RURAL INDUSTRIES RESEARCH
& DEVELOPMENT CORPORATION

Studies of Cloacal Haemorrhage, Vent Trauma and Beak Trimming in the Laying Hen

A report for the Rural Industries Research and Development Corporation

by Dr Greg Parkinson and Mr Peter Cransberg

July 2001

RIRDC Publication No 00/…
RIRDC Project No: *Egg 99-06*

ISBN 0 642 (…RIRDC to assign)
ISSN 1440-6845

Title of your publication: Studies of cloacal haemorrhage, vent trauma and beak trimming in the laying hen
Publication No. 00/
Project No: DAV-170A

Researcher Contact Details

(Name)	Dr Greg Parkinson
(Address)	Victorian Institute of Animal Science 475 Mickleham Rd Attwood, Victoria 3049
Phone:	9217 4200
Fax:	9217 4299
Email:	greg.parkinson@nre.vic.gov.au

RIRDC Contact Details
Rural Industries Research and Development Corporation
Level 1, AMA House
42 Macquarie Street
BARTON ACT 2600
PO Box 4776
KINGSTON ACT 2604

Phone:	02 6272 4539
Fax:	02 6272 5877
Email:	rirdc@rirdc.gov.au.
Website:	http://www.rirdc.gov.au

Published in July 2001
Printed on environmentally friendly paper by Canprint

Foreword

Experimental models developed at VIAS, Attwood, indicate that egg peritonitis, cloacal prolapse and vent trauma/picking are significant causes of mortality in the commercial laying hen. Combining these studies with additional epidemiological evidence, it is probable that national flock mortalities of 2-5% could be attributed to egg peritonitis, prolapse and vent trauma, despite the widespread use of beak trimming. The severe nature of the traumatic injuries created by prolapse or vent trauma is very controversial, and is the source of considerable scientific and public debate.

Craig and Muir (1993) have showed that the incidence of picking has a low heritability and therefore there must be large environmental/management factors, which exacerbate the problems in commercial flocks. Recent studies undertaken at VIAS indicated that individual birds frequently produced blood stained eggs and some cloacal haemorrhage, but overt picking was not an inevitable consequence. The important questions are therefore; what factors trigger the cloacal haemorrhage or prolapse, does the tissue damage produce oviduct infection and how consistent is this eversion to picking. Despite the potential involvement of tissue haemorrhage in the picking problems, it is also apparent that spontaneous vent picking occurs. Partitioning the relative significance of the two effects is difficult at this stage, but needs to be undertaken if the mechanisms for the behaviour are to be understood and a logical research direction established.

This research therefore has several approaches; firstly to undertake research on commercial farms to clarify some of the patterns of blood stained eggs and loss through egg peritonitis and picking. Secondly, to undertake research in small experimental flocks that examines the association between body weight, production and the incidence of haemorrhage, and enables tissue haemorrhage to be isolated from cannibalism/picking. The final phase of this project will be to use the knowledge accumulated to develop managerial approaches that will reduce the incidence of cloacal haemorrhage, and subsequent losses, in commercial flocks.

In the process of undertaking this research it will also be possible to begin stimulating the adoption of modified beak trimming practices and to investigate the opportunities to eliminate beak trimming in well defined environments with a high standard of management.

The long-term objectives for this research program will be to achieve worlds best practice egg production performances of 330 eggs per bird housed with annual mortalities of 2-3% in birds with intact beaks. There are some farms with high management standards and new technology shedding that will be able to achieve these standards with some fine-tuning and support.

This report, a new addition to RIRDC's diverse range of over 450 research publications, forms part of our Egg R&D program, which aims to support improved efficiency, sustainability, product quality, education and technology transfer in the Australian egg industry. This project was funded from industry revenue which is matched by funds provided by the Federal Government.

Contents

Executive Summary

Laboratory models have indicated that oviduct haemorrhage and/or picking behaviours in commercial layers is not uniformly distributed across the life of the laying flock. These problems are accentuated at stages that correspond to periods of high metabolic pressure (peak production and peak egg mass). Comparative studies with individually housed birds indicate that approximately 50% of the cloacal haemorrhage can occur independently of picking behaviours. Furthermore, the incidence of cloacal haemorrhage appears correlated with low body weights in early lay and production of disproportionately large eggs. Birds that experience cloacal haemorrhage in early lay can continue to manifest the problem, whilst some birds repair the damaged oviduct very rapidly. Superior management of the transition from pullet to layer and more attention to body weight management will reduce the extent of cloacal haemorrhage.

Two large Victorian egg farms with controlled environment shedding have been experimenting with non-beak trimmed flocks. In both instances annual mortality patterns have been at acceptable standards (5-7%), but it is clear that a more uniform distribution of shed light intensity at 10-20 lux in the layer house is likely to lower mortality by an additional 1-2%.

In the future, a combination of improved body weight management together with control over onset of sexual maturity, and uniform layer shed light intensities of 10-20 lux will significantly lower flock mortalities. Successful application of these approaches will facilitate the elimination of beak trimming as a routine husbandry practice in sophisticated shedding with light control.

More research is required on the induction of cloacal haemorrhage and prolapse, to consolidate an objective understanding of the management interactions, and to clarify the association that has been observed between under weight flocks and a high incidence of egg peritonitis.

The Australian Egg Industry needs to understand more about the consequences of farming birds that are below the genetically defined standards for body weight. At this stage this information has not been available from the International Breeders, who are inclined to focus on optimum performance and appear to have limited objective data on mismanaged flocks. The collation of objective data on the flocks that are below genetic potential will be integral to clarifying the long-term objectives of this research project.

Unfortunately the current experimental models have made use of pullet flocks that have achieved elite production performances and the research undertaken to date has therefore had a bias against sub-optimal body weights and predisposition to cloacal haemorrhage. Despite these limitations the findings have provided some very useful benchmarks about optimal management standards, and the potential for higher thresholds of egg production and lower mortality.

Chapter 1

The relationship between cloacal haemorrhage, body weight and production in a controlled environment shed.

1.1 Introduction

Recent experiments undertaken at the Victorian Institute of Animal Science (VIAS), Attwood, indicated that cloacal prolapse and vent trauma/picking can be significant causes of mortality in the commercial laying hen. Combining these studies with additional epidemiological evidence, it is conceivable that national flock mortalities of 2-5% could be attributed to prolapse and vent trauma, despite the widespread use of beak trimming. The severe nature of these traumatic injuries created by prolapse or vent trauma is very controversial and is the source of considerable scientific and public debate.

Craig and Muir (1993) have showed that the incidence of picking has a low heritability and therefore there must be large environmental/management factors that exacerbate the problems in commercial flocks. Recent studies undertaken at VIAS indicated that individual birds frequently produced blood stained eggs and some haemorrhage, but overt picking was not an inevitable consequence. The important questions are therefore; what factors trigger the cloacal haemorrhage/prolapse, and how consistent is this eversion to picking.

The trial reported here indicates the incidence of blood stained eggs and prolapse, and the relationship with body weight and production, in an experimental flock housed 2 birds per cage in controlled environment conditions.

1.2 Materials and Methods

96 ISA brown birds, raised on a commercial farm in cages, were randomly selected and transferred to the VIAS experimental poultry facility at 16 weeks of age. The pullets were not beak trimmed, which is conventional practice on the farm from where the pullets are obtained, and had been raised with 12 hours light at 1-2 lux intensity from 5 to 16 weeks of age. They were placed into two-bird cages in a controlled environment shed where the temperature was maintained between 18-25^{o}C, with an average of 20-22^{o}C. The controlled environment shed maintained a daylength of 16 hours per day and had a light intensity ranging from 100-200 lux. All birds were initially fed a commercial pre-lay diet containing 2.2% calcium, 17.5% crude protein and had a ME of 11.6 MJ/kg. At 19 weeks of age all birds were transferred onto a commercial layer diet containing 3.6% calcium, 18.4% crude protein and an ME content of 11.5 MJ/kg. All birds had water and feed available *ad lib.*

Egg production per cage was recorded each day of the experimental period and accumulated to provide weekly figures. Birds were weighed at two-week intervals. The incidence of blood stained eggs was recorded daily allowing the calculation of the total number of blood stained eggs per week and the number of blood stained eggs laid per cage. All birds that died were post-mortemed and the cause of death established.

1.3 Results

Body Weight

The average body weight at 16 weeks of age was 1500 grams. The birds experienced a drop in weight between 20-22 weeks of age. At 36 weeks of age the birds averaged 2070 grams.

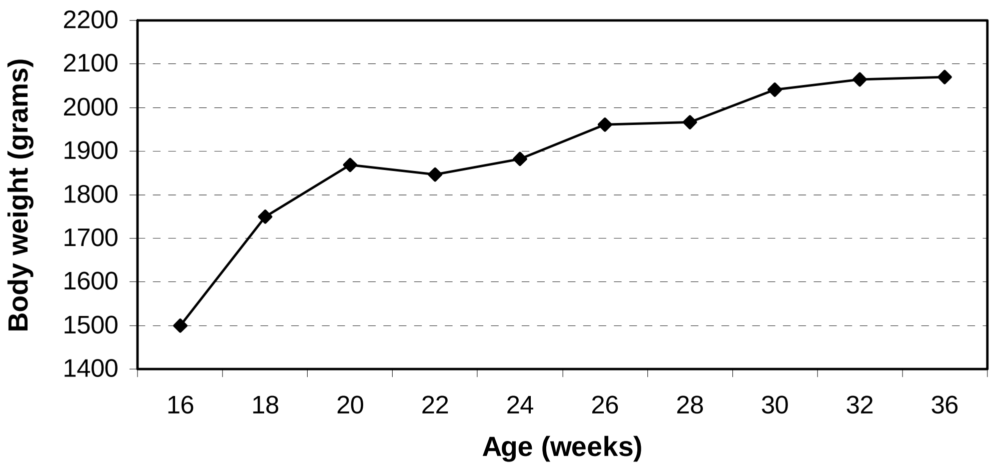

Figure 1: Average body weight of the ISA experimental flock

Production

Production peaked at 96.7% in week 29 (Figure 2) and was persistent throughout the experimental period.

