ISA

A Hendrix Genetics Company

ISA Brown

Commercial Management Guide

ISA

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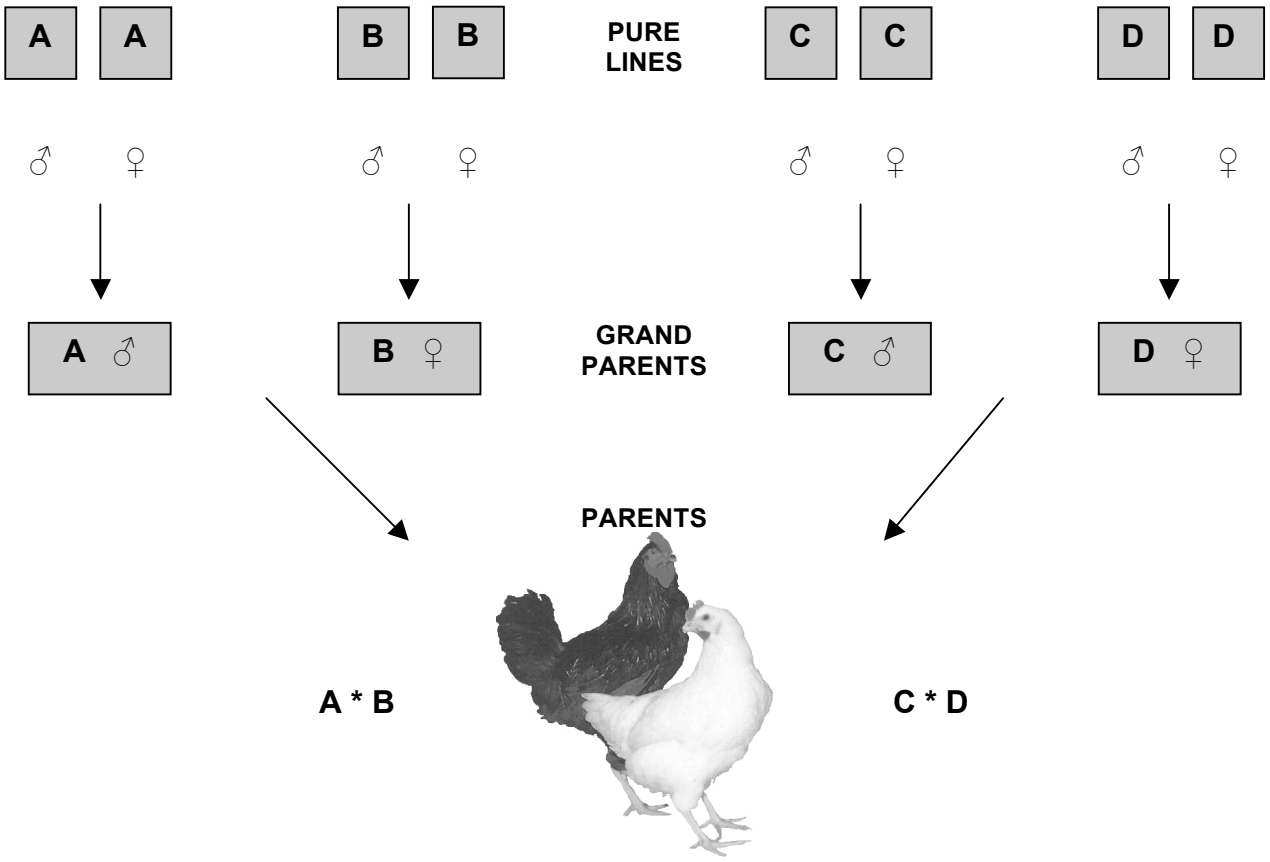
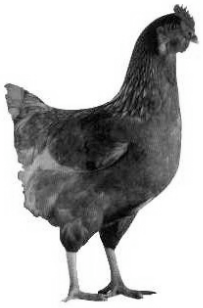
Note: The performance data contained in this document was obtained from results and experience from our own research flocks and flocks of our customers. In no way does the data contained in this document constitute a warranty or guarantee of the same performance under different conditions of nutrition, density or physical or biological environment.

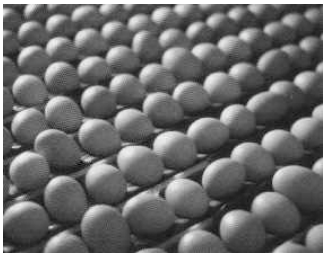
ISA Brown – Commercial Performance Objectives

Body weight at 18 weeks:	1500 g	3.30 lb.
Body weight at 30 weeks:	1870 g	4.12 lb.
Body weight at 80 weeks:	2000 g	4.40 lb.
Hen housed production		
at 60 weeks:	250 eggs	
at 72 weeks:	313 eggs	
at 80 weeks:	351 eggs	
Age at 50% rate of lay:	20 - 21 weeks	
Age at peak production:	27 - 28 weeks	
Peak production:	95 %	
Production rate:		
at 60 weeks:	83.3 %	
at 72 weeks:	75.0 %	
at 80 weeks:	68.4 %	
Total egg mass		
at 60 weeks:	15.5 kg	
at 72 weeks:	19.7 kg	
at 80 weeks:	22.1 kg	
Average egg weight:	63.1 g (50.0 lbs./case)	
Feed Conversion* (ratio by weight)	2.14 kg/kg	
Average feed consumption during lay per day	111 g (24.4 lbs./100)	
Shell Strength	3900 g	
Shell Color	32.0	
Livability (18 – 80 weeks)	93.2 %	

ISA Breeding Scheme







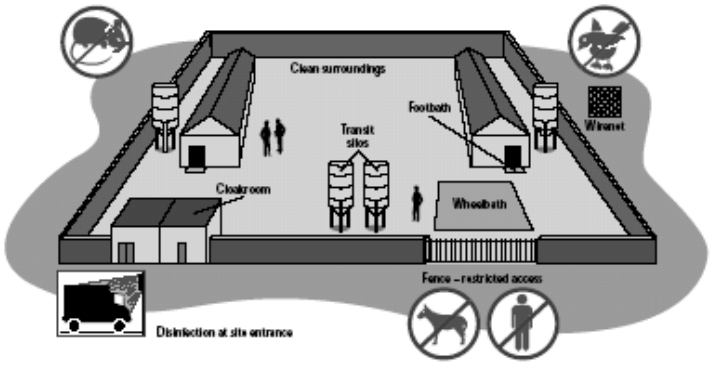
Your commercials chicks are the results of a multiple crossing process which give the commercial layer a high potential for egg production, as well as a good capability in adapting to the various environments.

❶ - Basic rules of farm location

Land governing regulations and environmental restrictions must be considered.

Farm should be placed as far as possible from other poultry houses. Each phase of production should be treated as a separate batch, according to the principle of "ALL IN – ALL OUT".

- On a rearing farm : one age only
- On a laying farm : one age only and naturally one source of supply
- No other poultry on the rearing or laying farm
- Ideally three separate laying units, supplied by the one rearing unit



❷ - Housing types

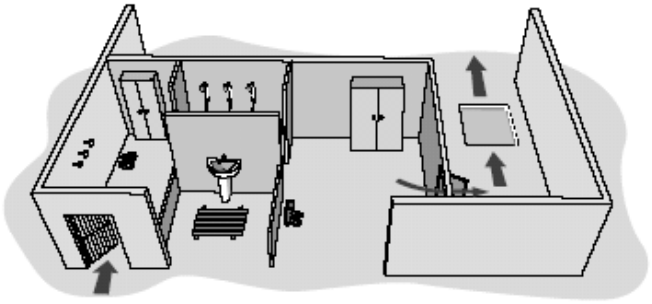
General rules

- Whatever the building style, they should be constructed so that they may be easily and thoroughly cleaned and disinfected between flocks. The walls and roofs should contain insulation with a moisture barrier and rodent proof materials.
- Adequate ceiling height for adequate ventilation purposes
- Equipment used in house should be designed for easy access and removal for clean-out, maintenance and biosecurity consideration
- In open sided housing it is important :
  - To have sun protection
  - To use insulated materials including a shield (protection) for water tanks and pipes
  - To place a wire netting and fencing over openings and ventilation inlets to control predators, rodents and wild birds and other disease vectors
  - To use a reliable source of electric power

❸ - Dirty & clean area concept

Control the entries and restrict to the minimum the number of entries in the farm with strict procedures

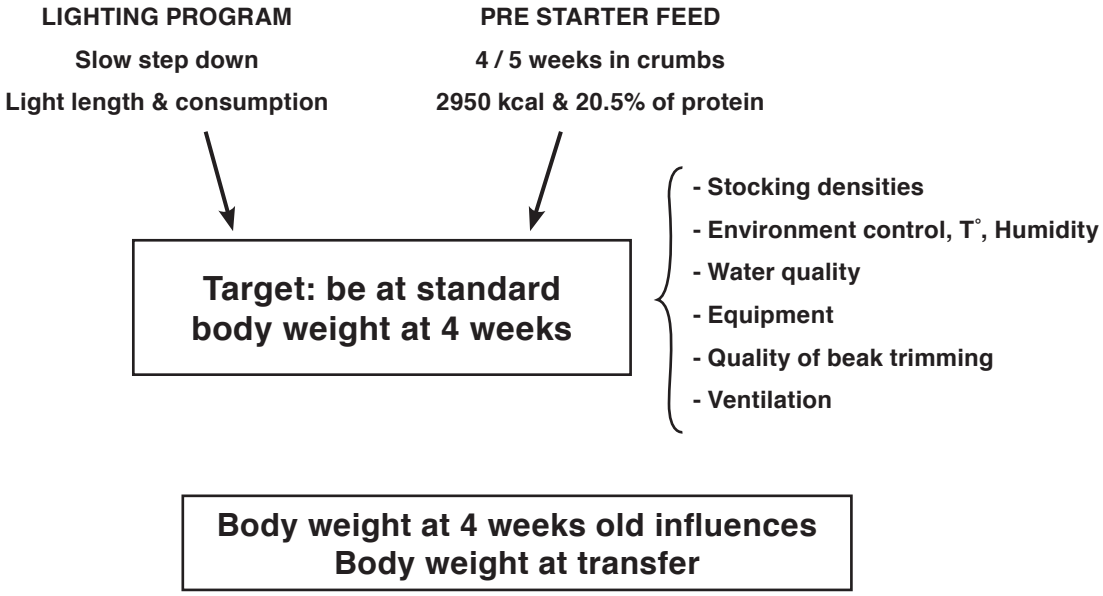
- Floor material choice for easy maintenance (clean up and disinfection)
- Clean hands with soap
- Wear protective clothing within the farm area
- Provide specific protective clothing for veterinarians, consultants, etc...
- Disinfect boots before entry
- Do not allow truck/Lorry drivers to enter the houses



❹ - Clean up & disinfection

- Use an insecticide just after the birds have been removed
- Remove all the non-stationary equipment and residual feed from troughs, conveyors and bins
- Exterminate all rodents and wild birds
- Remove all the manure, litter, feathers, dust, and any other organic materials
- Wash equipment, fans, ducts, water tanks, feed bins, walls and floor
- Disinfection is efficient only after cleaning thoroughly
    - Disinfect the interior of the building on surfaces and all equipment
    - If it is permitted and the building can be tightly enclosed, fumigate the building while it is still damp from disinfecting
    - After the building is fumigated, close up for 24 hours and then air out for another 24 hours

Key Period 1: From chicks arrival to 4 weeks of age



❶ – Tools to reach the target

- starting in house conditions (temperature, comfort, hydration of all the chicks on arrival)
- important to warm the pullet house 24 hours prior to chicks arrival
- if chicks brooding done in cages – rough, moisture-proof paper should be laid on the wire floor (first 7 days)
- stocking density in relation to space and equipment (competition creates stress, poor growth and uniformity)
- observe your birds several times per day
- control the body weight as soon as possible
- keep a slow down light program, so that all chicks can have enough time to eat
- if beak trimming: strong attention to details (frequency of blade replacement, temperature, proper trim etc.)
- usage of infrared beak treatment requires that chicks upon arrival to a farm will have very easy access to the source of water (water cups should be filled, droplets of water should be seen from the nipples, water pressure must be reduced during first few days)
- a high energy starter diet in crumb form for at least the first 4 weeks in temperate climates and 5 weeks in hot climates. Do not switch to a 'lighter' feed before you have verified that body weight is on target.

❷ - Essential points

Light

- During first few days:
  - Maintain 22 to 23 hours of light
  - With 30 – 40 lux to encourage intake of water and feed
- Afterwards
  - Normal decreasing lighting program
  - 10 lux at 15 days old (dark houses) and then adapt to bird behaviour

Water

- Wash of drinking system after disinfection
- Any medication should be carried out via the feed
- During the first 2 days, use tepid water at 20-25°C
- 50 g of vitamin C per litre the first day if chicks are dehydrated
- Supplementary drinkers during the first few days (removal should be done gradually)
- Drinkers should be cleaned daily the first 2 weeks and then once a week
- When nipple drinkers are used, we recommend that strips of embossed paper are placed under the nipples

Feed

- Starter diet should be distributed when chicks have drunk enough water to restore their body fluid (4 hours after delivery)
- Diet presented in crumb form with adequate protein and energy concentration
- For first few feeds, special small feed on non-smooth paper help feed consumption
- To avoid built up of fine particles, we advise allowing them to become empty once or twice each week

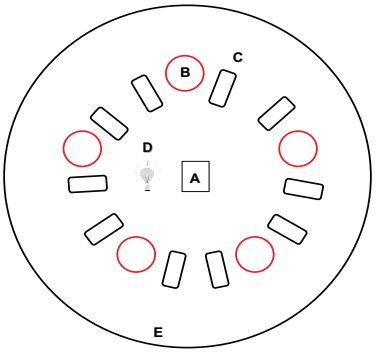
Starting Conditions: Respect the basics to be successful

❸ - Stocking densities & environment from arrival to 4 weeks of age

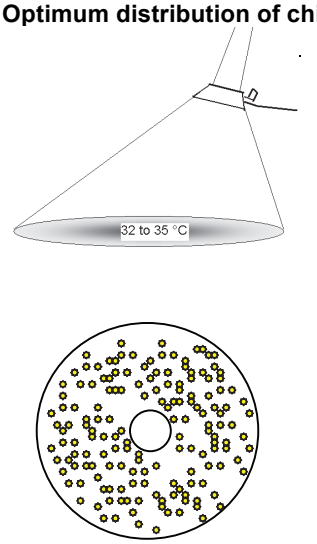
		Floor		Cages	
Stocking density (maximum)		14 birds / m^2	1.3 birds / sq.ft	200 cm^2	31 sq.in
Minimum ventilation rate		0.7 m^3 / h / kg	11.2 cu.ft / h / pds	0.7 m^3 / h / kg	11.2 cu.ft / h / pds
Heating		2 gas brooders or 2 radiant heaters of 1450 Kcal / 1000 birds			
Drinkers	**Starters**				
	Temperate climate	1 starter / 100 birds			
	Hot climate	1 starter / 80 birds			
	Bell drinkers	150 birds / Hanging bell drinker (80 to 100 in hot climate)			
	Nipples				
	Temperate climate	16 birds / nipple			
	Hot climate	10 birds / nipple			
Feeders	**Per starting pans**	50 birds / starting pan			
	Linear Chain	4 cm / bird	1.6 in / bird	1.5 cm / bird	1.0 in / bird
	Per feeder	1 unit / 50 birds	1 unit / 50 birds	1 unit / 50 birds	1 unit / 50 birds

❹ - Starting conditions

Recommended lay out for 500 chicks



Optimum distribution of chicks



A : Radiant heater of 1450 kcal capacity
B : Drinkers (5) but (7) in Hot climate
C : Feed trays (10)
D : 75 watt bulb at 1.50 m above floor level
E : Surround : 4 m diameter – 0.6 m high

