out to 152.91 paise in AW and 130.95 paise in RW (Table 19). This will not be economical in commercial practice and hence these birds have to be reared under backyard system of rearing by providing least cost rations.

Feed efficiency

Table 11 showed that the overall feed efficiency per dozen eggs from 25 to 44 weeks which were 2.60 in AW and 2.05 in RW was statistically significant. This might be due to the significantly better feed efficiency in RW in periods II, V and VI. The relatively better feed efficiency in AW was observed in period III (1.78) which was statistically comparable with that of period IV within and between AW and RW. Jain et al (1978) stated the feed efficiency of 2.479 per dozen eggs upto 400 days in RW birds while Babu et al (1988) observed an efficiency of 5.09 in AW from 21 to 40 weeks.

Egg Weight

The overall mean egg weight presented in Table 12 revealed that it was 48.02 g in AW and 46.5 g in RW and was significantly higher in AW. The

age-wise differences also showed that it was significantly higher in AW at 28, 32 and 40 weeks of age, in periods II, III and V respectively. At other ages; 24,36 and 44 weeks, it was statistically comparable between AW and RW although the mean values were numerically higher in AW. The increase in egg weight from 24 to 44 week was from 43.33 to 50.82 g in AW whereas in RW it was from 42 .67 to 49.5 g indicating lower egg weight consistently in all the weeks studied. The reason for low egg weight in RW can be attributed to the early sexual maturity in this group as is evident from Table 5. The mean egg weight reported by Babu et al (1988) in AW in period I and the mean EW given by Chowdhury et al (1983) in RW and that given by Radhakrishnan and Ramakrishnan (1983) in AW and RW are in close agreement with the results obtained in the present study .

Egg Mass

The overall mean egg mass as well as the mean egg mass per day measured at various ages (Table 13) showed statistically comparable data between AW and RW at the weeks studied inspite of significantly higher mean egg weights not only at various ages but also the overall mean egg weight for 24 to 44 week age (Table 12). The non significant variation in egg mass was due to the significantly higher egg yield recorded in RW as indicated in Tables 6 to 9. Therefore the mean egg mass per day at 24,36,40 and 44 weeks and thereby the overall mean egg mass per day were numerically higher in RW. The egg mass recorded at 28 and 32 weeks of age were numerically higher in AW than that of RW because of the significantly higher mean egg weights in AW at 28 and 32 week of age. Thus the advantage of high mean egg weight in AW was surpassed by the higher egg number in RW at other ages. Thus it can be surmised that even if the eggs were marketed on weight basis at that particular ages 28 and 32 weeks, an advantage can be expected from AW eggs. But on overall basis no advantage can be achieved from AW and RW eggs if marketed on weight basis.

Gintovt et al., (1981) reported the egg mass of 11.99 Kg in WL and 12.34 Kg in RIR per bird upto 500 days of age would not be comparable with the part year production recorded in the present study.

Egg quality traits

The egg quality traits presented in Tables 14 to 17 revealed that the variations between AW and RW were significant only in the overall mean per cent albumen in AW and per cent yolk in RW eggs.

Percent Shell

The overall mean values of per cent shell which was 10.86 in AW and 11.10 in RW did not differ significantly between AW and RW. The per cent shell (Table 14) at 40 weeks of age was 7.52 in AW and 9.74 per cent in RW where significantly low in comparison to other ages studied. This can be attributed to the higher ambient temperature in that period. The per cent shell was significantly lower in AW at 40 weeks in comparison to RW birds. This trait in AW birds were more severely affected by temperature but this significant variation did not lead to any marked lowering of overall mean per cent shell in AW. In RIR eggs Stino et al (1977) observed average per cent shell of 12.95 and Simeonovova et al (1989) observed 8.5 per cent . Whereas Khan et al (1989) observed per cent shell of 10.94 in WL eggs were showed wide variations.

Shell Thickness

The overall mean shell thickness in AW (0.42 mm) and in RW (0.41mm) did not very markedly and the variation was between different ages studied. It was significantly higher at 24 and 28 weeks in AW in comparison to

other weeks (Table 15). The above trend was similar in RW except the mean shell thickness at 28 and 36 weeks was also comparable. The decrease in shell quality as the ambient temperature increased is in agreement with the results obtained in the present study. Low values of shell thickness were reported by Mohapatra et al (1985) in RIR eggs and Khan et al (1989) in WL eggs and Kotaiah et al (1976) in Australorp eggs. The mean shell thickness reported by Kumararaj et al (1991) in WL eggs is in full agreement with the results obtained in the present study both in AW and RW.