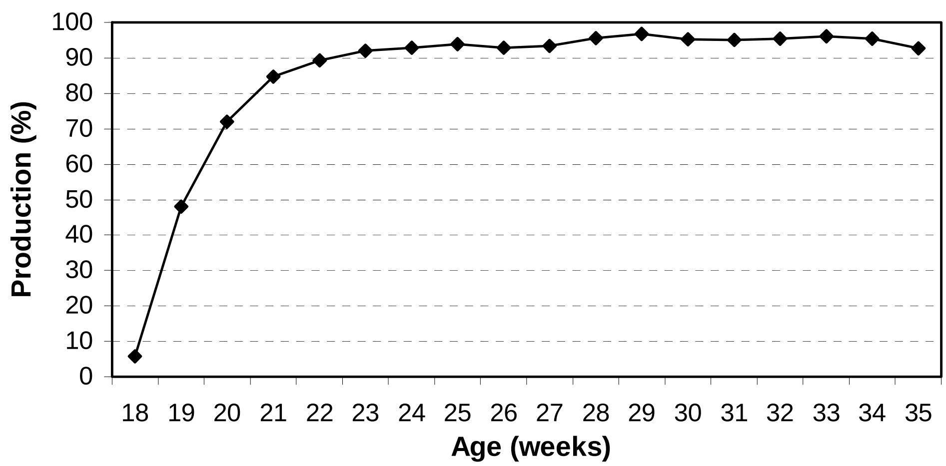

Figure 2: Average egg production of the ISA experimental flock.

Incidence of blood stained eggs

The incidence of blood stained eggs peaked in week 23 (2.2%) and remained high through weeks 23-26 (Figure 3). This period was immediately following the period of weight loss seen in the flock between weeks 20-22 (Figure 1). The incidence of blood stained eggs increased again in weeks 34 and 35 (Figure 3), a period where the flock was approaching peak egg mass.
The number of cages from which a blood stained egg was collected during the experiment was 22 (46%). The most blood stained eggs collected from one cage over the experimental period was 15, with 6 cages providing 10 or more blood stained eggs.

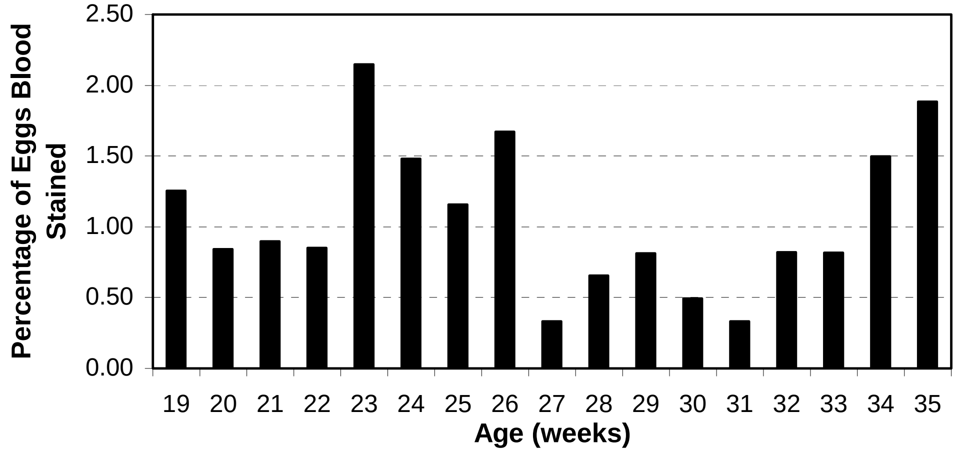

Figure 3: Incidence of blood stained eggs in an experimental flock of ISA brown layers housed in controlled environment conditions.

Mortality

Table 1: Age of bird and cause of mortality

Bird Number	Age of Bird	Cause of death
1	18 weeks	Culled (picking)
2	19 weeks	Culled (prolapse)
3	24 weeks	Culled (prolapse)
4	28 weeks	Culled (salpingitis)
5	33 weeks	Culled (prolapse)

Five birds were culled during the course of the experiment due to various reasons (see Table 1). Two of the birds in the trial that were eventually culled came from cages that had produced blood stained eggs prior to prolapsing. Due to the blood around the cloaca it was assumed that the culled birds had been responsible for producing the blood stained eggs coming from their respective cages. One of the birds produced 11 blood stained eggs prior to it prolapsing, while the other produced 6. The other bird that prolapsed had no history of blood stained eggs.

The bird that was culled due to salpingitis had laid 3 blood stained eggs, went out of lay and was culled approximately 5 weeks later when it became listless and stopped eating.

1.4 Discussion

The incidence of blood stained eggs is highest in the early lay period immediately following a period where, on average, the flock experienced a period of weight loss. Previous experimental work carried out at VIAS also indicated a relationship between weight loss in early lay and a high incidence of blood stained eggs.

Despite the high incidence of blood stained eggs in the experiment, the incidence of picking was only 1% in birds with intact beaks and housed in high light intensities. This low level of picking behaviour in a high light intensity environment is hypothesised to result from positive behavioural imprinting of the pullets, achieved by the use of low light intensities during rearing.

Most of the mortality recorded in the experiment was cloacal/uterine prolapse which was able to be clearly distinguished from picking by daily observation of affected birds and cage mates. The reason for some birds to prolapse after producing blood stained eggs while other birds did not is unknown, but may be linked to the severity of the initial haemorrhage. There may also be factors other than cloacal haemorrhage influencing the birds to prolapse. An interesting observation made during this experiment was the number of birds in this trial that produced only one blood stained egg, an observation illustrating the rapid regenerative power of the oviduct.

The culling of a bird with salpingitis illustrates one of the peripheral problems with cloacal haemorrhage. In this case the bird may have been infected as a result of the haemorrhage and has subsequently been culled. However, from a commercial standpoint, the bird stopped laying 5 weeks prior to its culling, appeared healthy and kept eating a similar amount to the rest of the flock until just prior to culling. Thus there are two commercial considerations; the continued consumption of feed and the absence of egg production.

Chapter 2

The relationship between cloacal haemorrhage, body weight and production in birds housed in single cages in a controlled environment shed.

2.1 Introduction

Despite the potential involvement of tissue haemorrhage in the incidence of picking, it is apparent that spontaneous vent picking occurs. Partitioning the relative significance of the two effects is difficult at this stage, but needs to be undertaken if the mechanisms for the behaviour are to be understood and a logical research direction established. To study the incidence of cloacal haemorrhage and prolapse in an experimental model independent of picking behaviours, birds were housed individually in controlled environment conditions. The incidence of blood stained eggs and prolapse was recorded, along with egg production, body weight and feed consumption.

In the second component of this experiment, 50% of the flock had their feed intake reduced by approximately 15% in weeks 32–40, to enable a comparison between these restricted birds and the remainder of the flock which was kept on an *ad lib* diet. The feed restriction of birds in lay was undertaken to simulate a period of metabolic stress and to assess whether these sorts of stresses could trigger birds to produce a higher incidence of blood stained eggs.

2.2 Materials and Methods

48 ISA brown birds, raised on a commercial farm in cages, were randomly selected and transferred to the VIAS experimental poultry facility at 16 weeks of age. Each bird was housed individually and the cages were in a controlled environment shed where the temperature was maintained between 18-25^{o}C, with an average of 21-23^{o}C. The controlled environment shed maintained a daylength of 16 hours per day and had a light intensity ranging from 100-200 lux. The lighting program used on the commercial farm during the rearing of these birds is shown in Table 1.

Table 1: Lighting program used in rearing the experimental flock

Age	Daylength	Light intensity
Week 1	23 hours light	75 – 106 lux
Weeks 2 - 5	Gradually reduced from 23 to 16 hours light	Gradually reduced to 19 – 26 lux at 5 weeks
Week 6	14 hours light	2 lux 30 cm from globe, no reading at lowest tier
Weeks 7 - 15	12 hours light	As for week 6
Week 16	14 hours light	As for week 6

All birds were initially fed a commercial pre-lay diet containing 2.2% calcium, 17.5% crude protein and had a ME of 11.6 MJ/kg. At 19 weeks of age birds were transferred onto a commercial layer diet containing 3.6% calcium, 18.4% crude protein and had a ME content of 11.5 MJ/kg. All birds had water and feed available *ad lib* until 32 weeks of age.

At 32 weeks of age the feed intake of half of the flock (randomly selected) was restricted to 100 grams/bird/day (the flock was averaging approximately 115 grams/bird/day at this point) for the remainder of the experimental period. The rest of the flock remained on *ad lib* feeding.
Egg production and the incidence of blood stained eggs per cage was recorded daily during the experimental period and accumulated to provide weekly figures. Birds were weighed at two-week intervals and feed consumption was measured at 22, 24, 30 and 32 weeks of age.

At the end of the experiment the birds were divided into two groups, those that had produced a blood stained egg and those that did not. A comparison was then made between the two groups in terms of production, body weight and egg weight. This was only done for the period prior to 32 weeks of age.

2.3 Results

A. Total Population

Body Weight

The average body weight at 16 weeks of age was 1420 grams (Figure 1). Before the restriction period (32 weeks of age), there was a steady increase in average body weight up to 28 weeks of age. Between 28-32 weeks of age there was a decrease in average body weight. After 32 weeks of age the effect of the restriction program can be seen in Figure 1 where body weight of the two groups diverged. It should be noted that prior to restriction at 32 weeks of age, the average body weight of the control group was 1868 grams while the average body weight of the restricted group was 1899 grams.