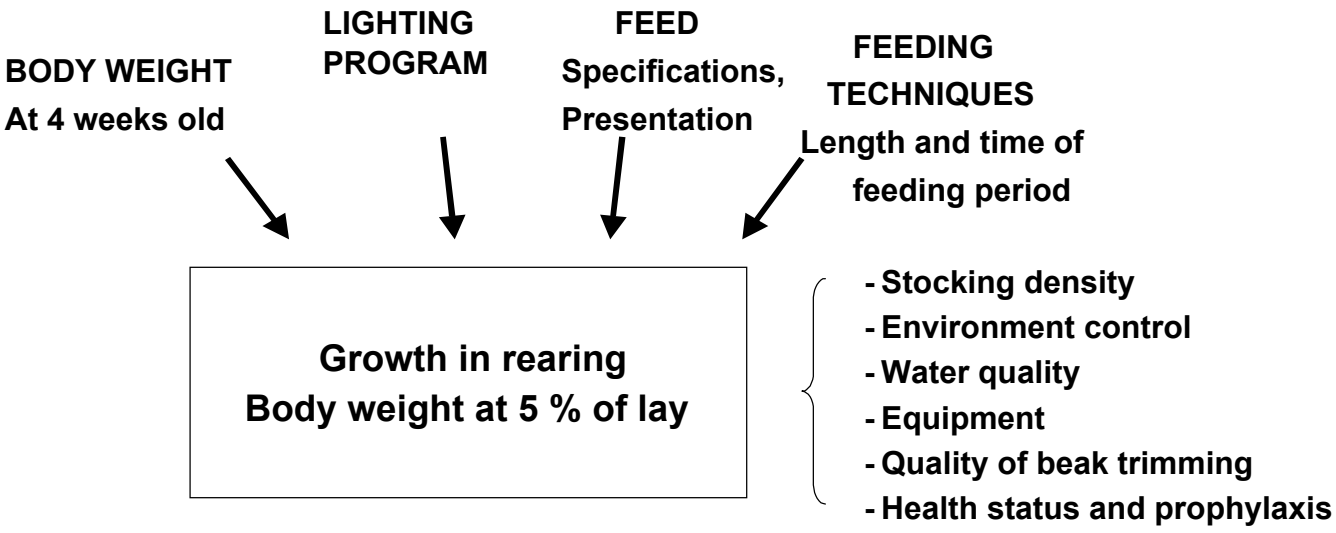
Standards for temperature and humidity

Age (days)	Brooding temperature		Room temperature	Relative humidity
	At the edge of the brooders	At 2/3 m from the brooders		Optimum & Maximum in %
0 – 3	35 °C	29 – 28 °C	33 – 31 °C	55 – 60
4 – 7	34 °C	27 °C	32 – 31 °C	55 – 60
8 – 14	32 °C	26 °C	30 – 28 °C	55 – 60
15 – 21	29 °C	26 – 25 °C	28 – 26 °C	55 – 60
22 – 24		25 – 23 °C	25 – 23 °C	55 – 65
25 – 28		23 – 21 °C	23 – 21 °C	55 – 65
29 – 35		21 – 19 °C	21 – 19 °C	60 – 70
After 35		19 – 17 °C	19 – 17 °C	60 – 70

- For floor rearing, the standard is 500 chicks per 1450 kcal
- Preheat the building for 24 to 36 hours before the chicks arrive to obtain a litter temperature at 28 to 31°C
- Uniform temperature and relative humidity, throughout the building

- On floor rearing, distribution of chicks throughout the building should be uniform. If the chicks crowd together under the brooder: temperature is too low. If the chicks are close to the surround: the temperature is too high.

Key Period 2: From 4 to 16 weeks, building potential of the future layer



Too low body weight at start of lay could induce lower overall performance (below normal egg size, reduction of peak of production and post peak drops)

The achievement of this objective depends on :

- **Stocking density and the age chicks are moved to the laying location**
- **Length of the lighting period**
- **Quality of beak treatment**
- **Prevention of stress**

- **Feeding methods**
  - **Emptying of feeders every day**
  - **Timing of feed distribution**
  - **Feed presentation**
  - **Use of midnight feeding in growing (if behind body weight standard)**

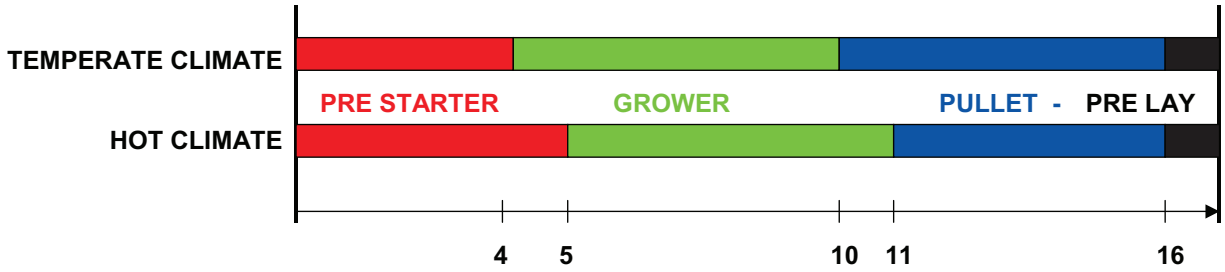
Pullet growing space and equipment requirements (5 - 16 weeks) :

	Floor		Cages	
Stocking density (minimum)				
In temperate climate	10 birds / m^2	1.07 sq. ft./bird	361 cm^2	56 sq.in
In hot climate				
With evaporative cooling	9 birds / m^2	1.19 sq. ft./bird	400 cm^2	62 sq.in
Without evaporative cooling	8 birds / m^2	1.34 sq. ft./bird	497 cm^2	77 sq.in
Minimum ventilation rate				
Temperate climate	4 m^3 / h / kg – 64 cu.ft / h / pds			
Hot climate	6 m^3 / h / kg – 96 cu.ft / h / pds			
Heating	Space heating			
Drinkers				
Temperate climate	10 hanging drinkers / 1000 pullets or 1 nipple / 12 pullets			
Hot climate	13 hanging drinkers / 1000 pullets or 1 nipple / 10 pullets			
Feeders	5 cm – 2 in / pullet or 1 pan / 25 pullets			

Body weights & approximate feed consumption for ISA Brown pullets

Age		Body Weight		Approximate Feed Consumption Grams		Approximate Feed Consumption Lbs	
Weeks	Days	Grams	Lbs.	Daily	Cumulative	Daily	Cumulative
1	7	65-68	0.14-0.15	11	77	2.42	0.17
2	14	110-120	0.24-0.26	17	196	3.74	0.43
3	21	195-210	0.43-0.46	25	371	5.51	0.82
4	28	285-305	0.63-0.67	32	595	7.05	1.31
5	35	380-400	0.84-0.88	37	854	8.15	1.88
6	42	470-500	1.03-1.10	42	1148	9.26	2.53
7	49	560-590	1.23-1.30	46	1470	10.14	3.24
8	56	650-680	1.43-1.50	50	1820	11.02	4.01
9	63	740-775	1.63-1.71	54	2198	11.90	4.84
10	70	830-865	1.83-1.91	58	2604	12.78	5.74
11	77	920-960	2.03-2.12	61	3031	13.44	6.68
12	84	1010-1050	2.22-2.31	64	3479	14.10	7.67
13	91	1095-1140	2.41-2.51	67	3948	14.77	8.70
14	98	1180-1230	2.60-2.71	70	4438	15.43	9.78
15	105	1265-1320	2.79-2.91	73	4949	16.09	10.91
16	112	1350-1410	2.97-3.11	76	5481	16.75	12.08
17	119	1430-1505	3.15-3.32	80	6041	17.63	13.31
18	126	1500-1600	3.31-3.53	84	6629	18.51	14.61

❶ - The range of diets



Grower Diet

- 4 to 10 weeks in temperate climate
- 5 to 10 or 11 weeks in hot climate
- Can be in mash form if the grist is right or as crumbs

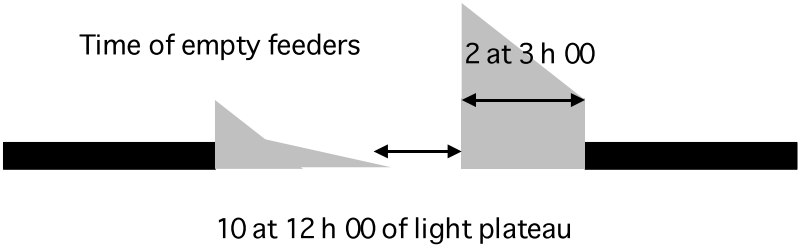
Pullet Diet

- 10/11 to 15/16 weeks
- Must meet birds' requirements for amino-acids
- Too low energy level will result in a reduction of growth
- Too high in energy will restrict the development of digestive tract and lead to reduced feed intake at start of lay
- So, we recommend an energy level slightly lower than layers diet

Pre-Lay Diet

- 2 weeks before reaching 2 % lay
- Medullary bone which acts as a reservoir of mobilisable calcium for egg shell formation has its development during this period. Necessary to provide a feed rich in protein, phosphorus and calcium.
- To avoid under-consumption caused by powdery calcium carbonate, around 50% of calcium should be supplied in particles form (2 to 4 mm).

❷ - Feeding techniques



<u>In order to :</u>

- avoid the build up of fine particles
- encourage crop development by having rapid feed consumption
- encourage gizzard development by using a coarse grist (50% of calcium in particles from 10 weeks)

Build up of fine particles residues

- Birds are natural grain eaters.
- Start to eat large particles and leave the finest ones.
- But accumulation of fine particles leads to under consumption.
- Essential to empty the feeders once a day.

Rapid feed intake

- Crop is a storage organ.
- Crop allows the bird to eat enough feed in the evening to satisfy its energy needs throughout the night.
- Rapid feed consumption during rearing leads to the development of the crop.

Feeding times

- Birds naturally eat more in the evening and in the morning.
- Empty feeder period is recommended in the middle of the day and could be started between 4 and 8 weeks.
- Length of empty feeder should be gradually increased to get a minimum of 2-3 hours (of empty feeder) at 12 weeks old.
- First feed distribution 2 to 3 hours before lights off.
- If a second one is necessary, it could be done just before lights off, birds will quite easily eat the finest particles in the morning.
- If difficult to obtain empty feeders, reduce the amount of feed distributed

Feed presentation

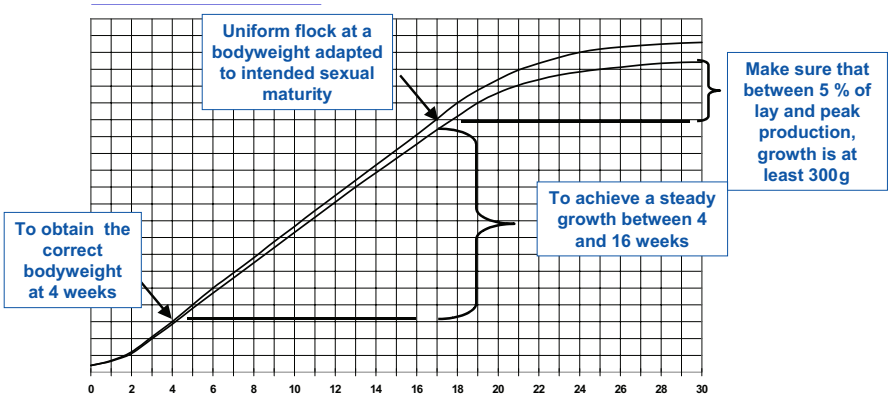
- Particles below 0.5 mm : 15 % maximum
- Particles above 3.2 mm : 10 % maximum

Use of Insoluble grit or limestone particles

Weekly :

- 3 g / pullet from 3 to 10 weeks (2 to 3 mm)
- 4 - 5 g / pullet from 10 weeks (3 to 5 mm)

The control of growth: a must every week, to check the real evolution of the flock - the earlier you know the earlier you can correct, if necessary



Productivity of laying hens is influenced by :

- The body weight and uniformity at start of lay
- By the growth potential from start of lay to peak of production.

The control of growth from day old is an important parameter to control.

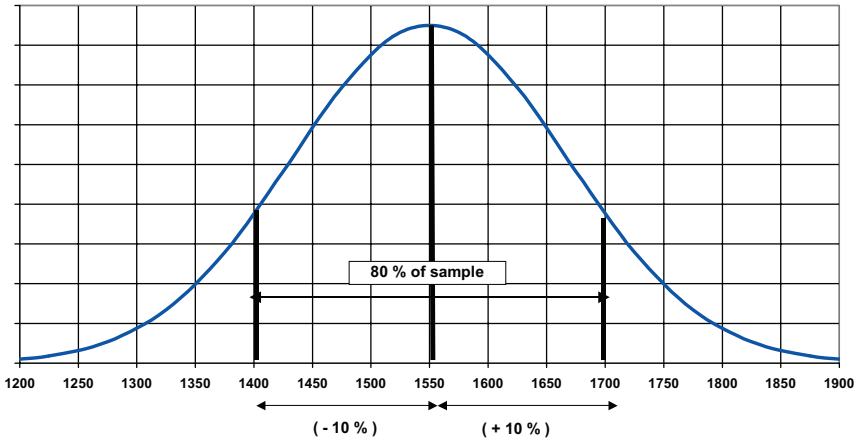
- Body weight at 4 weeks depends on brooding conditions, lighting program and feed presentation
- From 4 to 16 weeks, exceeding the growth rate often leads to a reduction in appetite during the first weeks of production. So we recommend during this period to keep the pullets' appetite active thanks to a daily empty feeder. Ration during this period should be adapted in order to maintain growth at higher standard line.

❶ - Method of weighing

- Time of weighing should be fixed preferably in the afternoon
- We advise carrying out individual weighing when chicks are 4 weeks old
- Surround a group of birds in the middle of the flock, and then weigh all the birds in the pen

A sampling with a minimum of 100 birds gives a good estimate of mean body weight and uniformity (or 2 times 50 birds if there are 2 pens). When rearing in cages, one should weigh all the birds from 5 or 6 cages chosen at random in different parts of the building.

❷ - Uniformity of the flock



Uniformity of individual birds is important as well as average flock weights

A batch is uniform when all the weights within the sample fall between ±20 % of the mean or , when 80 % of the weights lie within ±10% of the mean.

Within the limits of ±20 % of the mean, the smallest and the heaviest birds are of the same quality. Only those which are too small should be culled.

The beak trimming: to be carried out with strict guidance in accordance with welfare requirements

❶ - Why to Beak Trim?

⇨ reduction of incidence of pecking when it is a recurrent problem
⇨ reduction of feed wastage.

❷ - When to beak trim?

IN DARK HOUSES (CAGES)

Beak trimming should be carried out carefully, at day old or at about 10 days old.

IN SOME CONDITIONS

Beak trimming at around 10 days will not prevent pecking entirely. Therefore, we recommend a light trimming at 10 days (cauterisation of the beak tip and of the lateral edges) and then carrying out a second operation between 8 and 10 weeks of age, if it is allowed by codes and regulations of the country.

❸ - Carrying out beak trimming

DELICATE OPERATION
risk of unevenness + difficulties with feeding and drinking → **Performed only by trained personnel**

Before Trimming

- do not beak trim when the birds are not healthy or when reacting to vaccinations
- add vitamin K to the drinking water (to prevent haemorrhages)
- check the equipment (temperature of the trimming blade : 600-650°C)
- replace blade with frequency specified by equipment manufacturer, do not trim with dull blade

Beak Trimming

AT ABOUT 10 DAYS

- Choose carefully the correct diameter hole on the beak-trimming machine, so as to cut the beak at least 2 mm from the nostrils
- Hold the chick in one hand, with the thumb behind the head (the head firmly in position resting on the thumb)
- Tilt the chick's beak upwards through 15° and cauterize the reinforced side edges of the beak, to avoid unequal re-growth of the 2 mandibles
- Check the temperature of the blade, each operator and the machine every hour

AT 8-10 WEEKS

- insert a finger between the 2 mandibles
- cut the beak perpendicularly at a right angle to its long axis, so that after cauterisation about half the length of the beak between the tip and the nostrils is left
- cauterize each mandible with care, particularly at the sides of the beak, so as to round off the sides of the beak and avoid lateral re-growth

Female where the beak has been trimmed at 8 - 10 weeks of age for floor housed laying systems or in cages in naturally lit houses

AT TRANSFER

- If necessary, re-trim the beaks of any birds which require it, if it is allowed by codes and welfare regulations of the particular country

After Trimming

- increase the water level in the drinkers, and the pressure in the pipes
- make sure that the depth of feed is adequate (do not empty the feeders for a week)

Growth and sexual maturity control through lighting program

❶ – How to encourage growth?