Per cent albumen

The results pertaining to the internal quality (Table16) revealed that the overall per cent albumen was significantly high in AW eggs (60.11) in comparison to RW eggs (59.39 per cent). At 40 and 44 weeks of age the albumen content was higher in AW than that of RW. Low egg number (Tables 5 and 6) and higher mean egg weight (Table 12) in AW were also noticed at 40 weeks of age. Within AW group, the variation in Albumen content in eggs between ages was significantly higher at 24 and 40 weeks in comparison to the other weeks. Within RW, albumen content was significantly low at 44 weeks and thus the mean values at all weeks studied upto 40th week were high and were comparable statistically. Stino et al (1977) stead 55.8 per cent albumen in RIR eggs and Khan et al (1989) recorded 60.02 per cent albumen in WL eggs.

Per cent Yolk

Significantly higher overall mean per cent yolk was recorded in RW eggs (29.47) in comparison to AW eggs (Table 17). None of the mean values at various ages studied were significant between AW and RW. The mean values were numerically higher in all weeks studied in RW except 32 weeks wherein it

was numerically high in AW. Higher per cent yolk in eggs might be due more active synthesis and deposition of yolk material or might be due to difference in the moisture present in egg contents. The age wise differences in AW ad RW showed that the yolk content were significantly lower at 24 and 28 weeks in comparison to the subsequent weeks studied indicating the normal trend both in AW and RW. The mean values at 24, 28 and 32 weeks were comparable and 36, 40 and 44 weeks showed higher mean values in RW forming a homogenous group. The intermediary mean values at 32 and 36 were comparable statistically. Stino et al (1977) recorded 31.7 per cent yolk in RIR eggs and Khan et al (1989) obtained 29.04 per cent yolk in WL eggs are comparable with the present findings.

Livability

The overall livability during the period from 21 to 44 weeks (Table 18) was 95.83 per cent in RW was significantly better than that recorded in AW wherein it was only 89.17 per cent. The mortality rate was high in AW from 36 week onwards. However the reasons for mortality did not indicate any specific disease in both groups. The causes of death were oophoritis, peritonitis and air sacculitis. Mishra (1996) recorded 95 per cent livability in RW birds from 21 to 72 weeks whereas livability observed by Radhakrishnan (1981) was higher in AW than that in RW is contrary to the present findings.

Economics

Data presented in Table 19 revealed that the cost of feed per egg was lower in RW than that in AW group (130.95 vs 152.91 paise). This indicated that ad libitum feeding not be economical in the case of crossbred layers under the present market price of eggs.

The summary of performance presented in Table 20 indicated that the Austra-white birds were significantly better in overall mean egg weight and per cent albumen content in eggs. While the Rhode-white birds were significantly better in body weight at 44 week, overall HH and HD egg production, overall mean feed efficiency, livability and per cent yolk in eggs. At the same time AW and RW birds were statistically comparable with respect to certain traits like body weight at 20 week, age at sexual maturity, feed consumption, per cent shell and shell thickness.

Based on the above findings, it was concluded that the Rhode White birds were superior to Austra-white birds in terms of egg production, feed efficiency, livability, body weight at 44 weeks and per cent yolk in eggs. The performances of Austra-white were significantly better in respect of mean egg weight and per cent albumen in eggs. Further studies are warranted in Austra-white and Rhode-white layers under backyard system of rearing for exploitation of egg production characters favourably.

Summary

6. SUMMARY

An experiment was conducted at the Kerala Agricultural University Poultry Farm, Mannuthy to evaluate and compare the production performance of Austra - white and Rhode - white hens on litter floor. The Australorp and Rhode Island Red male lines were used for producing the crosses. The `F' strain of White Leghorn formed the female line in both crosses. The objective of the study was to evaluate and compare the production performance of Austra - white and Rhode - white layers under deep litter system of rearing.

One hundred and twenty (120) pullets each of Austra - white (AW) and Rhode - white (RW) at the age of 18 weeks were housed in identical pens in eight replicates each at the rate of 15 birds per replicate at random. Layar mash with BIS specifications was fed throughout the experimental period. Standard routine managemental practices were followed in the study. The production performance on deep litter for six periods of 28 - days each were recorded during the period from December'97 to June' 98. The body weight, age at sexual maturity, egg production, feed consumption, feed efficiency, egg weight, egg mass, livability and egg quality in terms of shell thickness, per cent shell, albumen and yolk and the economics in terms of feed cost per egg were recorded. Data were analysed statistically and the following observations were made in the present study:-

1. The mean body weight at 20 week was 1181.50 g in AW and 1178.75 g in RW and the BW at 44 week of age was 1477.45 g in AW and 1539.79 g in RW and it was significantly higher in RW at 44 weeks ($P < 0.01$).