The loss of body weight (50 grams average) in the *ad lib* fed birds between 28 to 32 weeks has been characteristic of at least two high performing experimental flocks, and occurs just after peak production. It is also noteworthy that the flock experienced consistent incremental growth between 18-28 weeks of age and this appears related to the high egg production performance recorded in the *ad lib* fed birds.

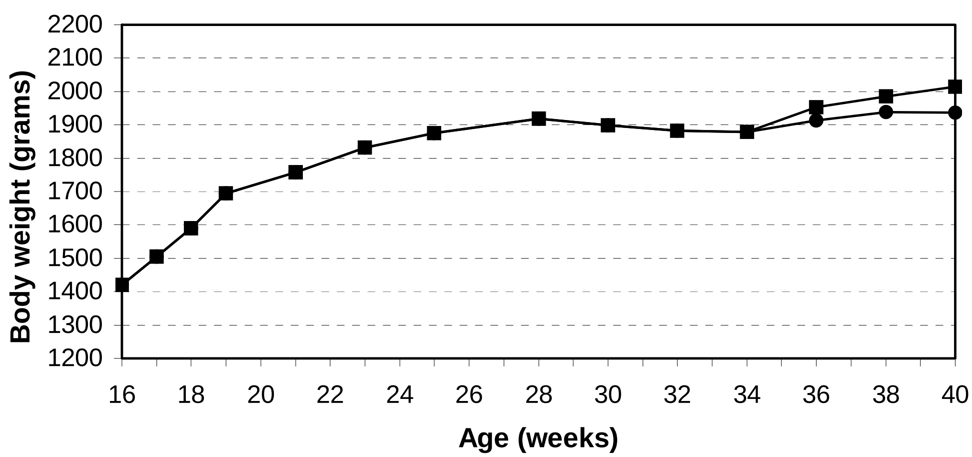

Figure 1: Average body weight of a flock of 48 ISA brown layers housed in controlled environment conditions. At 32 weeks of age half of the flock was restricted to 100 gm/bird/day (●) while the remainder of the flock remained on *ad lib* feeding (■).

Production

Production peaked at 97.6% in week 26 and was 96.4% in week 32 prior to restriction. After the restriction period commenced, egg production fell to 85.1% at 40 weeks in the restricted birds, while egg production in the *ad lib* birds remained high at 94% in week 40 (Figure 2). Prior to restriction at 32 weeks of age, the average egg production of the control group was 94.6% while the average production of the restricted group was 98.2%.

The loss of average body weight between 28 to 32 weeks of age was not associated with a loss in egg production.

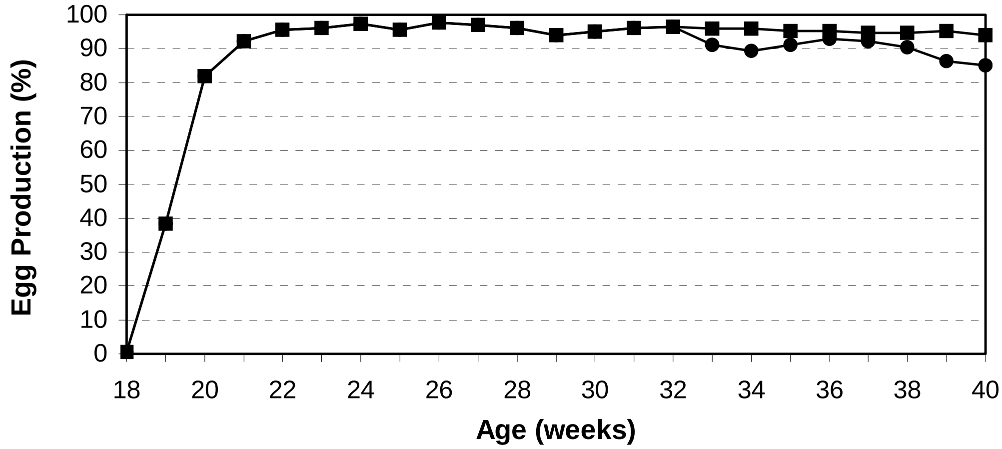

Figure 2: Average egg production of a flock of 48 ISA brown layers housed in controlled environment conditions. At 32 weeks of age half of the flock was restricted to 100 gm/bird/day (●) while the remainder of the flock remained on *ad lib* feeding (■).

Incidence of blood stained eggs

Seventeen blood stained eggs were collected over the course of the experiment from 7 birds. The number of eggs produced by each of the 7 birds was 7, 4, 3, 2, 1, 1 and 1. Between 32-40 weeks there was no significant difference in the incidence of blood stained eggs between those birds that were restricted and the control birds, and numbers shown in figure 3 are total blood stained eggs regardless of treatment (Figure 3).

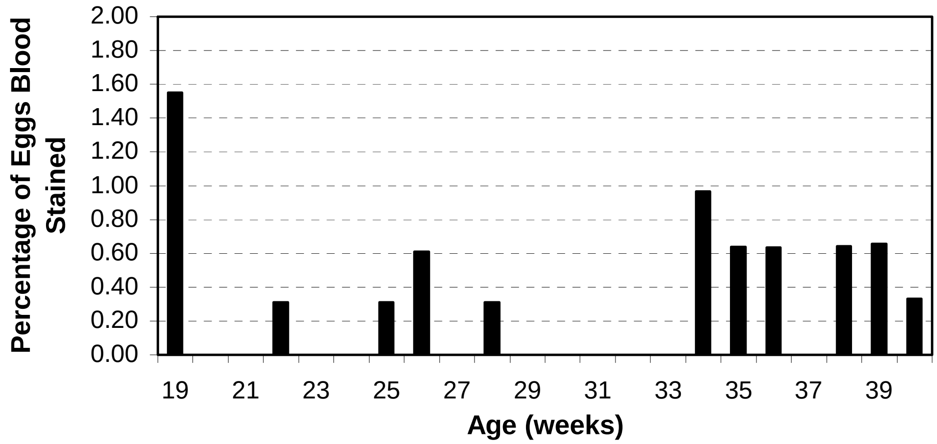

Figure 3: Incidence of blood stained eggs in a flock of 48 ISA brown layers housed in controlled environment conditions.

Mortality

No mortality was recorded during the experimental period.

Feed Consumption

Average feed consumption from weeks 17-32 was 114.7 gm/bird/day while average feed consumption was 119.3 in those birds not restricted after week 32 (Figure 4). Average feed consumption in the restricted birds was 101.6 gm/bird/day from weeks 32-40.

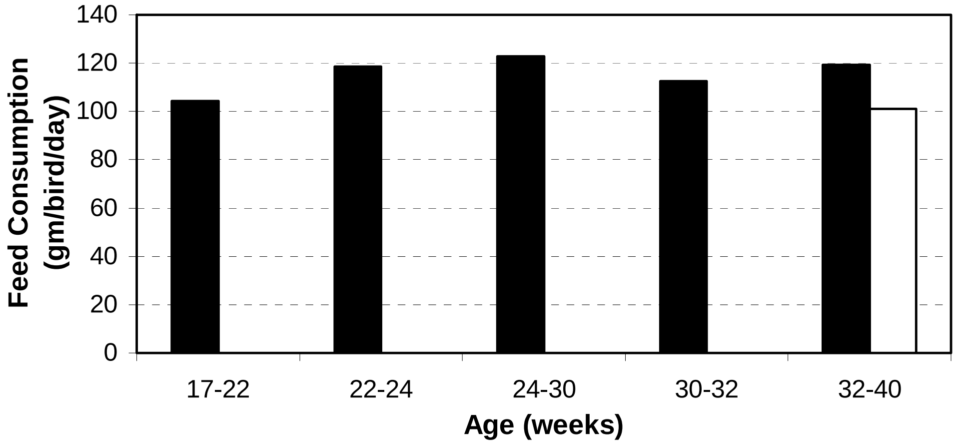

Figure 4: Average feed consumption of the ISA brown flock. At 32 weeks of age half of the flocks feed consumption was restricted (□) while the remainder of the flock stayed on *ad lib* feeding (■).

B. Comparison between birds producing blood stained eggs and those that did not

General

There were 7 birds out of the flock of 48 that produced at least one blood stained egg during the experimental period. These 7 birds were grouped and compared to the remaining birds in the flock. Comparisons between the two groups were only made up until 32 weeks of age, the time at which half of the flocks feed intake was restricted.

Body Weight

Body weight to 32 weeks was significantly higher ($P<0.01$) in those birds that did not produce a blood stained egg than those birds that produced at least one blood stained egg (Figure 5). There was no significant difference ($P>0.05$) between the two groups at any individual measurement point.

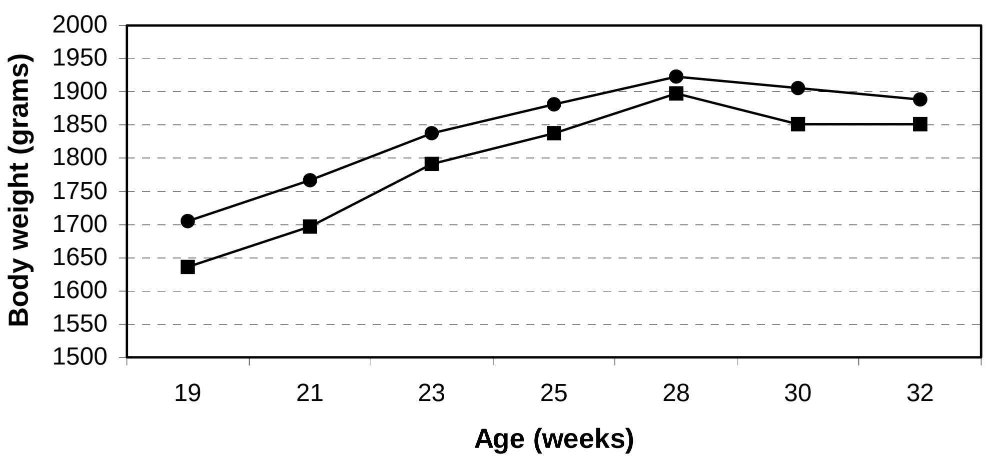

Figure 5: Body weight comparison between those birds that produced a blood stained egg (■) and those birds that did not (●).