- Feed consumption is greatly influenced by light duration to which the pullets are exposed.
  - Continuous light during the first three days
  - From three days to 7 weeks old, reduce light duration to a constant light duration in temperate climate
- From 7 weeks old, maintain a constant light duration of 10.00 hours:
  - In open house system, the light duration at the plateau has to be adapted to type of housing, time of the year and location of the rearing farm.
- In summer time, in dark house system, the constant light duration at the plateau could be increased to 12.00 hours
- In hot climate, a program of long days decreasing until 15 weeks allows the bird to eat during the cooler parts of the days in order to compensate reduction of bird's appetite due to heat causes.
- In production, 15 hours of light duration at 50 % production encourage feed intake and allows birds to counteract the harmful effects of decreases of natural day-length.

❷ – How to manage sexual maturity?

- In absence of photo stimulation (constant light duration), the age at start of lay is determined by body weight. Once photo stimulation has started, age at start of lay is no more influenced by body weight.
- At all latitudes and irrespective of type of house :
  - Never increase day length between 8 and 14 weeks
  - Never increase day length before 1250 g bodyweight
  - Never decrease day length after start of lay
  - Any decrease leads to drop of production.
- Egg weight depends on body weight at start of lay. So there is a strong correlation between precociousness and mean egg weight. A low body weight at sexual maturity :
  - reduces mean egg weight
  - could also induce lower overall performance (egg numbers, shell quality, liveability,...)
- To modify the mean average egg weight obtained, we recommend to advance or delay photo stimulation according to bodyweight as previously explained.

	Target egg weight (Expressed as difference from standard)			
Bodyweight at stimulation	**- 1 g / std**	**Standard**	**+ 1 g / std**	**+ 2 g / std**
1100 g	**+ 2 h 00**			
1175 g	*			
1250 g	*	**+ 2 h 00**		
1325 g	*	*		
1400 g	*	*	**+ 2 h 00**	
1475 g	*	*	**+ 1 h 00**	
1550 g	*	*	*	**+ 2 h 00**
1625 g	*	*	*	**+ 1 h 00**
*	*	*	*	**+ 1 h 00**
*	**then 30 minutes per week until 16 hours**			

- Two weeks modification in photo stimulation will modify start of lay by one week, the egg number by 4.5 eggs and mean egg weight by 1 g. Total egg mass produced will be not affected.
- In order to control egg weight profile, an adequate lighting program has to be defined according to type of poultry house, location...

❸ – How to adapt light intensity?

- For the first few days, an intensity of 30-40 lux is recommended. After that the intensity used will depend on the intensity to be experienced during the laying period.

- Buildings are considered as dark houses when light penetration from outside, through all kinds of openings, produces intensity less than 0.5 lux . Others are considered as semi-dark.

In dark building :

- An intensity of 5 to 10 lux is sufficient if laying house is a dark building.
- If laying house is an open sided house design, to avoid too much of an increase in intensity at transfer, we recommend maintaining an intensity of 40 lux.

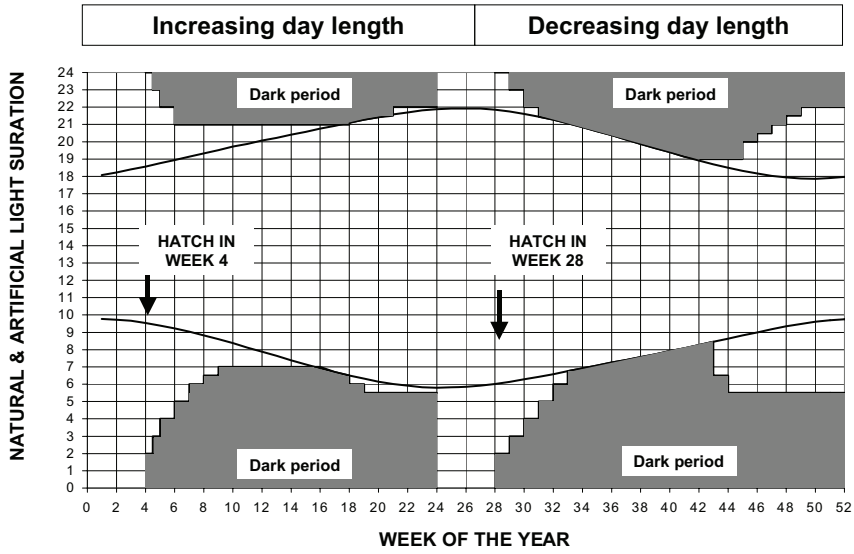
In a naturally lit or semi-dark house, in order to have an effective light program and to control sexual maturity, 40 lux may be required.
An increase of light intensity is not needed to stimulate the pullets

❹ – Rearing in dark poultry house (Less than 0.5 lux above 20° latitude)

- Basics rules :
  - Slow step down lighting program till 7 weeks
  - 10.00 hours of light as a constant day length, or 12.00 hours in summer time
  - 2.00 hours of photo stimulation and then 30 min per week
- If production in natural-lit laying house :
  - It is important to maintain 40 lux of light intensity to avoid too much of an increase in intensity at transfer.
  - It is important to have constant light duration at the plateau in order to avoid too much of an increase in light duration at transfer
- Get 16.00 hours light at 50 % lay. It is not necessary to exceed 16 hours light in production

❺ - Rearing in naturally lit house

- It is very difficult to have a good control of lighting programs in open house systems.
- The following examples suggested are only guides. They should be modified according to results previously obtained.
- The lighting programs have to be planned in conjunction with changes in the natural day length.
- One should make sure that lights on and lights out coincide with sunrise and sunset at the time photo stimulation starts.
- It is not necessary to exceed 16 hours in production, but we advice to get 16 hours at 50 % production



Increasing Day-length

- In increasing day-length, to avoid a too early sexual maturity, the length of the lighting given should be equal to the natural day-length to which the birds will be exposed at 1250 g (98 days).
- Light stimulation should start at 1250 g by increasing the length of light by one hour.

Decreasing Day-length

- In decreasing day-length, a step down lighting program will meet the natural day-length at 1250 g (98 days)
- To reduce delay in sexual maturity induced by decreasing day-length, we advise to start the photo stimulation by 2 hours.
- And then 30 minutes per week.

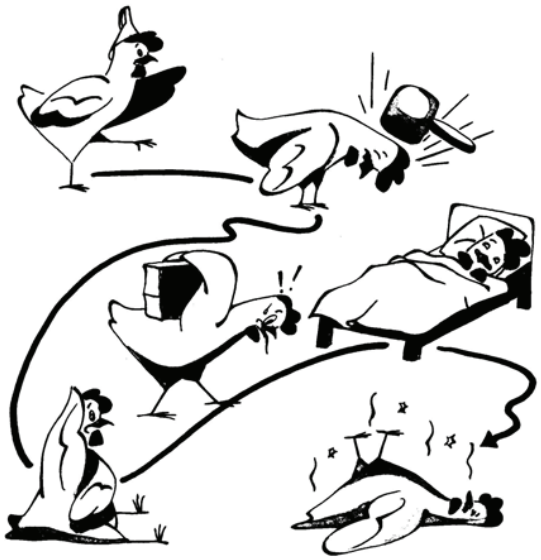
Hot climate between 20° North latitude and 20° South

- In these areas, we face nearly constant hours of natural day-length during the whole year.
- To compensate reduction in bird's appetite due to heat causes, a slowly decreasing light program till 15 weeks old is advised.
- By giving light early in the morning, we encourage feed consumption during the cooler part of the day.
- Photo stimulation at 5 % production

To get an efficient light stimulation, we advise light is added on in the morning instead of the evening.

Key Period 3: The transfer to the production house
How to reduce its negative effect?

Rearing unit → Laying unit



Sources of stress :

- **Transport**
- **Housing system (close, open house,…)**
- **Drinking system**
- **Feeding system**
- **Environment**
- **Light duration**
- **Temperature**

"The transfer is a major stress, accompanied by changes in environment (temperature, humidity...) and equipment. It should be carried out as fast as possible, ideally being completed within a day. The following points should reduce the severity of this stress."

❶ - When? Transfer at 16 - 17 weeks old

Because of stress to which birds are subjected during transfer and immediately afterwards :

- It is extremely important that transfer has been completed before the appearance of the first eggs (Major developments of reproductive organs occur during the 10 days prior to the first egg).
- We advise that vaccinations are given at least a week before transfer.
- A late transfer or a too long transfer often leads to delayed start of lay and higher mortality

❷ - Encouraging rapid adaptation to the new environment

- Give 22 hours of light the first day
- Light duration should be decided according to what has been used during rearing
- Increase the light intensity for 4 to 7 days to help the birds in the darkest cages to find nipples.
- High light intensity for longer than 7 days can increase the risks of pecking

❸ - Encouraging water consumption

The duration of transfer can be an important source of water loss, especially in some atmospheric conditions.

- Birds could be dehydrated
- Pullets should drink before feeding
- Absence of feed helps them to find the nipples
- Wait for 3 or 4 hours before distributing feed and check if drinking system is working properly
- A daily water consumption control is of paramount importance

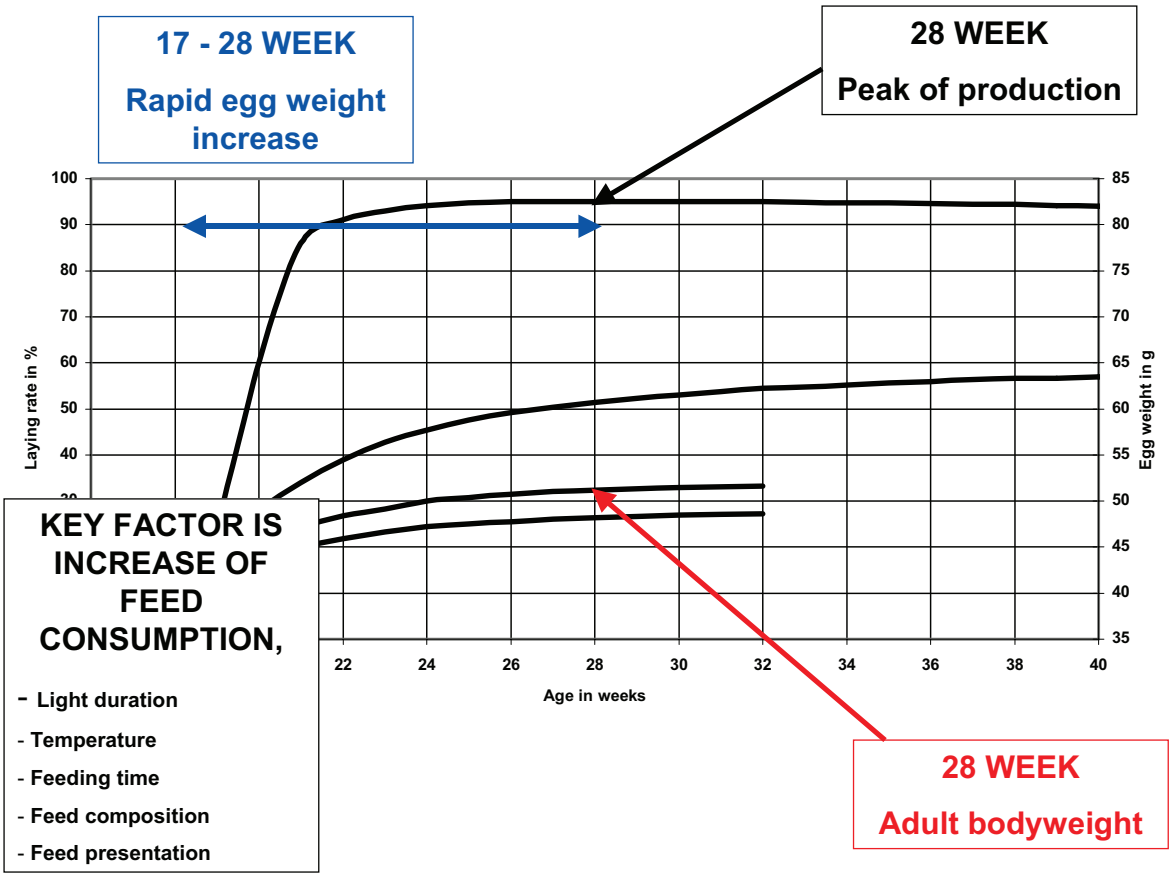
It is also important to maintain the temperature at point of lay as close as possible to which they have become acclimatised during rearing.

Note: if nipples used in production, necessary to have nipple drinkers in growing.

Adult space requirements

	Cages	Litter	Litter & Slats	All Slats
Floor	450 cm^2 (69.8 sq.in.) / bird	6 birds/m^2 1.8 sq.ft./bird	8 birds/m^2 1.3 sq.ft./bird	9 birds/m^2 1.2 sq.ft./bird
Feeder Trough **Pans**	10 cm (4") / bird -	7.5 cm (3") / bird 4/100 birds		
Drinker Trough	10 cm (4") / bird	5.0 cm (2") / bird		
Birds/Round Bell Drinker	-	90		
Cups or Nipples	maximum 10 birds/cup or nipple a minimum of 2 cups or nipples per cage	maximum 10 birds/cup or nipple		

Key Period 4: Laying phase
17 – 28 weeks



Between transfer and 28 weeks old, the bird has to cover :

- **its growth till adult body weight**
- **its requirements to achieve peak of production**
- **its requirements to get a rapid egg weight increase**

Advice on how to encourage feed consumption

Adapted light duration :

- Achieving 15 hours of light at 50 % production
- Using midnight feeding till 1850 g for brown egg layers

Feeding times should take into account the behaviour of the birds :

- 60 % of the feed is eaten during the last 5-6 hours of the day
- Minimizing the number of feed distributions according to equipment. Too many feed distributions leads to strong competition among the birds and a lack of uniformity due to preference for the larger feed particles

Below, we give some examples of feed distribution times:

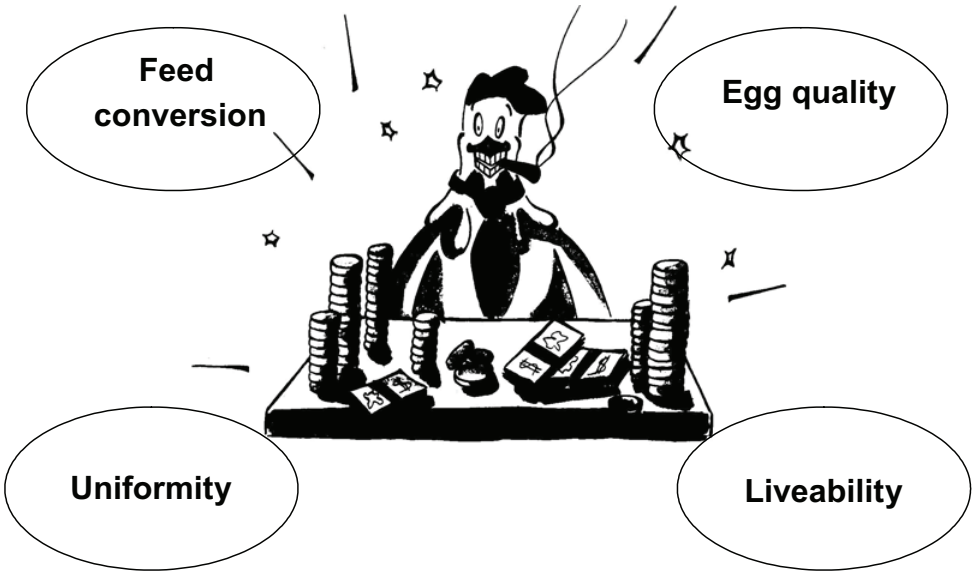
- **2 distributions**: 2/3 of the feed is given 5 to 6 hours before "lights-out" and the remaining 1/3 about 2 to 3 hours after "lights-on".
- **3 distributions**: the first should be 5 to 6 hours before "lights-out", the second about 3 hours before "lights-out", and the third at lights on.
- **4 distributions**: the same timetable as for 3 distributions, but with an extra distribution during the period of light given in the middle of the night.