2. The age at sexual maturity was estimated as age at first egg and ages at 10 and 50 per cent production and the mean values were 161.63, 166.25 and 179.13 days in Austra - white and 159.75, 163.0 and 176.75 days in Rhode - white respectively.

3. The overall mean hen -housed number from 23 to 44 weeks of age was 82.98 in AW and 98.80 in RW and the difference was statistically significant ($P < 0.05$) with the percentage of 49.39 in AW and 58.81 in RW.

4. The overall mean hen - day number was 85.72 and 101.21 with HD per cent of 51.02 and 60.24 in Austra -white and Rhode - white respectively and the difference was also significant ($P < 0.05$).

5. The highest HH number (5.64) was recorded at the age of 32 weeks in AW and at 31 weeks in RW (5.69) and the respective HH percentages were 80.57 and 81.21 per cent. The highest HD number (5.69) was recorded at the age of 32 weeks in AW and at 31 weeks in RW (5.82) and the respective HD percentages were 81.23 and 83.20.

6. The overall mean daily feed consumption during the period from 21 to 44 weeks of age was 113.22 g in AW and 113.66 g in RW and the difference between the genetic groups was statistically non-significant.

7. The overall mean feed efficiency was 2.60 in AW and 2.05 in RW on the basis of dozen eggs for the period from 25 to 44 weeks and the difference was statistically significant ($P < 0.05$)

8. The overall mean egg weight recorded during the period from 21 to 44 weeks of age was. 48.02 in AW and 46.50 g in RW and the difference was statistically

significant ($P < 0.05$). The Austra - white eggs were also significantly heavier ($P < 0.05$) at 28,32 and 40 weeks of age.

9. The overall mean egg mass per day was 3.32 and 3.56 kg in Austra - white and Rhode - white and showed a non - significant variation.

10. The overall mean per cent shell at different ages from 24 to 44 weeks of age was 10.86 in AW and 11.10 in RW eggs which were comparable. However, higher per cent shell was noticed at 40 weeks of age in RW eggs.

11. The overall mean shell thickness was 0.42 and 0.41 mm for Austra - white and Rhode - white eggs respectively and the differences between them at various ages studied were statistically non-significant.

12. The overall mean per cent albumen was 60.11 in AW and 59.39 in RW eggs and the differences were statistically significant ($P < 0.05$). Moreover the mean per cent albumen in Austra - white was significantly higher ($P < 0.05$) at 40 and 44 weeks of age.

13. The overall mean per cent yolk was 28.75 in AW and 29.47 in RW eggs and the difference was statistically significant ($P < 0.05$).

14. Livability per cent from 21 to 44 weeks of age was 89.17 in AW and 95.83 in RW showing significantly better livability in RW birds.

15. The cost of feed per egg was 152.91 paise in AW and 130.95 paise in RW

Based on the above findings, it is evident that the body weight at 44 weeks of age, overall HHN, HDN and its percentages, per cent livability and

per cent yolk in eggs were significantly higher ($P < 0.05$) in Rhode - white birds. Whereas the overall mean egg weight and per cent albumen were significantly higher in Austra - white eggs. The differences in body weight at 20 weeks, age at sexual maturity, overall feed consumption, per cent shell, shell thickness and egg mass per day were non- significant between Austra - white and Rhode - white. Therefore it was concluded that Austra-white birds have an edge over Rhode-white birds in the overall mean egg weight and per cent albumen. Rhode-white birds are superior to Austra-White birds in body weight at 44 weeks, egg production, feed efficiency, livability and per cent yolk in eggs under deep litter system of rearing. Further studies using AW and RW birds are warranted under backyard conditions for exploiting the above traits advantageously.

Table 20. Summary of performance in Austra - white and Rhode-white birds from 20 to 44 weeks of age.