Production

There was no significant difference ($P>0.05$) in egg production between the two groups. Production in the birds that did not produce a blood stained egg was consistent throughout the experimental period while the birds that produced at least one blood stained egg had a production curve characterised by a series of peaks and troughs (Figure 6).

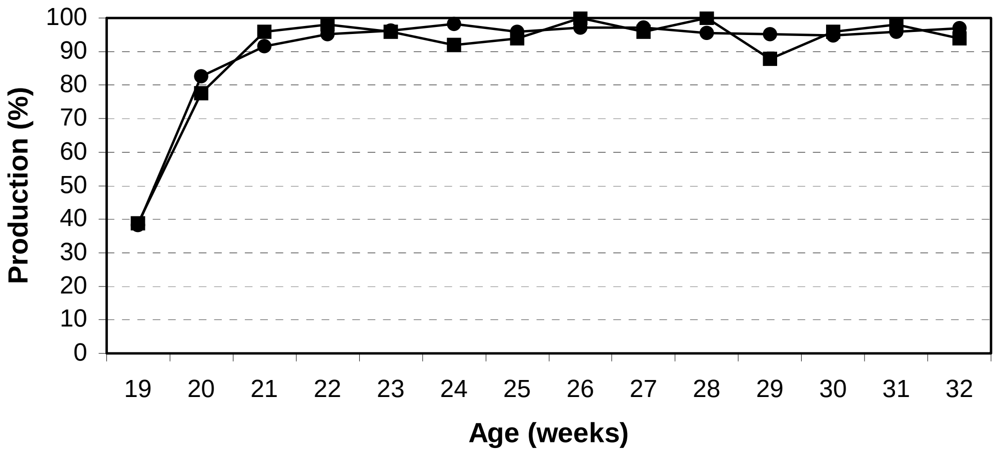

Figure 6: Egg production comparison between those birds that produced a blood stained egg (■) and those birds that did not (●).

Feed Consumption

There was no significant difference (P>0.05) in feed consumption between the two groups. There is however a trend that birds that produced a blood stained egg consumed approximately 5 grams less feed in the important early lay period between 17-22 weeks than the birds without a blood stained egg (Figure 7).

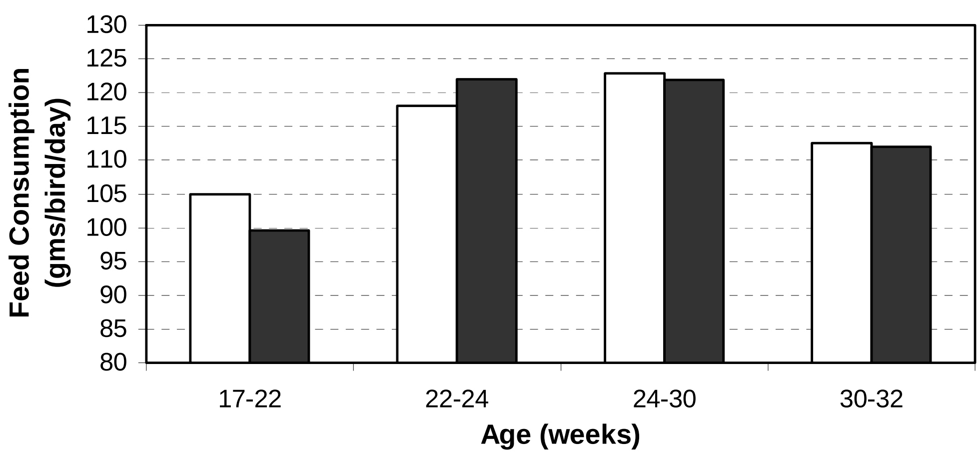

Figure 7: Feed consumption comparison between those birds that produced a blood stained egg (■) and those birds that did not (□).

Egg weight

Over the experimental period to 32 weeks egg weight in the birds that produced a blood stained egg is significantly higher than those birds that did not produce a blood stained egg (Figure 8).

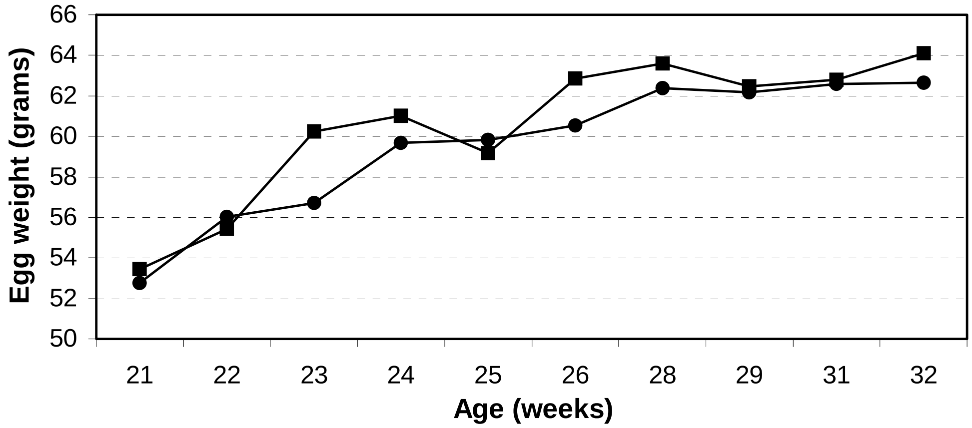

Figure 8: Egg weight comparison between those birds that produced a blood stained egg (■) and those birds that did not (●).

2.4 Discussion

The number of blood stained eggs in this experiment is low in comparison to previous studies conducted at VIAS Attwood. The experiment reported in Chapter 1 indicated that the incidence of blood stained eggs was as high as 2.2% and that the average incidence of blood stained eggs was approximately 0.7% in the period between 19-35 weeks. In the current experiment the average incidence of blood stained eggs throughout the experimental period was below 0.3%. For a comparison between the 2 experiments see Figure 9. In terms of the experimental methods the only difference between the two experiments is that the previous experiment had two birds per cage while in the current experiment the birds were individually housed.

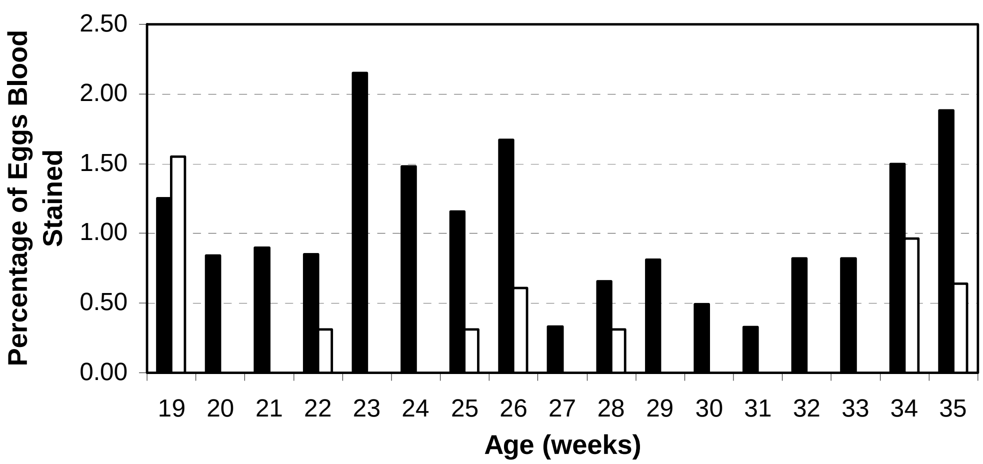

Figure 9: Comparison in the incidence of blood stained eggs between experiments housing birds individually (□) or two birds per cage (■).

There are two probable explanations for the variation in the incidence of blood stained eggs. The first is that there may be mild beak trauma to the oviduct in those birds housed two birds per cage that is not as severe as overt picking/cannibalism, but still of sufficient intensity to cause cloacal or oviduct damage. The second possible explanation for the variation in blood stained egg numbers between the two experiments is the growth rate of the respective flocks in early lay. In the experiment reported in Chapter 1 (two bird cages) the birds experienced a period of weight loss between weeks 20-22 while in the current experiment the birds continued to gain weight until after peak egg production. Layers that have body weights and growth rates in early egg production that are below breed standards may be more susceptible to cloacal haemorrhage and related problems such as oviduct infection and prolapse, than those birds with growth rates on the breed standard. In the earlier two bird per cage experiment approximately 82% of cages that produced blood stained eggs laid their first blood stained egg in the period between 18-26 weeks of age, and many birds then continued to produce blood stained eggs.

It should also be noted that in the previous experiment, where the incidence of blood stained eggs was relatively high, 5 birds died due to prolapse or salpingitis. In the current experiment, no mortality was recorded.

The number of birds from which a blood stained egg was collected during the current experiment was 7 (15% of the flock). The most blood stained eggs collected from one bird over the experimental period was 7, with 3 birds laying 3 or more blood stained eggs during the experimental period. Even though the number of blood stained eggs is reduced from the previous experiment, there were still 15% of the flock producing blood stained eggs in birds housed individually. This indicates that, although there may be some interaction between birds that may exacerbate the incidence of cloacal haemorrhage, there is still a basal level of cloacal haemorrhage in birds which is independent of picking.