By giving an early lay feed to satisfy the production and growth requirement:

- Using a diet with an amino acid content about 7 % higher than that of the diet used after peak
- Energy levels remain the same. As birds adapt their feed intake according to energy intake, too high energy diet content penalise the feed intake

Ambient temperature strongly influencing feed consumption. Lower temperatures in the laying barn encourage birds to consume more feed in order to maintain their body temperature. Very important after the housing give young layers opportunity to gain body weight and reach fast good early egg size. It is advisable to house layers with 70-71°F (21.1-21.7°C) to develop eating capacity and reach adult feed consumption. When peak production reached and feed consumption stabilized at around 30 weeks of age advisable gradually reach temperature in the barn at around 76°F or 24.4°C.

After 28 weeks: Managing for the best economical performances



❶ - Feed Conversion Ratio

When the body weight of the bird is correct, the feed conversion ratio can be improved slightly by :

Increasing house temperature

- A change of 1°C in the ambient temperature brings about an inverse change in feed consumption in the order of 1.4 g per bird per day. In such temperature, egg weight is slightly reduced
- Increase of temperature is only possible if temperature throughout the poultry house is uniform
- Ventilation should always be satisfactory in accordance with requirements
- Above 27 °C, the appetite falls too much and the pullet under-consumes. It is important to avoid 27°C in the hottest parts of the house.

Reducing light duration

- A reduction in light duration helps to maintain feathering and consequently reduces the average maintenance requirements.
- Lighting in the middle of the night encourages feed consumption at start of lay. According to its effect on shell quality later on, it is preferable to maintain it till end of lay.
- Discontinuous lighting program can only be considered in dark buildings. Progressive reduction of light period could be done with this type of program.
- In a normal lighting program, in dark houses, a period of darkness could be introduced and an increase from 35 weeks old if body weight is correct. Light on and light off has to be the same throughout the laying period.

❷ - Uniformity

In order to achieve persistency and good shell quality late in lay, it is essential to keep the flock uniform. Loss of uniformity during lay is the result of competition for the biggest feed particles. That depends upon:

- the percentage of particles greater than 3.2 mm in diameter
- the number of feed distributions
- the space and positioning of the feeders.

❸ - Liveability

Liveability depends, in naturally lit buildings, on the standard of beak trimming (see chapter on “Beak-Trimming") and, in dark buildings, on the lighting intensity used during the production period and most of all on the uniformity of light distribution (see chapter on "Light intensity").

Chlorination of the drinking water is essential to prevent infections from contaminated water. Frequent checks should be made on water quality.

Lighting programs:
Several options possible, according to the local conditions and targets

The amount of feed eaten is dependent on the day-length. A change in day-length of one hour changes feed intake by about 1.5 to 2.0 g.

❶ - Normal lighting program: 15 hours light from 50 % production

- Provide 15 hours light from 50 % lay.
- The day length (Interval between lights on and lights out) should not be decreased during lay.
- A day-length longer than 16 hours is not necessary in dark buildings.
- In naturally lit or semi dark buildings, day-length should be equal to the longest natural day experienced.

❷ - 1.0 h or 1.30 h light in the middle of the night

Light should be switched on about 3 hours after lights out, in order to :

- Encourage feed consumption and growth in pullets at start of lay
- It can be discontinued at about 30 weeks of age if body weight and feed consumption are on target
- Towards the end of lay, night lighting improves the quality and colour of the egg shell to satisfy the specific appetite for calcium during the egg shell formation.
- In hot climates or during a hot spell, lighting during the night reduces the ill effects of heat by encouraging feed consumption.

Lighting program in temperate climate

The programs suggested are only guides. They should be modified according to results previously obtained.

Production in dark laying houses

Age and / or Body weight	Duration of lit period Temperate season	Hot season	Intensity Lux
1 – 3 days	22 h	22 h	20 – 40
4 – 7 days	20 h	20 h	15 – 30
8 – 14 days	18 h	18 h	10 – 20
15 –21 days	16 h	16 h	5 – 10
22 – 28 days	15 h	15 h	5 – 10
29 – 35 days	13 h 30	14 h	5 – 10
36 – 42 days	12 h	13 h	5 – 10
43 – 49 days	11 h	12 h 30	5 – 10
After 49 days	10 h	12 h	5 – 10
1 250 g	12 h	14 h	5 – 15
1 325 g	12 h 30	14 h 30	5 – 15
1 400 g	13 h	15 h	5 – 15
1 475 g	13 h 30	15 h 30	5 – 15
After 1 475 g	Increase by 30 min / week So as to have 15 to 16 h at 50 % production		

Production in naturally lit or semi-dark houses

Age and / or Body weight	Duration of light at 14 weeks				
	≤ 10 h	11 h	12 h	13 h	≥ 14 h
1 – 3 days	22 h	22 h	22 h	22 h	22 h
4 – 7 days	20 h	20 h	20 h	20 h	20 h
8 – 14 days	18 h	18 h	18 h	18 h	18 h
15 –21 days	16 h	16 h	16 h	16 h	16 h
22 – 28 days	15 h	15 h	15 h	15 h	15 h
29 – 35 days	13 h 30	14 h	14 h	14 h	14 h 30
36 – 42 days	12 h	13 h	13 h	13 h 30	14 h
43 – 49 days	11 h	12 h	12 h 30	13 h	14 h
Decreasing day lengths :					
After 49 days	10 h	NL	NL	NL	NL
1 250 g	12 h	13 h	14 h	15 h	16 h
1 325 g	13 h	14 h	14 h 30	15 h 30	16 h 30
1 400 g	13 h 30	14 h 30	15 h	16 h	16 h 30
Increasing day lengths :					
After 49 days	10 h	11 h	12 h	13 h	14 h
1 250 g	11 h	12 h	13 h	14 h	15 h
1 325 g	12 h	13 h	14 h	14 h 30	15 h 30
1 400 g	13 h	14 h	14 h 30	15 h	16 h
After 1 400 g	Increase by 30 min / week in order to have 15 to 16 h at 50 % production				

Lighting program in hot climate

The programs suggested are only guides. They should be modified according to results previously obtained.

Lighting program for hot climates between latitudes 20° north and 20° south		
1 – 3 days	**23 or 24 h**	**40**
4 – 7 days	**22 h**	**40**
8 – 14 days	**20 h**	**40**
15 –21 days	**19 h**	**40**
22 – 35 days	**18 h**	**40**
36 – 49 days	**17 h**	**40**
50 – 63 days	**16 h**	**40**
64 – 77 days	**15 h**	**40**
78 – 91 days	**14 h**	**40**
92 – 98 days	**13 h**	**40**
99 – 105 days	**13 h**	**40**
106 – 112 days	**Natural light**	**40**
113 – 126 days	**Natural light**	**40**
After 127 days	**Natural light**	**40**
5 % lay	**14 h (+ 2 h)**	**40**
After 35 % lay	**15 h (+ 2 h)**	**40**
After 60 % lay	**16 h (+ 2 h)**	**40**

Note: (+ 2 h) refers to the period of artificial light given in the middle of the night to encourage feed consumption.

Adjusting egg weight to meet market requirements

❶ - Body weight of the pullet at sexual maturity

If one has a standard growth curve, and the age at start of lay is changed, then the body weight at sexual maturity is also changed. The age at start of lay has a direct effect on the adult weight and, therefore, on the egg size throughout the whole laying period. Earlier maturing flocks will produce a greater number of eggs, but these eggs will be smaller than those from delayed flocks because the pullets are lighter.

❷ - Control of the sexual maturity

- Research has shown that mean egg weight increases by 1 g when sexual maturity is delayed by one week. Conversely, the number of eggs will be decreased. For each change of one week in age at start of lay, there will be a change of about 4.5 eggs in number laid. By using the appropriate techniques, the age at start of lay can be modified to produce eggs of the required weight, without affecting the total egg mass produced.
- Rather than giving light stimulation according to age, we advise not starting to increase day-length until pullets have reached the target weight planned. By that means, they will not be allowed to come into lay at too low body weight, which would be prejudicial to egg weight and overall performance.

The following table shows us how to use light stimulation, according to the mean egg weight desired.

Body weight at light stimulation	Target Egg Weight (Expressed as Difference From Standard)			
	- 1 g	**standard**	**+ 1 g**	**+ 2 g**
1100 g	+ 2 h			
1175 g	*			
1250 g	*	+ 2 h		
1325 g	*	*		
1400 g	*	*	+ 2 h	
1475 g	*	*	+ 1 h	
1550 g	*	*	*	+ 2 h
1625 g	*	*	*	+ 1 h
*	*	*	*	+ 1 h
*	* then 0 h 30 hour per week until 16 hours			

❸ - Body weight at 24 weeks

Egg weight is highly dependent on bodyweight at 24 weeks. Between 5 % lay and peak production, body weight should increase by at least 300 g.

Our research has enabled us to determine optimum body weights throughout the rearing and laying periods. This plays an essential role in obtaining performance as measured by egg numbers, egg weights and feed conversion ratio.

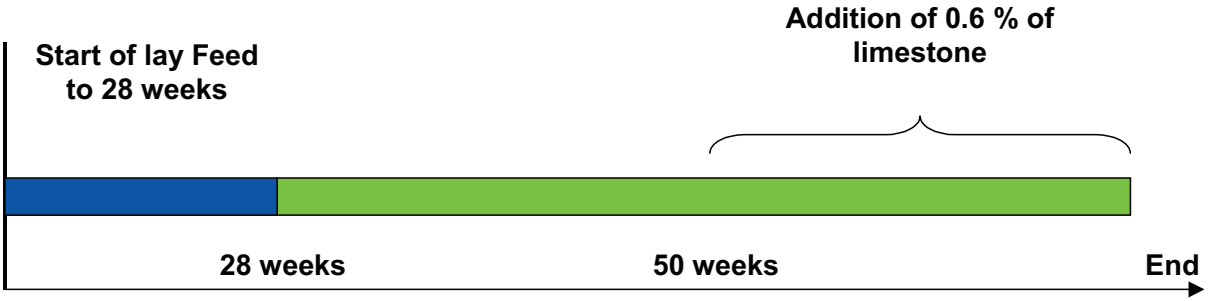
❹ - Management

- For a more precise treatment of this subject please refer to the chapter, "lighting program" in the production period.
  - 1.0-1.5 hours light in the middle of the night: this technique encourages feed intake at start of lay and allows egg weight to increase rapidly
  - Temperature of 21.1-21.7° C (70-71°F) at onset of lay will encourage feed consumption and consequently increase early egg size.
- Between 23 and 27 ° C, egg weight falls by 0.5 to 1 % for each 1°C rise in temperature. Above 27°C, it falls by 1 to 1.5 % per °C.

❺ - Oil

Egg size can be increased by the use of vegetable oil rich in linoleic acid. Its inclusion leads to an improvement in the digestibility of the diet and an increase in the energy intake (by about 2 %) due to the improvement in palatability. The addition of oil also causes the finer feed particles to stick together.

Feeding in production: Cover the daily requirement to maintain the persistency of lay & shell quality



❶ – Energy requirements

Chickens regulate their feed consumption quite well, according to its energy content at constant oil level. This can vary within relatively wide limits. Which energy level to choose depends more on economic than on nutritional considerations.
However, an important decrease of the energy level from pre-lay feed to layer feed will penalize quite a lot the capacity of the birds to intake the daily nutrient requirements. At a constant energy level, the birds already need to increase its feed consumption by 40 % between 17 and 26 weeks old.
Energy consumption is influenced by the percentage of oil, percentage of fiber added to the feed and feed presentation. Consequently a poor feed grist size can be compensated by a higher percentage of oil.

❷ – Protein requirements

- Between 17 and 24 weeks, feed consumption should increase by about 40 %. Maximum feed intake should be reached for several weeks around peak production. In order to satisfy the daily nutrient requirements, we have to consider that the average daily food consumption, between 17 weeks and 28 weeks old, is about 7 g lower than that observed in the period 28 – 72 weeks. So, the protein (digestible amino acids) specifications should be adapted to the mean intake level recorded during this period.
- Taking into account persistency in lay, individual variability and egg weight, the requirement for amino acids does not fall throughout the laying period. In an economic context, it may be worth reducing the safety margins slightly. However, the best results, in terms of productivity and feed conversion ratio, are obtained, when one maintains the intake level of amino acids. Any deficiency of amino acids, no matter which type of amino acid, shows up as a reduction in performance, of which 2/3 is due to a reduction in rate of lay and the remaining 1/3 is a decrease in mean egg weight.

❸ – Mineral requirements

Calcification of the shell starts shortly before "lights out" and finishes mainly at the end of the night. It lasts for about 12 hours. The quality of the shell depends on the quantity of calcium available during shell formation. Getting the correct feeding timetable, and giving extra light in the middle of the night, enables us to improve the shell quality.
Calcium retention depends on the size of particles used. Particles of less than 1.5 mm diameter are poorly retained in the gizzards, and some calcium is found in the droppings. This results in deterioration in shell quality.

- About 70 % of the total calcium supplied should be provided in granular form. This implies that 65 kg of granular calcium carbonate should be included per tonne of feed. To be retained in the gizzard these particles should be between 2 and 4 mm in diameter.
- The remaining 30% should be supplied in powder form to be used for replenishing the bone calcium reserves.

Shell weight increases with age throughout lay. For that reason, we advise increasing the calcium concentration in the diet throughout the laying cycle. Starting with 4.0-4.1% Ca and finishing with 4.5% Ca at the end of laying cycle.
The quality of the shell also depends on the solubility of the calcium. Sources of calcium, which are too soluble, lead to poor shell quality.

Failure to supply enough phosphorus leads to demineralisation of the hen's skeleton, possibly causing long term fractures and mortality.
During shell calcification, part of the bone calcium is mobilised bringing about the release into the blood of calcium and phosphate ions. The phosphate ions are then re-absorbed by the kidneys. The replenishment of bone reserves necessitates a supply of phosphate. The phosphorus requirement depends on how much is called on from the bone reserves. The phosphorus requirement is, therefore, dependent on the form in which calcium is supplied and on the methods by which it is fed.
At end of lay, an excess of phosphorus tends to lead to deterioration in shell quality.

Water quality

❶ - Chemical substances

As yet, there are no standards for drinking water in farm animal production. However, we indicate below the maximum concentrations of some chemical substances, which can lead to physiological troubles and a reduction in performance. Their presence can also lead to deterioration of the pipelines.

- chlorides (Cl)	500 ppm	- potassium (K)	500 ppm	- sulphates(So_4)	1100 ppm
- sodium (Na)	500 ppm	- iron (Fe)	500 ppm	- nitrates (NO_3)	50 ppm
- magnesium (Mg)	200 ppm	- nitrites (NO_2)	5 ppm	- arsenic (As)	0.01 ppm

Where the water is very saline, it could be worth reducing the level of salt in the feed, but at the same time making sure that there is no deficiency.
In areas, where the water is very hard, the use of softeners or ion exchangers can lead to a significant increase in the sodium content. A high content can be responsible for liquid droppings and shell quality problems, and even production problems.
For birds, the ideal pH lies between 6 and 7. If the pH is too acidic, corrosion of the pipes sets in. Above pH 7 conditions favour the growth of bacteria. Organic acids can be used to lower the pH.

❷ - Monitoring water quality

The value of any analysis depends on when, where, and how the sample has been taken. One should not forget that an analysis only refers to the quality of the water at the time, when the sample was taken, and is never a guarantee of its quality at another time. Where farms have their own water supply, it is necessary to take a sample at least twice a year. On farms using the mains supply an annual measurement should be adequate.

❸ - Treatment of drinking water

Chlorination is still the best and most economic method of treating drinking water. The chlorine can be injected by means of a dosing pump. A contact time of 15 to 30 minutes between the water and the chlorine is necessary for good disinfection. It is essential to monitor the residual active chlorine at the end of the pipe system once a week. The residual level of active chlorine at the end of the system should be 0.3 - 0.4 mg/litre (0.3 - 0.4 ppm).

❹ - Cleaning the drinkers

The water in drinkers often becomes soiled with feed residues, and possibly with infections. To prevent the development of germs in the drinkers, they should be cleaned at least once a day during the first 2 weeks, and once a week thereafter.

In a hot climate, the drinkers should be cleaned every day. The depth of water in the drinkers should be 15 mm.

It is essential to decontaminate the pipelines when the birds have gone, using alkaline and acid cleaners in succession in order to avoid accumulation of mineral and organic deposits in drinker pipelines.