Sl.No.	Parameter	Austra-white (AW)	Rhode-white RW)
1	Mean Body Weight(g) at 20 weeks	1181.50[a]	1178.75[a]
2	Mean Body Weight(g) at 44 weeks	1477.45[b]	1539.79[a]
3	Mean Age at first egg(days)	161.63[a]	159.75[a]
4	Mean Age at 10 per cent production(days)	166.25[a]	163.00[a]
5	Mean Age at 50 per cent production(days)	179.13[a]	176.75[a]
6	Hen-housed egg number(23-44 weeks)	82.98[b]	98.80[a]
7	Hen-housed per cent production (23-44weeks)	49.39[b]	58.81[a]
8	Hen-day number (23-44 weeks)	85.72[b]	101.21[a]
9	Hen-day per cent(23-44 weeks)	51.02[b]	60.24[a]
10	Mean daily feed consumption(g)	113.22[a]	113.66[a]
11	Mean feed efficiency/dozen eggs(25-44 weeks)	2.59[a]	2.05[b]
12	Mean egg weight(g)	48.02[a]	46.50[b]
13	Mean per cent shell	10.86[a]	11.10[a]
14	Mean shell thickness(mm)	0.42[a]	0.41[a]
15	Mean per cent albumen	60.11[a]	59.39[b]
16	Mean per cent yolk	28.75[b]	29.47[a]
17	Per cent livability	89.17[b]	95.83[a]

Means bearing same superscripts between AW and RW did not differ Significantly ($p<0.05$)

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PRODUCTION PERFORMANCE OF AUSTRA-WHITE AND RHODE-WHITE LAYERS ON LITTER FLOOR

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ABSTRACT OF A THESIS

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ABSTRACT

An experiment was conducted at Kerala Agricultural University Poultry Farm, Mannuthy in order to evaluate the production performance of Austra -white and Rhode -white hens on litter floor. The Australorp and Rhode Island Red formed the male lines and the 'F' strain of White Leghorn formed the female line for the production of AW and RW progenies.

One hundred and twenty (120) pullets each of Austra -white (AW) and Rhode -white (RW) at the age of 18 weeks were housed in identical pens in eight replicates each at the rate of 15 birds per replicate at random. Layer mash with BIS specifications was fed throughout the experimental period. Standard routine managemental practices were followed in the study. The production performance on deep litter for six periods of 28 days each were recorded during the period from December' 97 to June' 98. The objective of the study was to evaluate and compare the production performance of Austra-white and Rhode - white hens from 21 to 44 weeks of age under deep litter system of rearing.

Body weight at 20 and 44 weeks of age in Austra-white and Rhode-white were recorded individually and the respective mean values were found to be 1181.50 and 1178.75 g at 20 weeks and 1477.45 and 1539.79 g at 44 weeks of age. The average age at first egg was 161.63 days in Austra-white and 159.75 days in Rhode-white hens . The mean ages at 10 and 50 per cent production were 166.25 and 179.13 days in Austra-white and 163 and 176.75 days in Rhode-white respectively. The mean egg production recorded was 82.98 with 49.39 per cent in Austra-white and 98.80 eggs with 58.81 per cent in Rhode-white on hen-housed basis and on hen-day basis 85.72 eggs with 51.02 per cent in Austra-white and 101.21 eggs with 60.24 per cent in Rhode-white. The highest production was

obtained at 32 weeks in Austra-white and 31 weeks of age in Rhode-white birds on hen-housed and hen-day basis. The mean daily feed consumption was worked out to 113.22 g in AW and 113.66 g in RW. Feed efficiency on the basis of dozen eggs for Austra-white was 2.60 and 2.05 in Rhode-white hens . Egg weight at last three days in each period were individually recorded and the overall mean egg weight for 21 to 44 weeks of age was 48.02 g in Austra-white and 46.50 g in Rhode-white. The overall mean egg mass per day was 3.32 kg in AW and 3.56 kg in RW. The mean percentages of shell, albumen and yolk were 10.86, 60.11 and 28.75 in Austra-white and 11.10, 59.39 and 29.47 in Rhode-white eggs respectively. The mean shell thickness were 0.42 mm in AW and 0.41 mm in RW eggs. The livability per cent from 21 to 44 weeks of age was 89.17 in Austra-white and 95.83 per cent in Rhode-white. The feed cost per egg was 152.91 paise in AW and 130.95 paise in RW.

Based on the above findings, it is evident that the body weight at 44 weeks of age, overall HHN, HDN and its percentages, per cent livability and per cent yolk in eggs were significantly higher ($P < 0.05$) in Rhode - white birds. Whereas the overall mean egg weight and per cent albumen were significantly higher in Austra - white eggs. The differences in body weight at 20 weeks, age at sexual maturity, overall feed consumption, per cent shell, shell thickness and egg mass per day were non- significant between Austra - white and Rhode - white. Therefore it was concluded that Austra-white birds have an edge over Rhode-white birds in the overall mean egg weight and per cent albumen. Rhode-white birds are superior to Austra-White birds in body weight at 44 weeks, egg production, feed efficiency, livability and per cent yolk in eggs under deep litter system of rearing. Further studies using AW and RW birds are warranted under backyard conditions for exploiting the above traits advantageously.