Restricting the feed intake of birds in weeks 32-40 had no effect on the incidence of blood stained eggs. The experiment reported in Chapter 1 indicated that the majority of birds that lay a number of blood stained eggs produce their first blood stained egg in the early lay period (before 26 weeks). If growth rates are below breed standards in early lay, as they were in the previous experiment, this may predispose the birds to cloacal haemorrhage. It is suggested that a haemorrhage in early lay may become chronic and may lead to a number of blood stained eggs. In the current experiment, where growth rates in early lay are in accordance with the breed manual, there is a low incidence of blood stained eggs in the early lay period which has translated to the remainder of the experiment. Thus if the hypothesis that early growth rate is a major contributing factor to the incidence of blood stained eggs is correct, then it is not surprising that restricting intake from weeks 32-40 had no effect.

The comparison between those birds that had produced a blood stained egg against those birds that did not produce a blood stained egg over the experimental period support the hypothesis that body weight in early lay is critical. Those birds that produced a blood stained egg during the experiment were, on average, approximately 50 grams lighter than those birds that did not and also consumed 5 grams less feed in the period between 17-22 weeks. Interestingly these birds also had a significantly higher egg weight to 32 weeks, which may indicate a relationship between small birds and large egg size that is contributing to the incidence of cloacal haemorrhage.

Chapter 3

A comparison of cloacal haemorrhage, production and body weight between birds housed individually or housed two birds per cage

3.1 Introduction

In order to clearly separate the effects of picking from cloacal haemorrhage the following experiment compared birds housed individually, and thus unable to pick, with those birds housed two per cage. A comparison was made between the two treatments in terms of production, body weight, incidence of blood stained eggs, picking and prolapse, and egg weight.

3.2 Materials and Methods

Seventy-three ISA brown birds, raised on a commercial farm in cages, were randomly selected and transferred to the VIAS experimental poultry facility at 17 weeks of age. The pullets were non-beak trimmed and had been raised with 12 hours light at 1-2 lux intensity from 5 to 16 weeks of age. Fifty birds were placed into 25 two-bird cages, while the other 23 birds were housed individually. All birds were in a controlled environment shed where the temperature was maintained between 18-25^{o}C, with an average of 20-22^{o}C. The controlled environment shed maintained a daylength of 16 hours per day and had a light intensity ranging from 100-200 lux. All birds were fed a commercial layer diet containing 3.6% calcium, 18.9% crude protein and had a ME content of 11.6 MJ/kg. All birds had feed and water available *ad lib.*

Egg production per cage was recorded each day of the experimental period and accumulated to provide weekly figures. Birds were weighed at two-week intervals and feed consumption was calculated every 4 weeks. The incidence of blood stained eggs was recorded daily allowing the calculation of the total number of blood stained eggs per week and the number of blood stained eggs laid per cage. The number of birds that prolapsed or died from an oviduct infection was also recorded.

A large sister flock to these experimental pullets of 19,600 birds was housed in a controlled environment house on a commercial farm with a stocking density of 4 birds per cage. The body weight, egg production and mortality were monitored and then compared to the experimental model (feed was identical).

3.3 Results

Production

There was no significant difference in production between those birds housed individually and those housed two per cage. Production was exceptional throughout the period of the trial, peaking at 99% and remaining above 95% from week 21 until the trials end at week 32 (Figure 1). The sister flock on the commercial farm achieved a similar early onset of production to that identified in the experimental model. The sister flock achieved 94% production at 21 weeks, 97% production at 23 weeks and was still holding 96% production at 32 weeks of age.

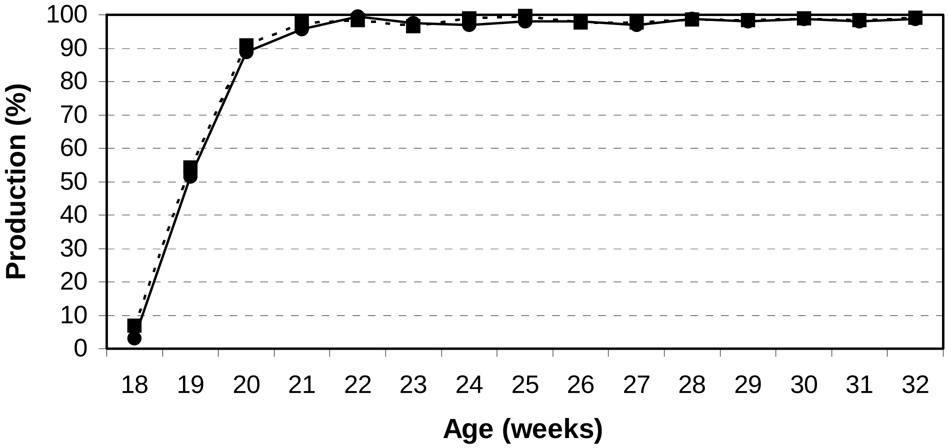

Figure 1: Average egg production of a flock of ISA brown layers housed in controlled environment conditions. Twenty-three birds were housed individually (●) and 50 birds were housed two per cage (■).

Body weight

There was no significant difference in body weight between the two treatments, although the individually housed birds were slightly heavier throughout the trial. There was a steady increase in bodyweight throughout the trial (Figure 2).

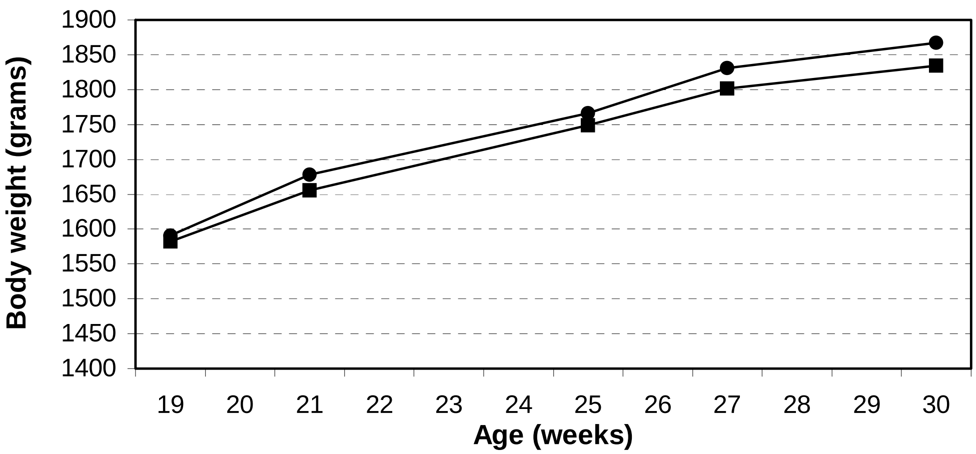

Figure 2: Average body weight of a flock of ISA brown layers housed in controlled environment conditions. Twenty-three birds were housed individually (●) and 50 birds were housed two per cage (■).

Incidence of blood stained eggs

In the two-bird cages, 8 out of 25 cages laid blood stained eggs or 16% of the birds. Of these 8 cages only 3 produced more than 3 blood stained eggs with one bird producing approximately 32 blood stained eggs. In the individually housed birds only 1 bird out of 23 produced a blood stained egg which is 4.3% of the population.

Mortality

Only 1 bird was culled from the 50 birds contained in the two-bird cages, because of the development of cloacitis that appeared to be a sequel to a cloacal haemorrhage and perhaps cannibalism. Another bird produced about 32 blood stained eggs and also developed cloacitis, but remained in production throughout the entire trial. The total loss from cloacal haemorrhage and/or cannibalism can therefore only be a maximum of 2% to 34 weeks of age, despite the maintenance of intact beaks at high light intensities (100-200 lux).

A close examination of two birds that layed blood stained eggs has begun to provide some evidence of the location of the haemorrhage and it could be seen easily just on the tissues internal to the cloacal orifice. In both these birds the initial haemorrhage was followed by the development of cloacitis. It was also observed that birds with cloacal haemorrhages and blood stained eggs can evert the cloacal tissues for prolonged periods.

Mortality from the sister commercial flock was also extremely low at 0.64% to 33 weeks of age.

3.4 Discussion

In this experiment the incidence of blood stained eggs was lower in both the single bird cages than in the previous experiments (5% verse 15%). In the complete experiment the majority of the blood stained eggs are produced in the period between 20-25 weeks of age, which is very consistent with previous experiments and there were very few blood stained eggs recorded between 25 to 34 weeks of age.

It is hypothesised that the use of these elite performing pullets, particularly in this later experiment where the growth between 16 to 30 weeks of age was very consistent and almost no birds were losing body weight, is biasing our experiments against the expression of cloacal haemorrhage and prolapse.

In the current experiment it appeared that there were at least two birds that illustrate the tendency to produce significant numbers of blood stained eggs without the development of overt cannibalism, and that many birds appeared capable of repairing a significant level of haemorrhage very rapidly within 24 hours. Hence for mild haemorrhage and birds with a rapid recovery process there is a limited selection pressure even during single bird-cage selection.

Chapter 4

The influence of low light intensity during rearing on mortality during the laying phase

4.1 Introduction

One of the major egg producers in Victoria has not beak trimmed their birds for many years, and has never experienced significant picking problems. The most obvious difference between this commercial farm and other farms is that during the rearing phase from 5-16 weeks the birds are kept in a controlled environment shed where the light intensity is kept between 1-3 lux. Birds are then housed in the laying shed (controlled environment) at conventional light levels (5-40 lux). Annual mortality of 4-6% is consistently recorded in these non-trimmed flocks, a figure that is, at least, equivalent to trimmed flocks. It has been hypothesised that the primary factor behind the lack of picking behaviour is the low light intensity during rearing. It is believed that the use of low light intensities at ages normally associated with feather picking acts to suppress the picking behaviour. Furthermore it is hypothesised that the suppression of picking during rearing produces persistent effects in the laying phase.