❺ Water consumption

Water consumption depends on ambient temperature. Above 20°C, consumption increases to enable the bird to maintain body temperature (respiratory evaporation). The actual consumption depends on temperature and humidity of the ambient air. The following table shows the relationship between water and feed consumption according to house temperature:

Temperature	Rearing	Production
15°C	1.6	1.70 (210 ml)
20°C	1.7	1.80 (205 ml)
25°C	2.3	2.10 (230 ml)
30°C	3.0	3.10 (320 ml)

In hot periods it is essential to provide cool water for the birds. In a hot climate, cool water will improve productivity. It is extremely important to protect the water tanks from the direct sun's rays.

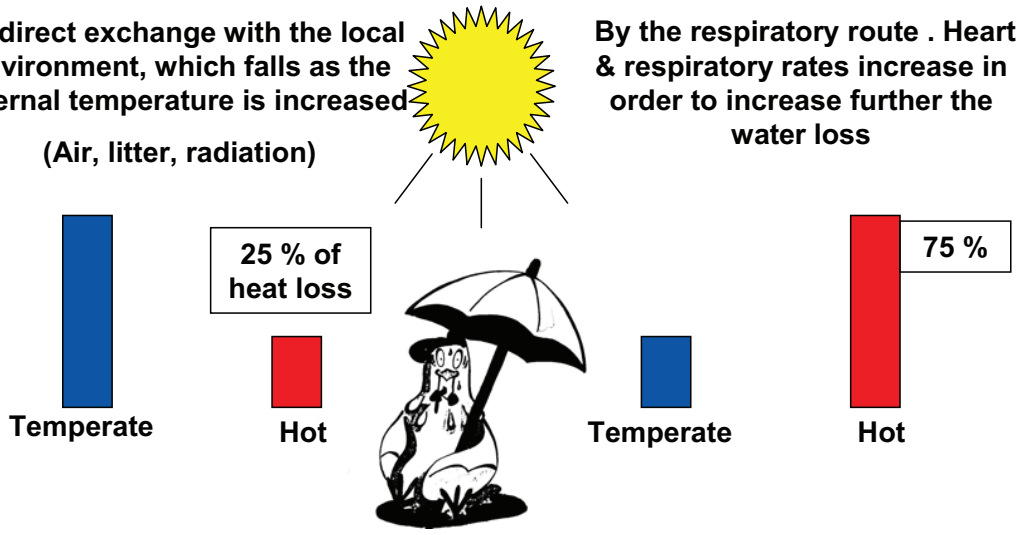
Hot seasons and climates: the effect of heat

The control of the body temperature of the bird is done …

By direct exchange with the local environment, which falls as the external temperature is increased

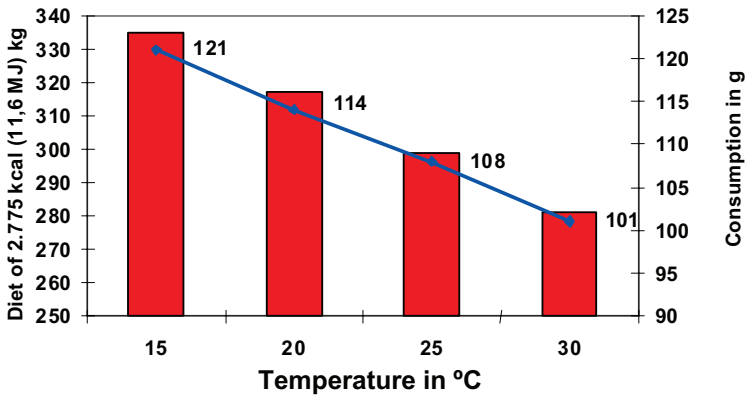
(Air, litter, radiation)

By the respiratory route . Heart & respiratory rates increase in order to increase further the water loss



" Drop in production is a consequence of a reduction of the capacity to lose heat."

With the increase of external temperature, a lower feed intake is noticed. This is the result of the reduction of the bird's ability to lose heat.



Lower growth rates during rearing and the reduced production during lay are only consequences of the reduction in feed consumption when the birds are incapable of regulating their temperature

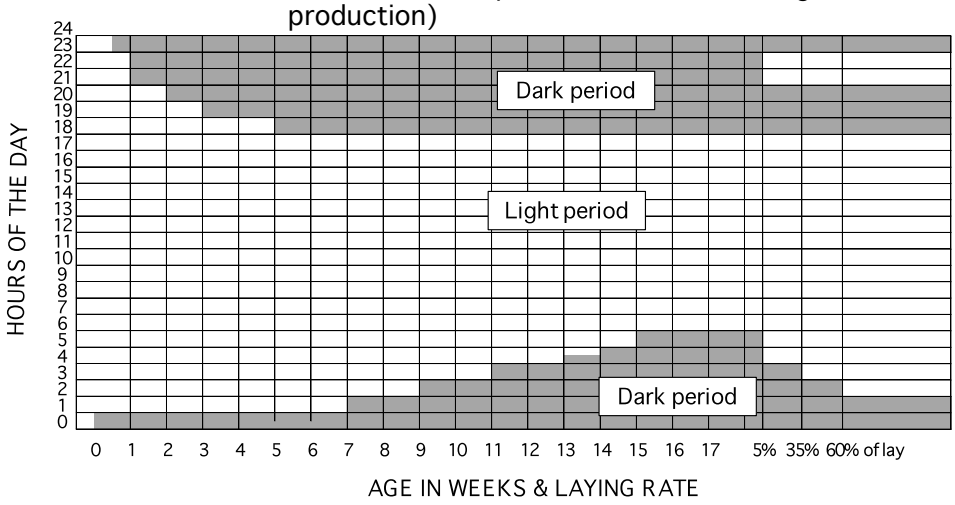
Reduce the ambient temperature	Increase the air speed	Equipment
- Insulation of the roof - Wide roof overhangs - Use of pad (evaporative) cooling	- By using air movers (paddle fans) - With longitudinal ventilation	- Have cages designed to facilitate air circulation - Reduce stocking density

Hot season: How to encourage feed consumption & growth?

" Allow birds to eat during the coolest hours : during night and early in the morning to maintain feed consumption and increase heat losses."

❶ - Encourage growth

- **Lighting program**
  - Use a slowly decreasing light program
  - Give early morning light to encourage feeding during the cooler part of the day
  - Starting at 15 weeks, give 1.0 – 1.5 hours of light in the middle of the night
  - To avoid too early sexual maturity, never stimulate before they reach 5 % production
  - At 5 % production :
    - Add 2 hours of light in the morning
    - And add 1 hour per week till 16 hours light (16 hours light at 50% production)



(Lighting program which could be used in hot climates between 20° North latitudes and 20° South)

- **Food specifications and food presentation**
  - Use a diet in crumb form rich in energy and protein for the first 5 weeks (diet similar to a broiler diet)
  - After 5 weeks, use a diet in crumb form or one with a very good texture (80% of the particles between 0.5 and 3.2 mm)
- **Feeding timetable**
  - Avoid the build up of fine particles by getting the feeders empty in the middle of the day
  - Distribute the food 3 hours before lights out
- **Stockmanship**
  - Provide cool drinking water of good bacteriological quality
  - Make a good job of beak trimming
  - Weigh the birds regularly (once a week)

❷ - Encourage food consumption

- **Lighting**
  - Encourage food consumption in the cooler part of the day :
  - By giving light early in the morning
  - By giving 1.0-1.5 hours of light in the middle of the night (3 hours after light out)
- **Quality of the diet**
  - Use a diet of good granular texture (75-80% particles between 0.5 to 3.2mm)
  - Provide 70 % of the calcium in granular form
  - Use a protein level appropriate to the actual feed intake level
- **Feeding timetable**
  - Distribute 1/2 of the food 5 to 6 hours before lights out
  - Distribute 1/2 of the food 2 to 3 hours after lights on
  - Avoid a built up of fine food particles by getting the feeders empty in the middle of the day
- **Stockmanship**
  - Provide cool water of good bacteriological quality
  - Weigh the birds regularly

Immunity

Birds possess two primary organs of primary lymphoid activity: the *thymus* and the *Bursa of Fabricius*.
Situated in the neck region, the thymus is the organ, where the T. lymphocytes mature, and is responsible for immunity due to cell mediation immunity. It is functional from hatching, and develops with age into the secondary lymphoid organ.

The Bursa of Fabricius is the organ, where B type lymphocytes mature, and is responsible for immunity via the humoral system. This is functional at hatching, and remains developed and active up to between 4 and 10 weeks of age, after which it regresses gradually.

Birds possess numerous secondary lymphoid structures distributed throughout the whole body:

- Peyer's patches on the intestinal mucosa
- Caecal tonsils on the ileo-caecal mucosa
- Lymphoid structures throughout the length of the respiratory network
- Harderian gland situated at the back of the third eyelid
- Small inclusions in most organs, including the nerves
- Spleen

All these immune structures are called upon, when vaccines are administered according to different routes: putting liquid into the ocular fluid (eye drops), impregnation of the palatine groove at the time of swallowing (drinking water), inhalation of droplets (spraying).

Individual vaccination
- Ocular-nasal instillation (Eye drops)
- Beak dipping
- Skin puncture and scarification
- Intramuscular and sub-cutaneous injections

Mass vaccination
- Through the drinking water
- By spraying

❶ - Ocular-nasal administration (eye drops)

Allows a local and a general immunity, due to the presence of the Harderian gland behind the third eyelid
- Always keep the bottle vertical to avoid contact with mucous membranes
- Generally 1000 droplets per 30 ml
- Coloured ocular diluents makes it easier to see that the vaccine is administrated properly
- Generally used for Infectious Laryngotracheitis often given at the same time as injection of oil vaccines

❷ - Beak dipping

This implies dipping the beak up to the nostrils in such a way that the vaccine solution gets into the nasal canals.
- Only to be used with chicks of less than 1 week old
- 150 to 200 ml per 1000 chicks
- Still used in many countries against Newcastle disease and Gumboro during the first week because of the need to achieve 100 % vaccination and reduce the possibility of adverse respiratory reactions
- Usually used when vaccination by drinking water is not possible (irregular water consumption before 5 days of age) and when a vaccination by spraying would run the risk of causing harmful respiratory reactions.

❸ - Skin puncture and scarification (scratch)

Only used for the administration of live fowl pox vaccination
Puncturing the wing web with the help of a double-channelled needle is generally preferred to scarification of the skin on the thigh, using a vaccination stylus.

❹ - Intramuscular and subcutaneous injections

- Equipment should be sterile
- Needle should be the appropriate length for the age of bird
- Change needle frequently (at least every 500 injections). This is a minimum frequency as more regular changes of the needle assist with the welfare of the birds (blunting needles) and from a disease spreading perspective – Avian leucosis.
- Take the bottles out of the fridge several hours before use to improve fluidity (inactivated oil based vaccines)
- Loose skin on the back of birds' neck (bacterial vaccines in oil based adjuvant) or breast muscle (especially for oil based inactivated vaccines)

❺ - Through drinking water

Ideally should only be used in birds of more than one week old (in order to get uniform water consumption/take up).

- Take care to regularly de-scale and clean the pipe system using water under pressure in a contra-flow direction and then adding organic acids to the drinking water four consecutive days.
- Before vaccination, check if the drinker and nipple are clean and working well. There should be no disinfection in the lines as this will inactivate vaccination. Ensure all water sanitising systems have been turned off and the water in the system is clean water only.
- Allow the birds to become thirsty, 30 min to 1 h 30 min or longer (depending on climate and thirst) before distributing the vaccine solution.
- Completely empty the whole water system. Make sure that all water present is drained out, especially in the bottom of the tank and in the lowest points of the piping system.
- Always have an area available to make up the vaccine in a hygienic way – disposable gloves should also be available
- Forecast the quantity of water required, enough to be consumed in about 2 hours. Quantity is about 1/7 of the quantity consumed the previous day.
- Dissolve 2.5 g of skimmed milk powder per litre of water (avoid lumps forming).
- Next, dissolve in a small quantity of commercial mineral water (or distilled water) the number of doses corresponding at least to the number of birds to be vaccinated according to their age. Mix this vaccine solution thoroughly (using a plastic stirrer) to the milky water prepared previously. A colour marker may be used to identify the vaccine solution. Keep the vaccine solution cool, and away from direct sun exposure.
- Check that all the drinkers and nipples are filled with the milky water. In specific case of nipples, open the water pipe at the other end to flush the air trapped and to ensure that the vaccine solution reach the other end.
- Walk slowly through the building and make sure that all the birds are drinking the vaccine solution.
- Finally, open the stopcock and return to normal watering.
- All the equipment used for the preparation of the vaccine solution should be clean without trace of disinfectant.
- Water quality aspects:
    - Should conform to the standards for human consumption without excess minerals.
    - pH should be slightly acidic for preference between 5.5 and 6.5.
    - Where city water or equipment with traces of chlorine are being used, add 2.5 g of skimmed milk powder to neutralise the chlorine.

To vaccinate correctly a flock, you need to have at least 90 % of the birds to have properly absorbed a full dose of vaccine in its fully live state.

❻ - Vaccination by spraying

This method consists of spraying a vaccine solution in such a way that droplets contain a sufficient number of living virus particles to come into contact with the mucous membranes of the eye and/or the respiratory tract so that they can multiply there. The immune response will at first be local, and then general.

Spraying is, therefore, particularly indicated for vaccination with less virulent viruses, with respiratory connotations (e.g. Hitchener B 1 and La Sota strains against Newcastle Disease, H120 against Infectious Bronchitis, and the vaccine against Swollen Head Syndrome...). In any case, follow the vaccine manufacturer instruction.

The effectiveness of spray vaccination and the severity of post-vaccinal respiratory reactions depends mainly on the size of the droplets in contact with the eye or the respiratory tract of the birds.

According to the equipment used and the atmospheric conditions, the quantity of water should be adjusted so that :
- the spraying of the group or flock lasts between 15 and 20 minutes
- several passages of spray can be made
- the fogging succeeds in wetting the birds' heads

Examples of equipment	Fogging			Atomisation
	Spravac	Birchmeier	Ulvavac	Atomist
Use	Primary vaccination at the hatchery	Primary vaccination at the hatchery or on the farm	Primary vaccination booster doses on the farm	Booster doses on the farm (> 15 days)
Pressure	3.5 bars	2 to 2.5 bars	Mechanical propulsion	Aerial propulsion
Droplet size		100 – 150 μ	78 – 80 μ	15 – 50 μ
Quantity of water for 1000 birds	70 ml / 200 ml	400 to 1200 ml	30 to 60 ml	300 to 600 ml

Atomisation refers exclusively to repeat vaccination against Newcastle disease.
Summary of practical advice :

- Only spray vaccinate when birds are in a good health.
- The equipment should be clean, without traces of chlorine or disinfectant, well maintained, correctly calibrated and reserved exclusively for vaccination.
- Prepare the vaccine solution immediately before use with water of high biological quality, cool, free from chlorine or disinfectants, slightly acidic (pH between 5.5 and 6.5), without excessive mineral content. Taking into account the low volumes needed, use for preference distilled water or commercial mineral water.
- Gather the birds together quietly into a very restricted area (so that the minimum quantity of droplets fall on the ground)
- Switch off the lights, the brooders and the ventilation. The flock should be calm, with heads up
- Wear a mask.
- Spray the heads of the birds for 15 to 20 minutes slowly making several passes. By the time the spraying is finished the heads of all the birds should be thoroughly wet.
- Ventilation could be forced 15 to 30 minutes after spray.
- To encourage multiplication of the vaccine virus in the bucal (mouth) region, make sure that the water drunk by the birds for a few hours immediately following vaccination is free of chlorine and disinfectants. If necessary, before vaccination, completely refill the water tank with water into which 2.5 g of skimmed milk powder per litre of water has been mixed to neutralise the chlorine.
- Rinse the equipment thoroughly in clean water, containing neither chlorine nor disinfectants

Feeding Program for ISA Brown in rearing at 20 °C

Dietary suggestions for general guidance :

- **Starter** — **2.950 kcal (1340 kcal/lb)/kg as crumbs**
- **Grower** — **2.850 kcal (1295 kcal/lb)/kg as mash or crumbs**
- **Pullet** — **2.750 kcal (1250 kcal/lb)/kg as mash**
- **Pre – lay** — **2.750 kcal (1250 kcal/lb)/kg as mash**

Diet		Mean Body weight (1)	Kcal / day		Ration g/d		Cumul. cons.	
Week	Day		Cages	Floor	Cages	Floor	Cages	Floor
Starter – 2.950 Kcal (1340 kcal/lb)/kg 20.5 % crude protein		**From day old to 300 g of Body Weight**						
1	1 – 7	**65 – 68**	30	30	11	11	77	77
2	8 – 14	**110 – 120**	49	51	17	17	196	196
3	15 – 21	**195 – 210**	73	75	25	25	371	371
4	22 – 28	**285 – 305**	93	96	32	33	595	602
Grower – 2.850 Kcal (1295 kcal/lb)/kg 19 % crude protein		**From 300 g to 850 g of Body Weight**						
5	29 – 35	**380 – 400**	106	111	37	39	854	875
6	36 – 42	**470 – 500**	119	125	42	44	1148	1183
7	43 – 49	**560 – 590**	132	138	46	48	1470	1519
8	50 – 56	**650 – 680**	141	149	50	52	1820	1883
9	57 – 63	**740 – 775**	151	160	54	56	2198	2275
10	64 – 70	**830 – 865**	161	170	58	60	2604	2695
Pullet – 2.750 Kcal (1250 kcal/lb)/kg 16 % crude protein		**After 850 g of Body Weight**						
11	71 – 77	**920 – 960**	169	179	61	65	3031	3150
12	78 – 84	**1010 – 1050**	177	187	64	68	3479	3626
13	85 – 91	**1095 – 1140**	185	195	67	71	3948	4123
14	92 – 98	**1180 – 1230**	192	203	70	74	4438	4641
15	99 – 105	**1265 – 1320**	199	211	73	77	4949	5180
16	106 – 112	**1350 – 1410**	207	219	76	80	5481	5740
Pre-lay – 2.750 Kcal (1250 kcal/lb)/kg 17 % crude protein		**Transfer between 16 and 17 weeks**						
17	**113 – 119**	**1430 – 1505**	**215**	**228**	**80**	**83**	**6041**	**6314**

(1) : Body weights above refer to weighing carried out in the rearing house in the afternoon. We stress that during transport, the pullet can lose 5 to 10 % of its body weight, depending on the time without food and in transport, and on the temperature. It is very difficult to make an accurate estimate of body weight after transfer.

Note: The ration should be adjusted so as to control body weight.

Feeding Program for ISA Brown in rearing at 28 °C

Dietary suggestions for general guidance :

- **Starter** — **2.950 kcal (1340 kcal/lb)/kg as crumbs**
- **Grower** — **2.850 kcal (1295 kcal/lb)/kg as mash or crumbs**
- **Pullet** — **2.750 kcal (1250 kcal/lb)/kg as mash**
- **Pre – lay** — **2.750 kcal (1250 kcal/lb)/kg as mash**

Diet Week	Day	Mean Bodyweight (1)	Kcal / day Floor	Ration g/d Floor	Cumul cons. Floor
Starter – 2.950 Kcal (1340 kcal/lb)/kg 20.5 % crude protein		**From day old to 400 g of Body Weight**			
1	1 – 7	**65 – 68**	30	11	77
2	8 – 14	**110 – 120**	51	17	196
3	15 – 21	**195 – 210**	73	25	371
4	22 – 28	**285 – 305**	92	31	588
5	29 – 35	**380 – 400**	105	36	840
Grower – 2.850 Kcal (1295 kcal/lb)/kg 20.0 % crude protein		**From 400 g to 850 g of Body Weight**			
6	36 – 42	**470 – 500**	118	41	1127
7	43 – 49	**560 – 590**	129	45	1442
8	50 – 56	**650 – 680**	139	49	1785
9	57 – 63	**740 – 775**	148	52	2149
10	64 – 70	**830 – 865**	157	55	2534
Pullet – 2.750 Kcal (1250 kcal/lb)/kg 16.8 % crude protein		**After 850 g of Body Weight**			
11	71 – 77	**920 – 960**	163	59	2947
12	78 – 84	**1010 – 1050**	171	62	3381
13	85 – 91	**1095 – 1140**	178	65	3836
14	92 – 98	**1180 – 1230**	184	67	4305
15	99 – 105	**1265 – 1320**	191	69	4830
16	106 – 112	**1350 – 1410**	198	72	5292
Pre-lay – 2.750 Kcal (1250 kcal/lb)/kg 17.5 % crude protein		**Transfer between 16 and 17 weeks**			
17	**113 – 119**	**1430 – 1505**	**205**	**75**	**5817**

(1) : Body weights above refer to weighing carried out in the rearing house in the afternoon. We stress that during transport, the pullet can lose 5 to 10 % of its body weight, depending on the time without food in transport and on the temperature. It is very difficult to make an accurate estimate of body weight after transfer.

Note: The ration should be adjusted so as to control body weight.

Nutritional specifications for growing diets

Between 18 & 24 °C	Units	Starter 0 - 4 weeks 1 - 28 days	Grower 4 - 10 weeks 28 - 70 days	Pullet 10 - 16 weeks 70 - 112 days	Pre - lay 112 days to 2 % lay
Forecast quantity / bird	g	600	2100	3000	
Metabolisable energy	kcal/kg	2950	2850	2750	2750
	kcal/lb	1340	1295	1250	1250
Crude protein	%	20.5	19	16	17
Methionine	%	0.52	0.45	0.35	0.36
Methionine + Cystine	%	0.86	0.76	0.62	0.65
Lysine	%	1.16	0.98	0.74	0.80
Threonine	%	0.78	0.66	0.50	0.54
Tryptophan	%	0.21	0.19	0.16	0.17
Digestible amino acids (1)					
Dig. Methionine	%	0.48	0.41	0.32	0.33
Dig. Meth. + Cystine	%	0.78	0.66	0.55	0.57
Dig. Lysine	%	1.00	0.85	0.64	0.69
Dig. Threonine	%	0.67	0.57	0.43	0.46
Dig. Tryptophan	%	0.18	0.16	0.14	0.15
Major minerals					
Calcium	%	1.05 - 1.10	1.0 - 1.20	1.0 - 1.20	2.0 - 2.10
Available Phosphorus	%	0.48	0.42	0.40	0.45
Chlorine minimum	%	0.15	0.15	0.15	0.15
Sodium minimum	%	0.17	0.17	0.17	0.17

Above 24 ° C	Units	Starter 0 - 5 weeks 1 - 35 days	Grower 5 - 10 weeks 35 - 70 days	Pullet 10 - 16 weeks 70 - 112 days	Pre - lay 112 days to 2 % lay
Forecast quantity / bird	g	850	1700	2800	
Metabolisable energy	kcal/kg	2950	2850	2750	2750
	kcal/lb	1340	1295	1250	1250
Crude protein	%	20.5	20.0	16.8	17.5
Methionine	%	0.52	0.47	0.36	0.38
Methionine + Cystine	%	0.86	0.80	0.63	0.68
Lysine	%	1.16	1.03	0.78	0.87
Threonine	%	0.78	0.69	0.53	0.56
Tryptophan	%	0.22	0.20	0.17	0.18
Digestible amino acids (1)					
Dig. Methionine	%	0.48	0.43	0.33	0.35
Dig. Meth. + Cystine	%	0.78	0.69	0.57	0.60
Dig. Lysine	%	1.00	0.89	0.67	0.72
Dig. Threonine	%	0.67	0.61	0.45	0.48
Dig. Tryptophan	%	0.19	0.17	0.15	0.16
Major minerals					
Calcium	%	1.05 - 1.10	1.0 - 1.20	1.0 - 1.20	2.0 - 2.10
Available Phosphorus	%	0.48	0.44	0.40	0.47
Chlorine minimum	%	0.15	0.16	0.16	0.16
Sodium minimum	%	0.16	0.17	0.17	0.17

(1) : These recommendations are based on the digestibility tables of RHONE POULENC ANIMAL NUTRITION (nutrition guide – Ed. 1993).

Daily nutrient requirements in lay

NUTRIENTS IN RAW MATERIALS	Unit	Requirements: Daily in mg per day RPAN (93)	Daily in mg per day NRC (94)	In mg per g of egg RPAN (93)	In mg per g of egg NRC (94)
Crude Protein	g/d	(19.5)	(19.5)		
Crude Lysine	mg/d	900	900	15,25	15,25
Crude Methionine	mg/d	455	455	7,6	7,6
Crude Methionine + Cystine	mg/d	770	770	13,0	13,0
Crude Tryptophan	mg/d	200	208	3,35	3,5
Crude Isoleucine	mg/d	820	775	13,9	13,0
Crude Threonine	mg/d	655	655	11,0	11,0
Crude Valine	mg/d	900	840	15,0	14,2
Crude Arginine	mg/d	1160	1130	19,5	18,9
DIGESTIBLE AMINO ACIDS (1)					
Digestible Lysine	mg/d	810	810	13,50	13,50
Digestible Methionine	mg/d	430	430	7,2	7,2
Digestible Methionine + Cystine	mg/d	690	690	11,45	11,45
Digestible Tryptophan	mg/d	171	180	2,85	3,00
Digestible Isoleucine	mg/d	740	690	12,3	11,5
Digestible Threonine	mg/d	565	565	9,4	9,4
Digestible Valine	mg/d	800	760	13,4	12,6
Digestible Arginine	mg/d	1050	1020	17,5	17,0

Added vitamins and minerals

Added trace elements		REARING PERIOD 0 – 10 weeks	REARING PERIOD 10 – 2 % LAY	LAYING PERIOD
Manganese (Mn)	PPM	60	60	60
Zinc (Zn)	PPM	60	60	60
Iron (Fe)	PPM	60	60	60
Iodine (I)	PPM	1	1	1
Copper (Cu)	PPM	5	6	6
Selenium (Se)	PPM	0.2	0.2	0.2
Cobalt (Co)	PPM	0.5	0.5	0.2
Added vitamins per kg of diet in IU or mg				
Vitamin A	IU	13.000	10.000	12.000
Vitamin D3	IU	3.000	2.000	3.000
Vitamin E	mg	25	25	25
Vitamin K3	mg	2	2	2
Vitamin B1 (Thianine)	mg	2	2	2
Vitamin B2 (Riboflavin)	mg	5	5	5
Vitamin B6 (Pyridoxine)	mg	5	5	5
Vitamin B12	mg	0.02	0.02	0.02
Nicotinic Acid (Niacin)	mg	60	30	40
Calcium Pantothenate	mg	15	10	10
Folic Acid	mg	0.75	0.75	0.75
Biotin	mg	0.2	0.2	0.2
Choline	mg	600	600	600

(1) : These recommendations have been derived from tables of the composition of raw materials RPAN (1993) and NRC (1994). The recommendations on digestible amino acids are based on the digestibility coefficients presented in tables in RPAN (1993).

Note: A minimum of fibre or lignin is required to prevent feather pecking

Nutritional recommendations for the laying period (1)

Recommended energy : 2800-2880 kcal / kg 1275-1310 kcal /lb Average food intake in g / day	FROM 2 % LAY TO 28 WEEKS OLD 95	100	105	110	115
Crude Protein	**(20.5)**	**(19.5)**	**(18.6)**	**(17.7)**	**(17.0)**
Crude amino acids % :					
Lysine	0.95	0.90	0.86	0.82	0.78
Methionine	0.48	0.46	0.43	0.41	0.40
Methionine + Cystine	0.81	0.77	0.73	0.70	0.67
Tryptophan *	0.210 / *0.219*	0.200 / *0.208*	0.190 / *0.198*	0.182 / *0.189*	0.174 / *0.181*
Threonine	0.69	0.66	0.62	0.60	0.57
Isoleucine *	0.86 / *0.82*	0.82 / *0.78*	0.78 / *0.74*	0.75 / *0.70*	0.71 / *0.67*
Valine *	0.95 / *0.88*	0.90 / *0.84*	0.86 / *0.80*	0.82 / *0.76*	0.78 / *0.73*
Arginine *	1.22 / *1.19*	1.16/ *1.13*	1.10 / *1.08*	1.05 / *1.03*	1.03 / *1.00*
Digestible amino acids % :					
Lysine	0.85	0.81	0.77	0.74	0.70
Methionine	0.45	0.43	0.41	0.39	0.37
Methionine + Cystine	0.73	0.69	0.66	0.63	0.60
Tryptophan *	0.180 / *0.189*	0.171/ *0.180*	0.163 / *0.171*	0.155 / *0.164*	0.149 / *0.156*
Threonine	0.59	0.56	0.54	0.51	0.49
Isoleucine *	0.78 / *0.73*	0.74/ *0.69*	0.70 / *0.66*	0.67 / *0.63*	0.64 / *0.60*
Valine *	0.84 / *0.80*	0.80 / *0.76*	0.76 / *0.72*	0.73 / *0.69*	0.70 / *0.66*
Arginine *	1.11 / *1.07*	1.05 / *1.02*	1.00 / *0.97*	0.95 / *0.93*	0.91 / *0.89*

From 2% lay up to 28 weeks, one should base it on a level of consumption, which is 7 g lower than the intake observed after 28 weeks.

Recommended energy : 2750- 2850 kcal / kg 1250-1295 kcal /lb Average food intake in g / day	FROM 28 WEEKS TO THE END OF LAY 105	110	115	120	125
Crude Protein	**(18.6)**	**(17.7)**	**(17.0)**	**(16.3)**	**(15.6)**
Crude amino acids % :					
Lysine	0.86	0.82	0.78	0.75	0.72
Methionine	0.43	0.41	0.40	0.38	0.36
Methionine + Cystine	0.73	0.70	0.67	0.64	0.62
Tryptophan *	0.190 / *0.198*	0.182 / *0.189*	0.174 / *0.181*	0.167 / *0.173*	0.160 / *0.166*
Threonine	0.62	0.60	0.57	0.55	0.52
Isoleucine *	0.78 / *0.74*	0.75 / *0.70*	0.71 / *0.67*	0.68 / *0.65*	0.66 / *0.62*
Valine *	0.86 / *0.80*	0.82 / *0.76*	0.78 / *0.73*	0.75 / *0.70*	0.72 / *0.67*
Arginine *	1.10 / *1.08*	1.05 / *1.03*	1.03 / *1.00*	0.97 / *0.94*	0.93 / *0.90*
Digestible amino acids % :					
Lysine	0.77	0.74	0.70	0.67	0.65
Methionine	0.41	0.39	0.37	0.36	0.34
Methionine + Cystine	0.66	0.63	0.60	0.58	0.55
Tryptophan *	0.163 / *0.171*	0.155 / *0.164*	0.149 / *0.156*	0.142 / *0.150*	0.137 / *0.144*
Threonine	0.54	0.51	0.49	0.47	0.45
Isoleucine *	0.70 / *0.66*	0.67 / *0.63*	0.64 / *0.60*	0.62 / *0.58*	0.59 / *0.55*
Valine *	0.76 / *0.72*	0.73 / *0.69*	0.70 / *0.66*	0.67 / *0.63*	0.64 / *0.61*
Arginine *	1.00 / *0.97*	0.95 / *0.93*	0.91 / *0.89*	0.88 / *0.85*	0.84 / *0.82*

(*) These recommendations are based on the tables in RPAN (Nutrition guide 1993) and NRC. When the values differ, those of NRC are printed in Italics.