4.2 Materials and Methods

To test this hypothesis, a trial was conducted with a second producer who agreed to use a similar lighting regime to that used by the producer who does not beak trim birds. Pullets (Hisex) were reared in cages in controlled environment conditions and the producer agreed not to beak trim 562 birds out of a flock of 9,600. These birds were then compared with those birds which had been beak trimmed as per conventional farm practice, which on this particular flock was a 6 and 18 week trim. In addition to these treatments a third treatment (600 birds) was also trialed and that was to provide only a 6-week trim. At 16 weeks of age all birds were shifted into the controlled environment layer house and housed 4 birds per cage. Results were obtained from the producer who was only able to provide mortality results for the 3 treatments. They were not able to separate egg production between the 3 treatments.

4.3 Results

At 52 weeks of age mortality in birds that were not beak trimmed was 6.58% while mortality in the remainder of the flock was 2.34%. Mortality in the birds that had a single trim at 6 weeks of age was similar to the shed average. Interestingly 16 of the 37 (43%) birds that died in the untrimmed group died in the period between 41-46 weeks of age, the period immediately following peak egg mass. Due to the constraints of running a commercial operation no assessments were made to determine the cause of mortality.

An observation made by the producer was that mortality in the top tier of the 4-tier shed was always greater than that observed in the lower tiers. In an attempt to provide a reason for this anomaly an assessment was made of light intensity at each of the 4 tiers. Readings taken between lights were 5, 9, 11 and 12 lux from bottom to top respectively. Measurements taken directly under the lights were 7, 15, 30 and 35 lux from bottom to top respectively.

4.4 Discussion

It is very difficult to make any conclusive statements about the outcomes seen in this commercial trial. It should be stated that even though mortality is higher in the untrimmed group this result is not significant and there was no observations made by the producer suggesting that these birds were picking more than the trimmed birds. However at this stage we have been unable to establish a causal relationship between the use of the low light intensity rearing programs and low mortality in non-beak trimmed flocks. Other unknown factors in the management of both the pullets and layers could be contributing to the successful performance of non-beak trimmed flocks.

The lower mortality seen in the trimmed birds in this trial indicates that if the producer that has consistently used non trimmed birds was to start trimming birds they may be able to reduce mortality by 1-2%. However that producer believes that he is financially better of by leaving the birds untrimmed as they save the cost of the trimming (~4 cents/bird). Additionally the trimming process produces a slump in growth rate following the trimming process, a factor that is likely to have a detrimental effect on overall production.

The other information to come out of this trial is that no differences were seen between those birds that were only trimmed once at 6 weeks of age and those birds that were trimmed at 6 and 18 weeks of age.

Chapter 5

Observations on the effect of altering the severity of beak trimming on picking behaviour, mortality and production characteristics.

5.1 Introduction

The effects of a light beak trim (~2mm as compared to a regular trim of 4-5mm) was assessed on a commercial property in a flock of 2000 Hyline brown egg layers housed in controlled environment conditions. It was hypothesised that lightly beak trimming a flock can be equally effective in reducing the incidence of picking as the traditional beak trim.

5.2 Materials and Methods

All birds were conventionally beak trimmed at day old at the hatchery. The birds were then taken to a commercial grower farm where they were reared in a litter based system in an old curtain sided broiler shed. No light intensity measurements were taken, and the curtains were moved up and down according to the weather conditions. Birds were fed conventional diets as recommended by the hatchery and feed and water was available *ad lib*. All birds had a very light beak trim (approximately 2mm from the top beak) at 11 weeks of age.

Birds were transferred from the rearing facilities to the layer house at 15-16 weeks of age where they were housed 4 birds per cage. Birds were fed a layer ration from the time of placement (2750 kCal ME MJ/kg and 18% protein). The light intensity in the layer house was approximately 15 lux.

5.3 Results

Production

Egg production peaked in week 28 at 95.5% after which there was a slump in production in week 29. Egg production then rose again and the persistency of the flock to 35 weeks was excellent (Figure 1).

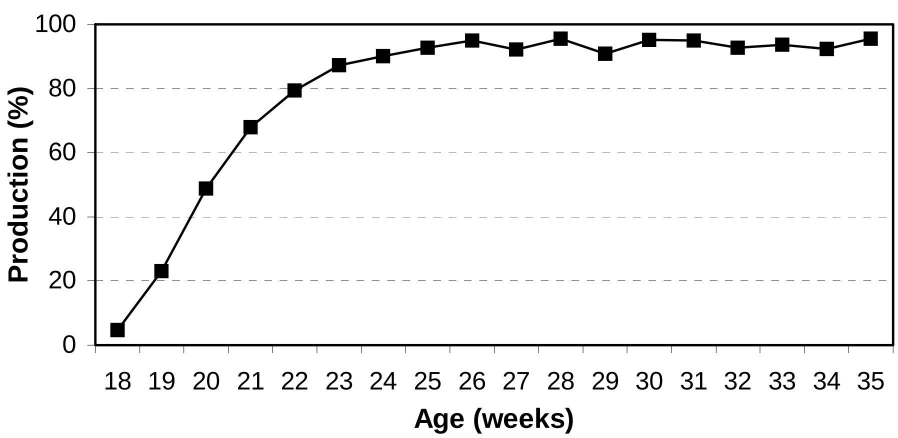

Figure 1: Egg production of a commercial flock of 2000 Hyline Brown layers

Incidence of blood stained eggs

The incidence of blood stained eggs peaked in early egg production between weeks 18-21 (Figure 2). The spike in early egg production was similar to results previously recorded at this property. The basal level of blood stained eggs was approximately 0.1%.

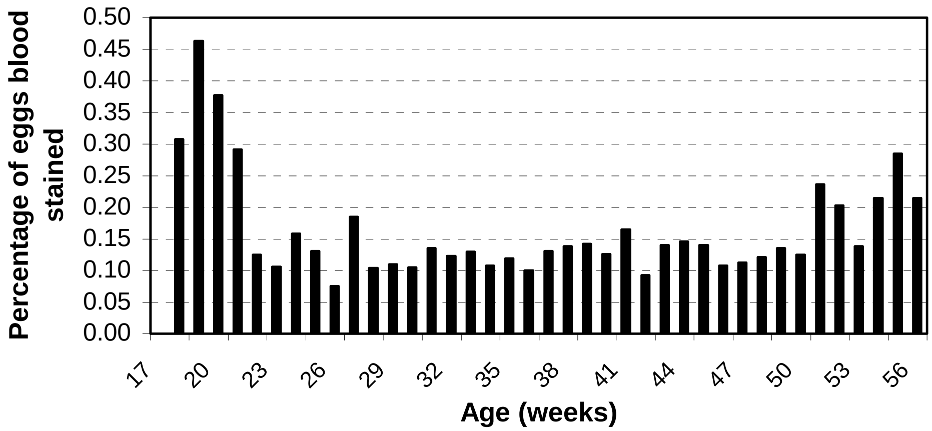

Figure 2: Incidence of blood stained eggs in a commercial flock of Hyline Brown layers

Observations on picking behaviour

At approximately 22 weeks of age the farm manager noticed a number of birds (~5-10%) that had bare patches on their backs. After a closer analysis it was determined that there was no picking as such, and that the behaviour was better described as feather pulling. No lesions, blood or healed wounds were observed on any of the birds examined and no increase in mortality was recorded. After this initial incidence, the problem stabilised and no further reports of feather pulling or picking was reported.

Mortality

Between 16 - 48 weeks of age, mortality was less than 1%.

5.4 Discussion

There was no difference in production, mortality and blood stained egg incidence in this flock as compared to previous flocks (that had been conventionally beak trimmed) that have been through this production facility. In fact production was superior to other flocks (same strain, feed and conditions) and mortality was lower. Thus the change in beak trimming protocol from the conventional trim to the light trim did not have any detrimental effects on the important production characteristics studied in this flock of 2000 Hyline brown layers. Additionally there was no incidence of picking recorded in the flock, despite the occurrence of a small amount of feather pulling in early lay.

The conclusion that can be drawn is that the mild beak trim was equally as effective as conventional beak trimming and may be less stressful for the hens.

Chapter 6

Observations on several commercial barn production systems

6.1 Introduction

Several case studies were undertaken on a commercial barn lay farm using conventional shedding to examine flock growth patterns in relationship to egg production performance and mortality.

6.2 Methods

Average body weights were determined sequentially for flocks on 3 different barn farms (Farm 1, Farm 2 & Farm 3) and some average flock performances (egg production and mortality) were correlated with the different body weight patterns.

6.3 Results and Discussion

There was a large variation in laying flock growth rates evident on barn Farm 1 and the correlation with the initial pullet weight is clearly evident (Figure 1). As barn Farm 1 increased the pullet weight, as seen in flocks Hyline 4b and Hyline 3, this had the effect of dramatically improving flock egg production and decreased mortality. If we compare the peak production and mortality of flocks Hyline 4a and Hyline 4b the respective figures are 20% mortality and a peak of 84% and for Hyline 4b the mortality was 6% and the flock achieved a peak egg production of 93%. Furthermore, the reversion to the lighter initial pullet weight in Hisex 5 in 2001 resulted in a marked deterioration of egg production performance (peak 83%) and an increase in mortality. The persistency of egg production is strongly correlated to peak egg production in all of the flocks discussed.