Nutritional recommendations for the laying period (2)

PERIOD OF USE		FROM 17 TO 28 WEEKS	FROM 28 TO 50 WEEKS	AFTER 50 WEEKS
Available Phosphorus	g / d	0.44	0.42	0.38
Calcium	g / d	3.9 – 4.1	4.1 – 4.3	4.3 – 4.6
Sodium minimum	mg / d	180	180	180
Chlorine minimum / maximum	mg / d	170 / 260	170 / 260	170 / 230
Linoleic acid	g / d	1.6 min	1.4 min	1 min – 1.25 max

FROM 2 % LAY TO 28 WEEKS						
Average food intake recorded g / day		**95**	**100**	**105**	**110**	**115**
Available Phosphorus	%	0.46	0.44	0.42	0.40	0.38
Calcium	%	4.1 – 4.3	3.9 – 4.1	3.7 – 3.9	3.5 – 3.7	3.4 – 3.6
Sodium minimum	%	0.19	0.18	0.17	0.17	0.17
Chlorine minimum / maximum	%	0.18 – 0.26	0.17 – 0.26	0.16 – 0.25	0.15 – 0.24	0.14 – 0.23
Linoleic acid minimum	%	1.70	1.60	1.50	1.40	1.30

FROM 28 WEEKS TO 50 WEEKS						
Average food intake recorded g / day		**105**	**110**	**115**	**120**	**125**
Available Phosphorus	%	0.40	0.38	0.37	0.35	0.34
Calcium	%	3.9 – 4.1	3.7 – 3.9	3.6 – 3.8	3.4 – 3.6	3.3 – 3.5
Sodium minimum	%	0.17	0.17	0.17	0.17	0.17
Chlorine minimum / maximum	%	0.16 – 0.25	0.15 – 0.24	0.15 – 0.23	0.14 – 0.22	0.14 – 0.21
Linoleic acid minimum	%	1.35	1.30	1.25	1.15	1.10

FROM 50 WEEKS TO THE END OF LAY						
Average food intake recorded g / day		**105**	**110**	**115**	**120**	**125**
Available Phosphorus	%	0.36	0.34	0.33	0.32	0.30
Calcium	%	4.1 – 4.3	3.9 – 4.1	3.8 – 4.0	3.6 – 3.8	3.5 – 3.7
Sodium minimum	%	0.17	0.17	0.17	0.17	0.17
Chlorine minimum / maximum	%	0.16 – 0.22	0.15 – 0.21	0.15 – 0.20	0.14 – 0.19	0.14 – 0.18
Linoleic acid maximum	%	1.20	1.15	1.10	1.05	1.00

Note: To avoid egg size becoming too large at the end of lay, we advise reducing the quantity of vegetable oil being used. A minimum of fibre or lignin is required to prevent feather pecking.

ISA Brown Production Table

Age in Weeks	% Hen Day Production	% Mortality Cumulative	Cumulative Eggs / Hen Housed	Average Egg Weight			Daily Egg Mass	Cumulative Egg Mass / Hen Housed		Feed Intake		Body Weight	
				g / egg	Oz./Doz.	Lbs. / case	grams	kg	lb.	bird/day (g)	100/day (lbs)	grams	Lbs
18	2.0	0.0	0	43.0	18.2	34.1	0.9	0.0	0.0	81	17.9	1500	3.31
19	17.2	0.1	1	45.5	19.3	36.1	7.8	0.1	0.1	85	18.7	1580	3.48
20	40.0	0.2	4	49.0	20.7	38.9	19.6	0.2	0.4	95	20.9	1640	3.62
21	65.0	0.2	9	52.0	22.0	41.3	33.8	0.4	1.0	105	23.1	1705	3.76
22	84.0	0.3	15	54.5	23.1	43.3	45.8	0.8	1.7	109	24.0	1755	3.87
23	91.0	0.4	21	56.4	23.9	44.8	51.3	1.1	2.4	111	24.5	1790	3.95
24	93.0	0.5	27	57.7	24.4	45.8	53.7	1.5	3.3	112	24.7	1805	3.98
25	94.0	0.6	34	58.8	24.9	46.7	55.3	1.9	4.1	113	24.9	1818	4.01
26	95.0	0.6	41	59.6	25.2	47.3	56.6	2.3	5.0	114	25.1	1830	4.03
27	95.0	0.7	47	60.2	25.5	47.8	57.2	2.7	5.9	114	25.1	1840	4.06
28	95.0	0.8	54	60.7	25.7	48.2	57.7	3.1	6.7	114	25.1	1850	4.08
29	94.7	0.9	60	61.1	25.9	48.5	57.9	3.5	7.6	114	25.1	1860	4.10
30	94.5	1.0	67	61.5	26.0	48.8	58.1	3.9	8.5	114	25.1	1870	4.12
31	94.3	1.1	73	61.9	26.2	49.1	58.4	4.3	9.4	113	24.9	1878	4.14
32	94.1	1.2	80	62.2	26.3	49.4	58.5	4.7	10.3	113	24.9	1883	4.15
33	93.9	1.3	86	62.4	26.4	49.5	58.6	5.1	11.2	113	24.9	1888	4.16
34	93.6	1.4	93	62.6	26.5	49.7	58.6	5.5	12.1	113	24.9	1893	4.17
35	93.3	1.5	99	62.8	26.6	49.8	58.6	5.9	13.0	113	24.9	1898	4.18
36	93.0	1.6	106	63.0	26.7	50.0	58.6	6.3	13.9	113	24.9	1903	4.20
37	92.7	1.7	112	63.2	26.8	50.2	58.6	6.7	14.8	113	24.9	1908	4.21
38	92.5	1.8	118	63.3	26.8	50.2	58.6	7.1	15.6	113	24.9	1913	4.22
39	92.2	1.9	125	63.4	26.8	50.3	58.5	7.5	16.5	113	24.9	1918	4.23
40	91.9	2.0	131	63.5	26.9	50.4	58.4	7.9	17.4	113	24.9	1925	4.24
41	91.6	2.1	137	63.6	26.9	50.5	58.3	8.3	18.3	113	24.9	1930	4.25
42	91.3	2.2	144	63.7	27.0	50.6	58.2	8.7	19.2	113	24.9	1935	4.27
43	91.0	2.3	150	63.7	27.0	50.6	58.0	9.1	20.0	113	24.9	1935	4.27
44	90.7	2.5	156	63.8	27.0	50.6	57.9	9.5	20.9	113	24.9	1940	4.28
45	90.4	2.6	162	63.9	27.0	50.7	57.8	9.9	21.8	113	24.9	1945	4.29
46	90.0	2.7	168	64.0	27.1	50.8	57.6	10.3	22.6	113	24.9	1945	4.29
47	89.6	2.8	174	64.1	27.1	50.9	57.4	10.7	23.5	113	24.9	1950	4.30
48	89.2	2.9	180	64.2	27.2	51.0	57.3	11.1	24.4	113	24.9	1950	4.30
49	88.8	3.1	186	64.2	27.2	51.0	57.0	11.4	25.2	113	24.9	1950	4.30
50	88.3	3.2	192	64.3	27.2	51.0	56.8	11.8	26.1	112	24.7	1955	4.31
51	87.8	3.3	198	64.4	27.3	51.1	56.5	12.2	26.9	112	24.7	1955	4.31
52	87.3	3.4	204	64.5	27.3	51.2	56.3	12.6	27.8	112	24.7	1960	4.32
53	86.8	3.5	210	64.6	27.3	51.3	56.1	13.0	28.6	112	24.7	1960	4.32
54	86.3	3.7	216	64.7	27.4	51.3	55.8	13.3	29.4	112	24.7	1960	4.32
55	85.8	3.8	222	64.7	27.4	51.3	55.5	13.7	30.2	112	24.7	1965	4.33
56	85.3	3.9	227	64.8	27.4	51.4	55.3	14.1	31.1	112	24.7	1965	4.33
57	84.8	4.0	233	64.8	27.4	51.4	55.0	14.5	31.9	112	24.7	1965	4.33
58	84.3	4.1	239	64.9	27.5	51.5	54.7	14.8	32.7	112	24.7	1965	4.33
59	83.8	4.3	244	64.9	27.5	51.5	54.4	15.2	33.5	112	24.7	1970	4.34
60	83.3	4.4	250	65.0	27.5	51.6	54.1	15.6	34.3	112	24.7	1970	4.34
61	82.7	4.5	256	65.0	27.5	51.6	53.8	15.9	35.1	112	24.7	1970	4.34
62	82.1	4.6	261	65.1	27.6	51.7	53.4	16.3	35.9	112	24.7	1975	4.35
63	81.6	4.7	266	65.1	27.6	51.7	53.1	16.6	36.6	112	24.7	1975	4.35
64	81.0	4.9	272	65.1	27.6	51.7	52.7	17.0	37.4	112	24.7	1975	4.35
65	80.5	5.0	277	65.2	27.6	51.7	52.5	17.3	38.2	112	24.7	1975	4.35
66	79.7	5.1	283	65.2	27.6	51.7	52.0	17.7	39.0	112	24.7	1980	4.37
67	78.9	5.2	288	65.3	27.6	51.8	51.5	18.0	39.7	112	24.7	1980	4.37
68	78.2	5.3	293	65.3	27.6	51.8	51.1	18.3	40.5	112	24.7	1980	4.37
69	77.4	5.5	298	65.4	27.7	51.9	50.6	18.7	41.2	112	24.7	1985	4.38
70	76.6	5.6	303	65.4	27.7	51.9	50.1	19.0	41.9	111	24.5	1985	4.38
71	75.8	5.7	308	65.5	27.7	52.0	49.6	19.3	42.6	111	24.5	1985	4.38
72	75.0	5.8	313	65.5	27.7	52.0	49.1	19.7	43.4	111	24.5	1985	4.38
73	74.3	5.9	318	65.6	27.8	52.1	48.7	20.0	44.1	111	24.5	1985	4.38
74	73.5	6.1	323	65.6	27.8	52.1	48.2	20.3	44.8	111	24.5	1990	4.39
75	72.7	6.2	328	65.6	27.8	52.1	47.7	20.6	45.5	111	24.5	1990	4.39
76	71.9	6.3	332	65.6	27.8	52.1	47.2	20.9	46.1	111	24.5	1995	4.40
77	71.1	6.4	337	65.7	27.8	52.1	46.7	21.2	46.8	111	24.5	1995	4.40
78	70.4	6.5	342	65.7	27.8	52.1	46.3	21.5	47.5	111	24.5	1995	4.40
79	69.6	6.7	346	65.8	27.9	52.2	45.8	21.8	48.1	111	24.5	2000	4.41
80	68.4	6.8	351	65.8	27.9	52.2	45.0	22.1	48.8	111	24.5	2000	4.41

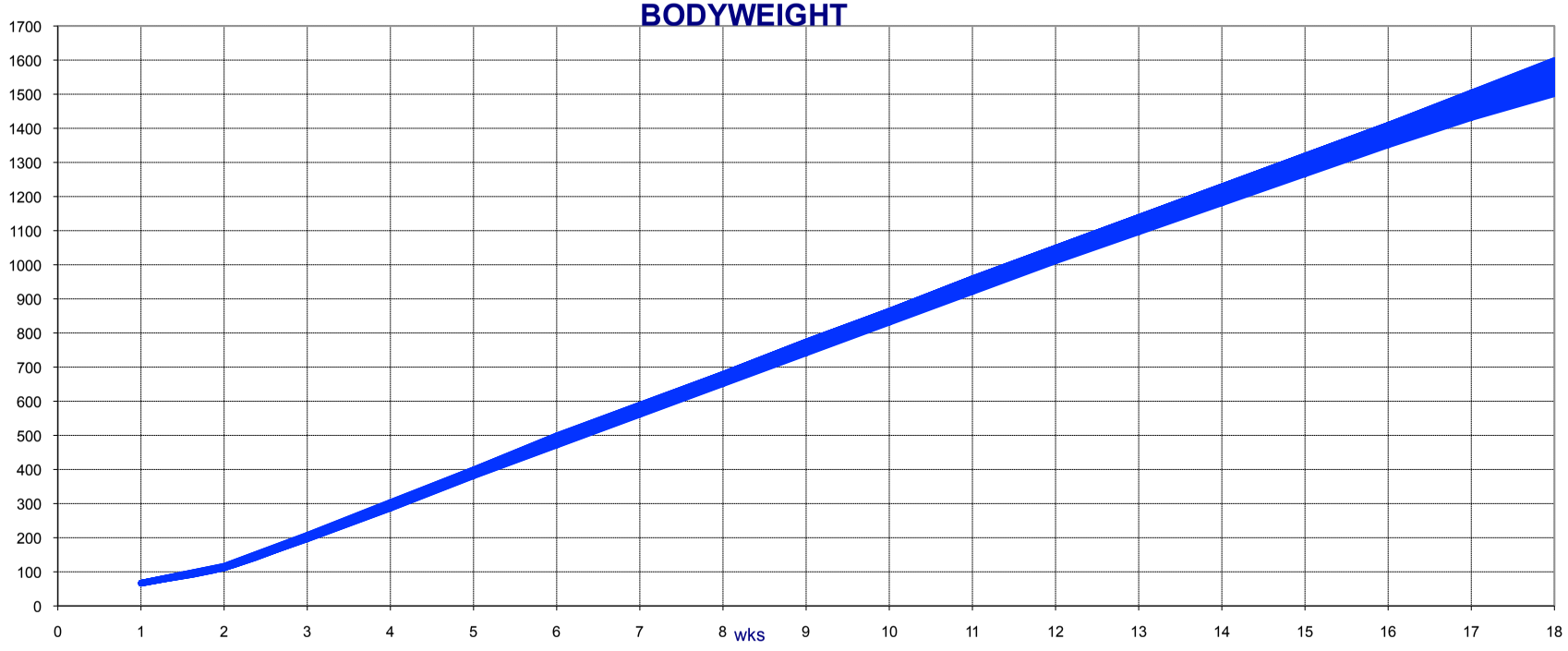
ISA Brown Egg Weight Distribution (%) – Canadian System