From the production information collected at Farm 1 it is clear that the mortality is markedly increased in the flocks that do not reach the appropriate body weights (1.9 kg) at 26-29 weeks of age. Mortalities of 15-20% have been recorded in the lighter flocks and egg production was similarly well below genetic potential. Systematic diagnostic studies of the under weight flocks has consistently indicated problems with egg peritonitis and salpingitis.

Although we do not have all the sequential production figures egg production performances were strongly correlated with both the initial pullet weights and the growth rate of the birds on this particular farm. Failure to reach the appropriate breed body weights at 26-30 weeks of age was always associated with very poor production performance and poor bird welfare.

The evidence collected from barn Farm 1 indicates that large improvements in both productivity and mortality have been achieved by using heavier pullets that enable the flocks to reach appropriate live weights and 30 weeks of age. This strategy takes account of the apparently slower growth patterns of birds placed on the floor.

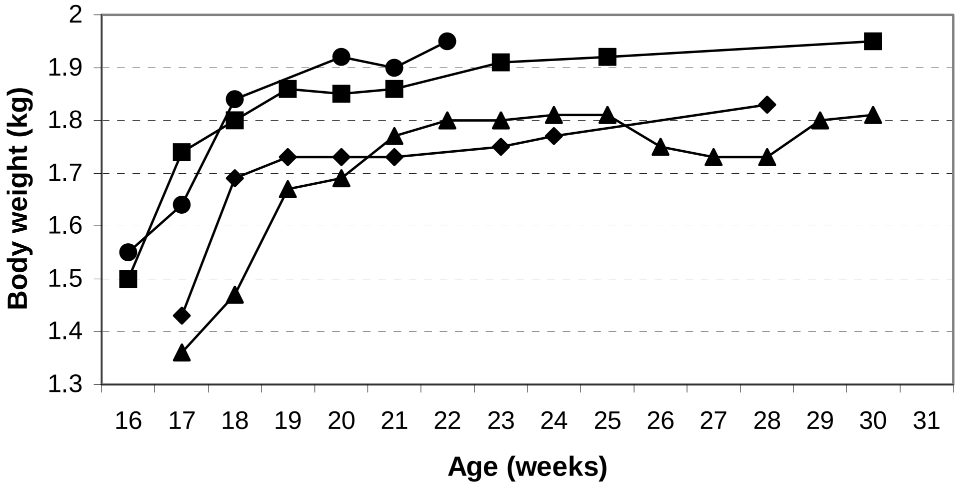

Figure 1: Average body weight patterns of 4 flocks (σ - Hisex 5, ν - Hyline 3, υ - Hyline 4a, λ - Hyline 4b) from barn Farm 1.

The flocks on barn Farm 2 routinely commenced egg production with heavier pullet weights of 1.6 kg at 16-17 weeks of age, and body weight has reached 2.0 kg by 28 weeks of age (Figure 2). The flocks on this farm have consistently achieved moderate egg production performances and bird losses (280-290 eggs per hen housed and 8% annual mortality) over a 2-year period by consistently utilising a heavy pullet management strategy.

Peak egg production of 93-94% has consistently been achieved on barn Farm 2, but there is still some variability between flocks, particularly in mortality patterns. The systematic analysis of one particular barn flock from this farm has illustrated a rapid upsurge of mortality between 22 to 28 weeks which was diagnosed as egg peritonitis on several occasions with sample sizes of about 20-30 birds.

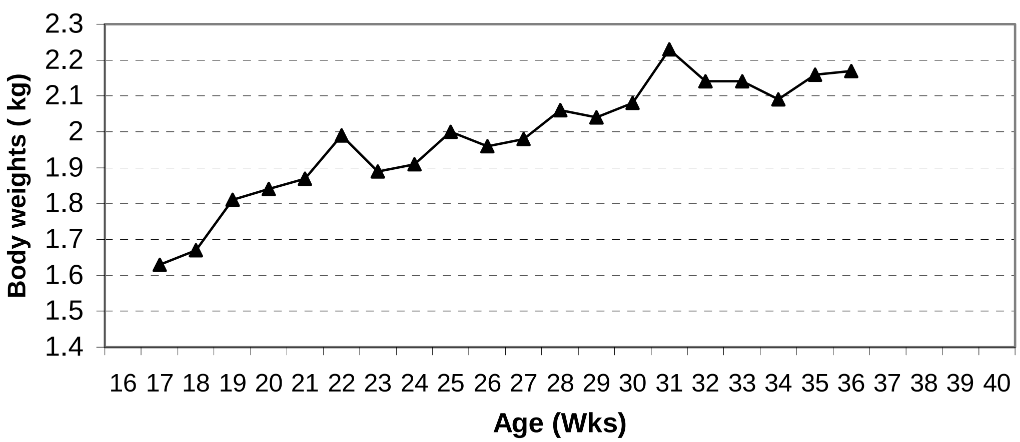

Figure 2. Average body weights of ISA brown flock recorded on barn Farm 2.

An overall analysis of the flock growth patterns from the three barn farms shown in Figure 3, illustrates a relatively consistent growth pattern between 16 and 30 weeks of age, provided that the initial pullet weight was standardised at approximately 1.6 kg at 16 weeks of age.

The egg production was similar between all flocks housed at 1.6 kg at 16 weeks of age. In flocks with the appropriate body weights mortality was moderate, and there have been limited problems with cannibalism even in flocks with a light beak trim and significant beak regrowth. The growth patterns of all of the 6 flocks from 3 different farms (Figures 1, 2, 3) show a remarkable consistency with a live weight gain of approximately 400 grams between 16 weeks of age and 30 weeks of age. Equivalent cage flocks could be expected to gain approximately 600 grams live weight in the same period.

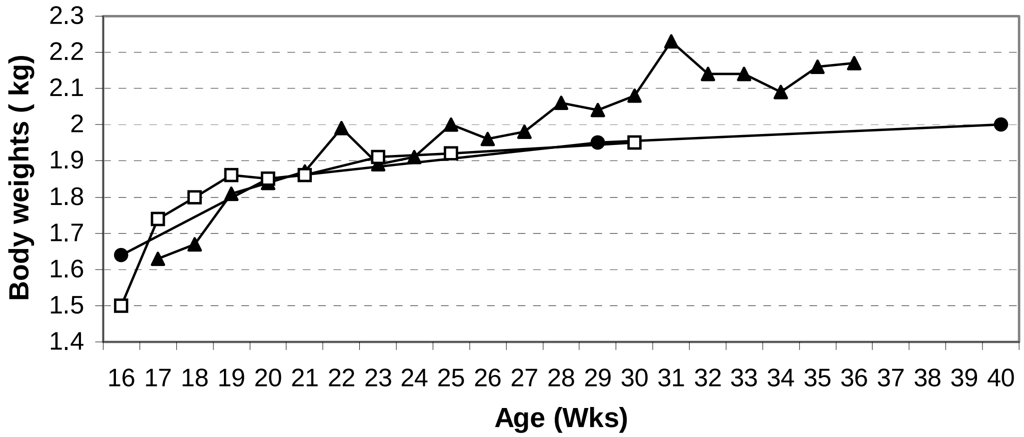

Figure 3: Comparison of body weight between 3 different barn farms (□ - Farm 1 σ - Farm 2, λ - Farm 3)

Chapter 7

Observations on egg peritonitis problems in a commercial flock

7.1 Introduction

An analysis of a commercial flock of 20,000 ISA brown layers housed in controlled environment conditions was undertaken after the owner reported an unusual increase in mortality in early lay. Body weight of the flock was above the breed standard at 16 weeks of age (Figure 1) and, in contrast to regular farm practice, the flock was rapidly stimulated into egg production using a rapid increase in day length from 16 weeks. Assessments were made on flock body weight between weeks 10-26, while mortality figures were available from week 18-46 (Figure 2).

7.2 Results

The growth rate of the flock decreased abruptly following light stimulation and body weight fell below the breed standard by 22 weeks of age (Figure 1). Growth rate plateaued between weeks 22-24 and then increased again between weeks 24-26 (Figure 1). Mortality was 0.2% or below up until week 24 and then increased to an average of 0.37% between weeks 25-31. Between weeks 31-46 the average mortality decreased to 0.27%. (Figure 2).

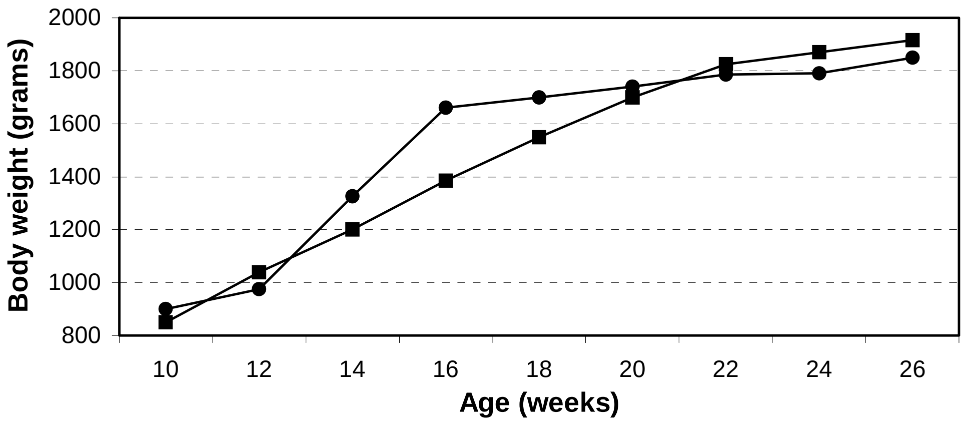

Figure 1: Body weight of a 20,000 bird commercial flock of ISA brown layers (●) in comparison to the breed standard (■).

Mortality

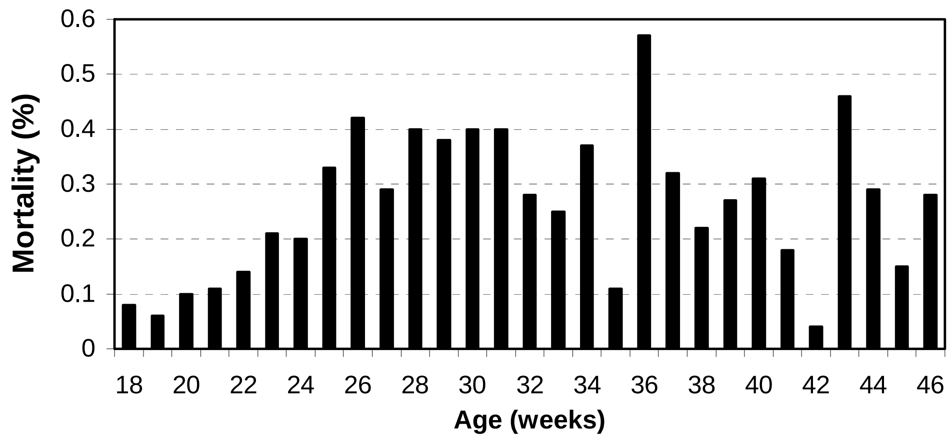

Figure 2: Mortality of a 20,000 bird commercial flock of ISA brown layers.

7.3 Discussion

During the early lay period where mortality was increasing, 20 birds were randomly taken from approximately 200 dead birds collected. These birds were post mortemed and 90% of these birds were found to have died from egg peritonitis. It is hypothesised that the poor growth rate in the early lay period predisposed these birds to oviduct infection and not surprisingly the drop in growth rate corresponded to the increase in mortality. The hypothesis concerning the relationship between early growth rate and oviduct infection mooted in Chapter 6 is supported by the assessment of this commercial flock. Unfortunately no records were available regarding the incidence of blood stained eggs.

The precise monitoring on this particular farm has identified an upsurge in mortality that is likely to be responsive to body weight management. It is not unreasonable to suggest that this particular problem would be widespread in the industry and contributing to at least 1% of mortality in this early lay period.

These observations on egg peritonitis problems on this farm do not establish a causal relationship with the body weight deteriorations as has been hypothesised, but do provide a model which could be replicated in a controlled experiment that may in turn provide important insights into the aetiology of egg peritonitis.

What is clear from these observations, however, is that there is likely to be a significant overlap in the cloacal haemorrhage problems with egg peritonitis problems, and that egg peritonitis is likely to be a significant source of mortality in relatively well managed flocks.

References

Craig, J.V. & Muir, W.M., 1993. Selection for Reduction of Beak-Inflicted Injuries Among Caged Hens. *Poultry Science*, **72:** 411-420.

8. Implications

Applied Implications

Cage Egg Production

- The resistance of the brown egg laying strains to cloacal haemorrhage, prolapse, and vent trauma seems remarkably high in models using intact beaks and high shed light intensities at the VIAS, Attwood
- This resistance to cannibalism may result from three factors, genetic improvements in the Australian stocks, near optimal body weight management of flocks and a low light rearing program designed to reduce picking behaviour in both pullets and layers.
- There is obvious potential to move to the farming of flocks with intact beaks on farms that have control over pullet management and shed light intensities in both the rearing and laying phases.
- Mortality on cage farms can be significantly higher in the top cage tiers that experience higher light intensities.
- Extremely high egg production performances have been achieved in the most recent experimental model, which have been able to be replicated in the sister commercial flocks.
- Worlds best practice egg production performances have begun to be achieved in both experimental and commercial flocks

Barn Egg Production

- Barn flocks with the appropriate body weights have markedly lower mortality than flocks that are under weight. Production is also far superior in heavier pullet flocks that achieve appropriate body weights standards by 28-30 weeks of age.
- In barn egg production systems there seems some potential for more moderate beak trimming practice where flocks are consistently achieving appropriate body weights.

Scientific Implications

- The incidence of cloacal haemorrhage is accentuated during early egg production (19-25 weeks) and around peak egg mass (35-40 weeks of age).
- Lighter birds that are producing disproportionately large eggs seem more susceptible.
- Some birds experience persistent problems with cloacal haemorrhage, whilst other birds appear able to heal the injury in less than 24 hours.
- There is some evidence for a relationship between cloacal haemorrhage and abnormal cloacal eversion/prolapse.
- A clear link between cloacal haemorrhage and oviduct infection has not been established.
- The farm studies have provided evidence of an association between under weight flocks and the development of serious egg peritonitis/salpingitis problems particularly in barn egg production systems.

9. Recommendations

- An industry wide survey of laying mortalities should be undertaken focusing on oviduct infection and cannibalism (longitudinal and cross sectional).
- Studies should be established using single bird-cages and pullets of lower quality in attempts to reproduce severe cloacal haemorrhage and prolapse.
- Sub-samples of flocks diagnosed with egg peritonitis problems should be transported to the laboratory for study.
- Farms with elite pullets and histories of high egg production performance and light controlled sheds should be encouraged to test the use of intact beaks in controlled studies against beak trimmed flocks.
- Barn egg production farms with appropriate body weights and moderate egg production should be systematically studied for beak trimming practice and mortality.
- Farmers should be encouraged to study the incidence of blood stained eggs and correlate these patterns with body weight, pullet quality and genotype.

An important question remains to be resolved by additional analysis:

Is the variability in the predisposition of flocks to picking and cannibalism influenced by better control of body weight and cloacal haemorrhage and/or by the use of special low intensity rearing programs ??

Unfortunately the current experiments using the elite pullets are a mixture of both effects, and the responses may be additive or one component may be more significant than the other.

Recent information and feed back from additional egg producers in other states indicates that birds can be successfully farmed in cages, in controlled environment housing, without beak trimming. At a practical level the industry needs to gather more information on these "on farm" experiments, and separate out some of the variation in response. A program needs to be developed that clearly illustrates that the adoption of a non-beak trimming policy in controlled environment systems could be taken up by the industry, without large economic and welfare risks. This is both a practical and research challenge, involving collection of important farm knowledge together with complementary supporting controlled experimentation.

If this plan could be successfully implemented the sophisticated cage sector could look forward to low annual mortalities (2-3%) in birds with intact beaks that produce 330-340 eggs per hen housed.

Plain English Compendium Summary

Project Title:	
RIRDC Project No.:	EGG 99-06

Researcher: Dr Greg Parkinson
Organisation: Victorian Institute of Animal Science
Phone: (03) 9217 4200
Fax: (03) 9217 4299
Email: Greg.parkinson@nre.vic.gov.au

Objectives

1. To develop management strategies that ameliorates the incidence of prolapse and picking behaviours (vent trauma and cannibalism) in the laying hen.
2. To reduce flock mortalities from approximately 10% to 7% by strategic control of prolapse and vent trauma (vent picking).
3. Stimulate the adoption of improved beak trimming practice.

Background

Experimentation undertaken at the Victorian Institute of Animal Science (VIAS), Attwood, indicated that cloacal prolapse and vent trauma/picking can be significant causes of mortality in the commercial laying hen. Combining these studies with additional epidemiological evidence, it is conceivable that national flock mortalities of 2-5% could be attributed to prolapse, oviduct infection, and vent trauma, despite the widespread use of beak trimming. The severe nature of these traumatic injuries created by prolapse or vent trauma is very controversial and is the source of considerable scientific and public debate.

Clearly these prolapse and picking problems have a low heritability and there must be large environmental/management factors which exacerbate the problems in commercial flocks. A research program was therefore designed to study management practices in relationship to cloacal haemorrhage/prolapse incidence and imprinting of eversion behaviours in both pullets and layers.

Research

This research program has several approaches; firstly to undertake research on commercial farms to clarify some of the patterns of blood stained eggs and loss through egg peritonitis and picking and secondly, to undertake research in small experimental flocks that examines the association between body weight, production and the incidence of picking and cloacal haemorrhage.

Studies of barn egg production flocks were also undertaken to evaluate both productivity and mortality patterns, and this information was able to be bench marked against cage production systems.

The final phase of this project was to use the knowledge accumulated in these studies to develop practical managerial approaches that will reduce the incidence of cloacal haemorrhage and cannibalism in both commercial cage and barn flocks.

Outcomes

1. Three strategies have been identified to moderate the incidence of cloacal haemorrhage, prolapse and picking behaviours in the laying hen. These are, i. better understanding of the importance of body weight management in early lay, ii. the use of low light intensity rearing to moderate bird behaviour, and iii. the ability to achieve a more moderate and uniform light intensity in poultry houses.
2. Producers achieving appropriate growth rates of flocks in early egg production have recorded reductions in annual flock mortalities of 2-3%.
3. Producers are now experimenting with more moderate beak trimming practice.

Implications

Farms with elite pullets, high egg production performance and light controlled sheds should be encouraged to test the use of intact beaks in controlled studies against beak trimmed flocks.
More controlled research may be required to study management interactions in the farming of flocks with intact beaks in controlled environment sheds to determine clear causal relationships.
Barn egg production farms with appropriate body weights and moderate egg production should be studied for beak trimming practice and mortality.
During the course of this research it became clear that significant mortality in layers was also occurring as a result of oviduct infection (egg peritonitis/salpingitis). A high incidence of egg peritonitis/salpingitis has been recorded in under weight flocks and there may be an association with cloacal haemorrhage.
Studies should be established using single bird-cages and pullets of lower quality in attempts to reproduce severe cloacal haemorrhage and prolapse, and to investigate any relationships that can be found with egg peritonitis/salpingitis

Publications