		Weekly						Cumulative					
Age in weeks	Av. egg weight, g	Jumbo over 70 g	Extra Large 64-70 g	Large 56-64 g	Medium 49-56 g	Small 42-49 g	Peewee under 42 g	Jumbo over 70 g	Extra Large 64-70 g	Large 56-64 g	Medium 49-56 g	Small 42-49 g	Peewee under 42 g
18	43.0				4.0	57.4	38.6			0.0	4.0	57.4	38.6
19	45.5			0.2	16.6	66.4	16.8			0.2	15.3	65.4	19.1
20	49.0			3.7	46.3	46.3	3.7			2.6	36.2	52.5	8.7
21	52.0		0.2	16.6	59.6	22.7	0.8		0.1	9.9	48.5	36.9	4.6
22	54.5		1.4	35.1	53.1	10.1	0.2		0.6	20.1	50.3	26.1	2.8
23	56.4	0.1	4.5	48.9	41.4	5.0	0.1		1.8	28.8	47.6	19.7	2.0
24	57.7	0.4	8.2	55.8	32.7	2.9		0.1	3.3	35.2	44.1	15.7	1.5
25	58.8	0.9	12.6	59.0	25.7	1.8		0.3	5.1	39.8	40.5	13.1	1.2
26	59.6	1.5	16.3	59.7	21.2	1.3		0.5	6.9	43.0	37.4	11.1	1.0
27	60.2	2.1	19.4	59.3	18.2	1.0		0.7	8.7	45.3	34.7	9.7	0.9
28	60.7	2.8	22.1	58.5	15.9	0.8		0.9	10.3	46.9	32.4	8.6	0.8
29	61.1	3.4	24.2	57.5	14.2	0.7		1.2	11.8	48.1	30.4	7.8	0.7
30	61.5	4.2	26.4	56.3	12.6	0.5		1.5	13.3	48.9	28.7	7.0	0.6
31	61.9	5.1	28.5	54.8	11.2	0.5		1.8	14.6	49.4	27.1	6.5	0.6
32	62.2	5.8	30.0	53.5	10.2	0.4		2.2	15.9	49.7	25.7	6.0	0.5
33	62.4	6.4	31.0	52.6	9.6	0.4		2.5	17.0	50.0	24.5	5.5	0.5
34	62.6	7.0	32.0	51.6	9.0	0.3		2.8	18.1	50.1	23.4	5.2	0.5
35	62.8	7.6	33.0	50.6	8.5	0.3		3.1	19.0	50.1	22.5	4.9	0.4
36	63.0	8.2	33.9	49.6	8.0	0.3		3.4	19.9	50.1	21.6	4.6	0.4
37	63.2	8.9	34.8	48.6	7.5	0.2		3.7	20.8	50.0	20.8	4.3	0.4
38	63.3	9.3	35.2	48.0	7.2	0.2		4.0	21.6	49.9	20.1	4.1	0.4
39	63.4	9.7	35.6	47.5	7.0	0.2		4.3	22.3	49.8	19.4	3.9	0.3
40	63.5	10.0	36.0	46.9	6.8	0.2		4.6	22.9	49.6	18.8	3.7	0.3
41	63.6	10.4	36.4	46.4	6.6	0.2		4.9	23.5	49.5	18.2	3.6	0.3
42	63.7	10.8	36.8	45.8	6.3	0.2		5.1	24.1	49.3	17.7	3.4	0.3
43	63.7	10.8	36.8	45.8	6.3	0.2		5.3	24.7	49.2	17.2	3.3	0.3
44	63.8	11.2	37.2	45.2	6.1	0.2		5.6	25.2	49.0	16.8	3.2	0.3
45	63.9	11.6	37.6	44.7	5.9	0.2		5.8	25.6	48.9	16.4	3.1	0.3
46	64.0	12.1	37.9	44.1	5.7	0.2		6.0	26.1	48.7	16.0	3.0	0.2
47	64.1	12.5	38.3	43.5	5.5	0.2		6.3	26.5	48.5	15.6	2.9	0.2
48	64.2	12.9	38.6	42.9	5.4	0.2		6.5	26.9	48.3	15.3	2.8	0.2
49	64.2	12.9	38.6	42.9	5.4	0.2		6.7	27.3	48.1	15.0	2.7	0.2
50	64.3	13.4	38.9	42.3	5.2	0.1		6.9	27.6	48.0	14.7	2.6	0.2
51	64.4	13.9	39.2	41.8	5.0	0.1		7.1	28.0	47.8	14.4	2.5	0.2
52	64.5	14.3	39.5	41.2	4.8	0.1		7.3	28.3	47.6	14.1	2.5	0.2
53	64.6	14.8	39.8	40.6	4.7	0.1		7.5	28.6	47.4	13.8	2.4	0.2
54	64.7	15.3	40.1	40.0	4.5	0.1		7.7	29.0	47.2	13.6	2.3	0.2
55	64.7	15.3	40.1	40.0	4.5	0.1		7.9	29.2	47.0	13.3	2.3	0.2
56	64.8	15.8	40.3	39.4	4.4	0.1		8.1	29.5	46.8	13.1	2.2	0.2
57	64.8	15.8	40.3	39.4	4.4	0.1		8.3	29.8	46.6	12.9	2.2	0.2
58	64.9	16.3	40.6	38.8	4.2	0.1		8.5	30.0	46.4	12.7	2.1	0.2
59	64.9	16.3	40.6	38.8	4.2	0.1		8.7	30.3	46.3	12.5	2.1	0.2
60	65.0	16.8	40.8	38.2	4.1	0.1		8.9	30.5	46.1	12.3	2.0	0.2
61	65.0	16.8	40.8	38.2	4.1	0.1		9.0	30.7	45.9	12.1	2.0	0.2
62	65.1	17.3	41.0	37.6	3.9	0.1		9.2	31.0	45.7	12.0	2.0	0.2
63	65.1	17.3	41.0	37.6	3.9	0.1		9.4	31.2	45.6	11.8	1.9	0.2
64	65.1	17.3	41.0	37.6	3.9	0.1		9.5	31.4	45.4	11.6	1.9	0.2
65	65.2	17.9	41.2	37.0	3.8	0.1		9.7	31.6	45.3	11.5	1.8	0.2
66	65.2	17.9	41.2	37.0	3.8	0.1		9.9	31.7	45.1	11.4	1.8	0.1
67	65.3	18.4	41.4	36.4	3.7	0.1		10.0	31.9	44.9	11.2	1.8	0.1
68	65.3	18.4	41.4	36.4	3.7	0.1		10.2	32.1	44.8	11.1	1.7	0.1
69	65.4	19.0	41.6	35.8	3.5	0.1		10.3	32.2	44.6	10.9	1.7	0.1
70	65.4	19.0	41.6	35.8	3.5	0.1		10.5	32.4	44.5	10.8	1.7	0.1
71	65.5	19.5	41.7	35.2	3.4	0.1		10.6	32.6	44.3	10.7	1.7	0.1
72	65.5	19.5	41.7	35.2	3.4	0.1		10.7	32.7	44.2	10.6	1.6	0.1
73	65.6	20.1	41.9	34.7	3.3	0.1		10.9	32.8	44.0	10.5	1.6	0.1
74	65.6	20.1	41.9	34.7	3.3	0.1		11.0	33.0	43.9	10.4	1.6	0.1
75	65.6	20.1	41.9	34.7	3.3	0.1		11.2	33.1	43.8	10.3	1.6	0.1
76	65.6	20.1	41.9	34.7	3.3	0.1		11.3	33.2	43.6	10.2	1.6	0.1
77	65.7	20.7	42.0	34.1	3.2	0.1		11.4	33.3	43.5	10.1	1.5	0.1
78	65.7	20.7	42.0	34.1	3.2	0.1		11.5	33.5	43.4	10.0	1.5	0.1
79	65.8	21.2	42.1	33.5	3.1	0.1		11.7	33.6	43.3	9.9	1.5	0.1
80	65.8	21.2	42.1	33.5	3.1	0.1		11.8	33.7	43.1	9.8	1.5	0.1

ISA Brown Egg Weight Distribution (%) – USA System

		Weekly						Cumulative					
Age in weeks	Av. egg weight, Lbs/Case	Jumbo over 30 oz/doz	Extra Large 27-30 oz/doz	Large 24-27 oz/doz	Medium 21-24 oz/doz	Small 18-21 oz/doz	Peewee under 18 oz/doz	Jumbo over 30 oz/doz	Extra Large 27-30 oz/doz	Large 24-27 oz/doz	Medium 21-24 oz/doz	Small 18-21 oz/doz	Peewee under 18 oz/doz
18	34.1				2.7	53.0	44.2				2.7	53.0	44.2
19	36.1			0.1	12.9	66.5	20.5			0.1	11.8	65.1	23.0
20	38.9			2.5	41.4	51.2	4.9			1.7	31.8	55.7	10.7
21	41.3		0.2	12.7	58.9	27.1	1.1		0.1	7.5	46.0	40.7	5.7
22	43.3		1.6	29.0	56.3	12.8	0.3		0.7	16.2	50.1	29.5	3.5
23	44.8	0.1	5.0	42.3	46.1	6.5	0.1		2.0	24.1	48.9	22.5	2.5
24	45.8	0.2	9.1	49.3	37.5	3.9		0.1	3.7	30.1	46.2	18.1	1.9
25	46.7	0.5	13.9	52.8	30.2	2.5		0.2	5.7	34.5	43.1	15.1	1.5
26	47.3	0.9	18.0	53.9	25.4	1.8		0.3	7.7	37.6	40.2	12.9	1.3
27	47.8	1.3	21.4	53.9	22.0	1.4		0.4	9.6	39.9	37.7	11.3	1.1
28	48.2	1.8	24.4	53.3	19.4	1.1		0.6	11.4	41.6	35.4	10.0	1.0
29	48.5	2.2	26.8	52.6	17.5	0.9		0.8	13.1	42.8	33.5	9.0	0.9
30	48.8	2.8	29.2	51.5	15.7	0.8		1.0	14.7	43.6	31.7	8.2	0.8
31	49.1	3.5	31.6	50.3	14.0	0.6		1.2	16.2	44.2	30.1	7.6	0.7
32	49.4	4.0	33.4	49.2	12.9	0.6		1.4	17.6	44.6	28.7	7.0	0.7
33	49.5	4.4	34.5	48.4	12.2	0.5		1.6	18.9	44.9	27.5	6.5	0.6
34	49.7	4.9	35.7	47.5	11.5	0.5		1.9	20.0	45.1	26.4	6.1	0.6
35	49.8	5.3	36.8	46.7	10.8	0.4		2.1	21.1	45.2	25.4	5.7	0.5
36	50.0	5.9	37.8	45.7	10.2	0.4		2.3	22.1	45.2	24.4	5.4	0.5
37	50.2	6.4	38.9	44.8	9.6	0.4		2.6	23.1	45.2	23.6	5.1	0.5
38	50.2	6.7	39.4	44.3	9.3	0.3		2.8	24.0	45.1	22.8	4.9	0.4
39	50.3	7.0	39.9	43.8	9.0	0.3		3.0	24.8	45.1	22.1	4.6	0.4
40	50.4	7.3	40.4	43.3	8.7	0.3		3.2	25.5	45.0	21.5	4.4	0.4
41	50.5	7.6	40.9	42.8	8.5	0.3		3.4	26.2	44.9	20.9	4.2	0.4
42	50.6	7.9	41.3	42.3	8.2	0.3		3.6	26.9	44.8	20.3	4.1	0.4
43	50.6	7.9	41.3	42.3	8.2	0.3		3.8	27.5	44.7	19.8	3.9	0.4
44	50.6	8.2	41.8	41.8	7.9	0.3		3.9	28.0	44.6	19.4	3.8	0.3
45	50.7	8.5	42.2	41.3	7.7	0.3		4.1	28.6	44.4	18.9	3.6	0.3
46	50.8	8.9	42.7	40.7	7.5	0.2		4.3	29.1	44.3	18.5	3.5	0.3
47	50.9	9.2	43.1	40.2	7.2	0.2		4.5	29.6	44.2	18.1	3.4	0.3
48	51.0	9.6	43.5	39.7	7.0	0.2		4.6	30.1	44.0	17.7	3.3	0.3
49	51.0	9.6	43.5	39.7	7.0	0.2		4.8	30.5	43.9	17.4	3.2	0.3
50	51.0	10.0	43.9	39.2	6.8	0.2		5.0	30.9	43.7	17.1	3.1	0.3
51	51.1	10.4	44.3	38.6	6.5	0.2		5.1	31.3	43.6	16.7	3.0	0.3
52	51.2	10.7	44.7	38.1	6.3	0.2		5.3	31.7	43.4	16.4	2.9	0.3
53	51.3	11.1	45.0	37.5	6.1	0.2		5.4	32.1	43.2	16.1	2.8	0.3
54	51.3	11.5	45.4	37.0	5.9	0.2		5.6	32.4	43.1	15.9	2.8	0.2
55	51.3	11.5	45.4	37.0	5.9	0.2		5.8	32.8	42.9	15.6	2.7	0.2
56	51.4	12.0	45.7	36.4	5.7	0.2		5.9	33.1	42.8	15.4	2.6	0.2
57	51.4	12.0	45.7	36.4	5.7	0.2		6.1	33.4	42.6	15.1	2.6	0.2
58	51.5	12.4	46.0	35.9	5.6	0.2		6.2	33.7	42.4	14.9	2.5	0.2
59	51.5	12.4	46.0	35.9	5.6	0.2		6.4	34.0	42.3	14.7	2.5	0.2
60	51.6	12.8	46.3	35.4	5.4	0.2		6.5	34.2	42.1	14.5	2.4	0.2
61	51.6	12.8	46.3	35.4	5.4	0.2		6.6	34.5	42.0	14.3	2.4	0.2
62	51.7	13.3	46.6	34.8	5.2	0.1		6.8	34.8	41.8	14.1	2.3	0.2
63	51.7	13.3	46.6	34.8	5.2	0.1		6.9	35.0	41.7	13.9	2.3	0.2
64	51.7	13.3	46.6	34.8	5.2	0.1		7.0	35.2	41.6	13.7	2.2	0.2
65	51.7	13.7	46.9	34.3	5.0	0.1		7.2	35.5	41.4	13.6	2.2	0.2
66	51.7	13.7	46.9	34.3	5.0	0.1		7.3	35.7	41.3	13.4	2.2	0.2
67	51.8	14.2	47.1	33.7	4.9	0.1		7.4	35.9	41.1	13.3	2.1	0.2
68	51.8	14.2	47.1	33.7	4.9	0.1		7.5	36.1	41.0	13.1	2.1	0.2
69	51.9	14.7	47.4	33.2	4.7	0.1		7.7	36.3	40.9	13.0	2.0	0.2
70	51.9	14.7	47.4	33.2	4.7	0.1		7.8	36.5	40.8	12.8	2.0	0.2
71	52.0	15.1	47.6	32.6	4.5	0.1		7.9	36.6	40.6	12.7	2.0	0.2
72	52.0	15.1	47.6	32.6	4.5	0.1		8.0	36.8	40.5	12.6	2.0	0.2
73	52.1	15.6	47.8	32.1	4.4	0.1		8.1	37.0	40.4	12.4	1.9	0.2
74	52.1	15.6	47.8	32.1	4.4	0.1		8.2	37.1	40.2	12.3	1.9	0.2
75	52.1	15.6	47.8	32.1	4.4	0.1		8.3	37.3	40.1	12.2	1.9	0.2
76	52.1	15.6	47.8	32.1	4.4	0.1		8.5	37.4	40.0	12.1	1.8	0.2
77	52.1	16.1	48.0	31.5	4.2	0.1		8.6	37.6	39.9	12.0	1.8	0.2
78	52.1	16.1	48.0	31.5	4.2	0.1		8.7	37.7	39.8	11.9	1.8	0.2
79	52.2	16.6	48.2	31.0	4.1	0.1		8.8	37.9	39.7	11.8	1.8	0.2
80	52.2	16.6	48.2	31.0	4.1	0.1		8.9	38.0	39.6	11.7	1.8	0.2

REARING GRAPH ISA BROWN FINAL PRODUCT



Hatchery: _____ Hatch date: _____ Transport date

Rearing farm: _____ Housing date: _____ (to laying farm): _____

House nr.: _____ No. of hens Age at transport date: _____wks_____days

Feed supplier: _____ housed.: _____ No. of hens transported: _____

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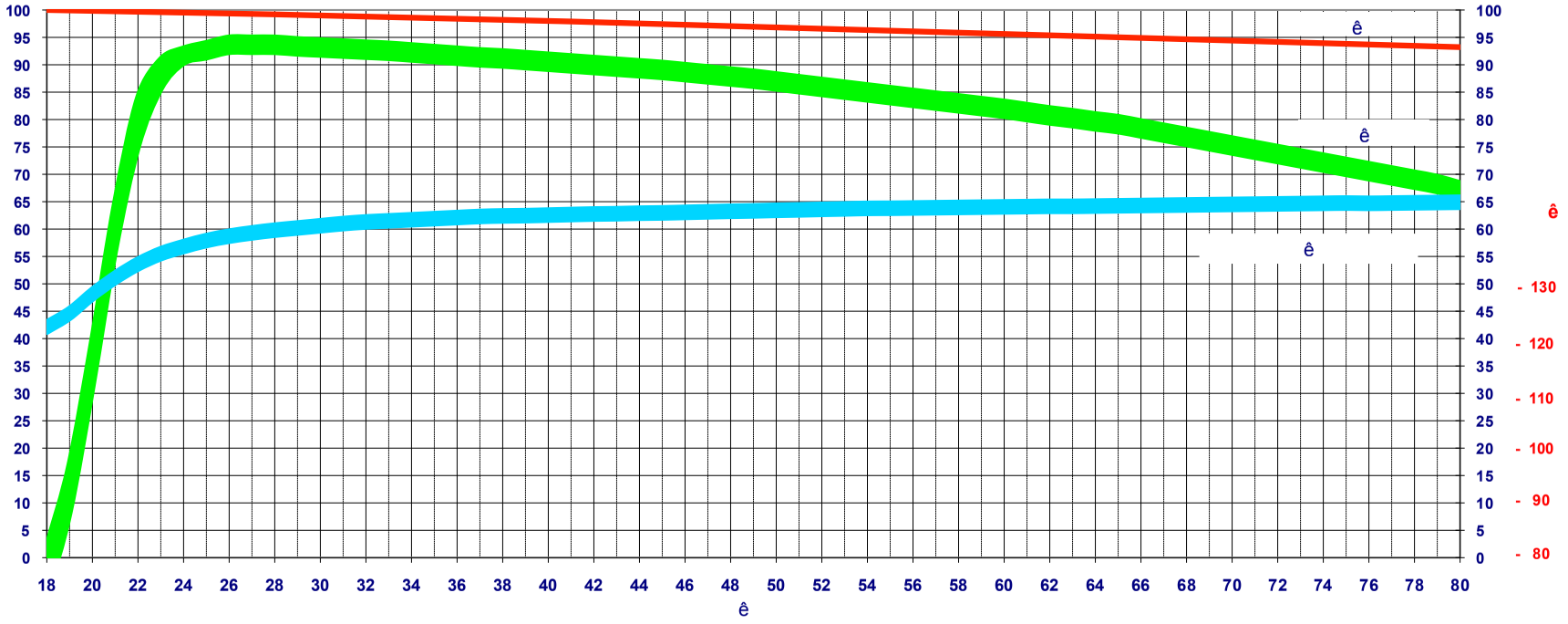
PRODUCTION RECORDING GRAPH ISA BROWN F.P.



Farm: _____ Hatch date : _____ No. of birds housed: _____

House no.:_____ Rearing farm : _____ Housing date: _____

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