TETRA

SELECTED FOR QUALITY

BÁBOLNA TETRA HYBRIDS

TETRA-SL LL
HARCO
BLANCA

MANAGEMENT GUIDE

BÁBOLNA TETRA
COMMERCIAL LAYER
HYBRIDS
MANAGEMENT GUIDE

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Introduction

Eggs are one of the most essential sources of nutrition available to us in a natural form. The importance of eggs to a balanced diet means that most people are unlikely to reduce their weekly consumption even in times of economic crisis. It is in the interest of the breeder, the egg producer and the consumer that production costs are kept as low as possible while maintaining the quantity and quality of eggs produced for the table and for processing.

The new ownership and management structure of Bábolna Tetra Ltd. is committed to continue with the ideals and innovation of its former parent company, the famous Babolna Shareholding Company and produce layer genetics of the highest quality. In parallel to the 50 year old breeding program of the Tetra-SL layer hybrid we have launched a radically new breeding program. Our research and development program has developed an alternative to the trusted Bábolna Tetra hybrid, TETRA-SL. We can now offer a viable option and provide our customers with a new layer, TETRA-SL LL, with a prolonged production period.

The primary objective of the TETRA-SL LL, "Long Life" layer, is to expand the production period of the hybrid and this has been achieved through our research program "Long-Life-Laying" The production potential of the TETRA-SL LL ensures that it is one of the leading hybrids in the world.

Harco is a black-feathered hybrid laying brown eggs and with a slightly lower production level. Harco is perfectly suited to the alternative systems that are increasing in popularity. Blanca is a leghorn type hybrid producing white eggs. Historically some countries preferred not to produce white eggs, but today there is a rising demand for them thanks to the numerous advantages of the white hybrids. These include lower feed intake, higher dry matter content of eggs and excellent performance characteristics.

Babolna Tetra is continuously improving the performance characteristics of the hybrids through dedicated teamwork. We examine the performance potential of our pedigrees by testing not only the pedigree itself but progeny flocks as well. On the basis of these production results we are able to produce new pedigree flocks with improved heritability year by year. We focus our selection on production and feed consumption with equal emphasis on quality criteria such as egg weight, shell colour, shell strength and albumen height. We successfully apply modern molecular genetic programs integrating them with selection methods based on traditional population genetic research. Our breeding flocks and hatcheries are able provide our customers with high quality day old chicks in the quantities they require.

The current Management Guide contains the main information necessary to be followed by producers in order to achieve the genetic potential of Bábolna Tetra hybrids. The guide contains the production parameters of Tetra-SL LL, Harco and Blanca layer-hybrids. We do not expect our customers to rely entirely on the Management Guides. We are always available to provide further technical support. We know that it is important to maintain permanent contact with our egg producer customers to support and advise on all of the circumstances and aspects that may arise in practice. Customers are always encouraged to contact our highly trained team of skilled specialists and veterinarians at Bábolna Tetra Kft, who are always available to help.

BÁBOLNA TETRA Kft. **MMXII**

Performance Specifications in controlled environment conditions

Parameters	TETRA-SL LL	HARCO	BLANCA	
	BROWN EGG LAYER		WHITE EGG LAYER	Unit
Liveability				
0-17 weeks of age	97-98	97-98	96-97	%
18-80 weeks of age	94-96	93-95	93-95	%
18-90 weeks of age	93-95			%
Feed Intake				
0-17 weeks of age	5.7-5.9	5.8-6.0	5.3-5.4	kg
18-80 weeks of age	107-113	118-123	95-105	g/day
18-90 weeks of age	108-114			g/day
Body Weight				
At 17 weeks of age	1.42-1.46	1.45-1.50	1.25-1.30	kg
At 80 weeks of age	1.9-2.0	2.1-2.2	1.6-1.7	kg
At 90 weeks of age	1.95-2.0			kg
Sexual Maturity				
Age at 50% rate of lay	143-145	149-151	143-145	days
Age at 90% rate of lay	160-162	164-166	161-163	days
Egg Production (Hen Day)				
Peak Production	95-96	94.5-95.5	95-96	%
Egg Production above 90%	24-26	16-18	20-22	weeks
Total Eggs for 72 weeks of age	325-330	305-308	320-325	eggs
Total Eggs for 80 weeks of age	370-375	343-348	360-365	eggs
Total Eggs for 90 weeks of age	420-425			eggs
Egg Mass Output (Hen Housed)				
Total Mass for 72 weeks of age	20.05	18.8	18.9	kg
Total Mass for 80 weeks of age	22.80	21.3	21.4	kg
Total Mass for 90 weeks of age	25.96			kg
Egg Weight				
Egg Weight at 32 weeks of age	62.0	60.9	59.4	g
Egg Weight at 52 weeks of age	64.1	65.3	62.8	g
Egg Weight at 80 weeks of age	65.5	67.1	65.1	g
Egg Weight at 90 weeks of age	65.9			g
Average Egg Weight	63.3	63.5	61.2	g
Shell Strength	4100	3700	4100	g
Shell Colour	30	34		

These specifications assume an average ambient house temperature of 20°C (68°F)

It is important to note that in some countries welfare regulations may stipulate stocking rates and feeding and drinking spaces, which are different to those given in this manual. Regulations may also prohibit or restrict certain husbandry practices.

Things to do before delivery of chicks

The risk of an infection of any kind of poultry disease can be minimized by isolating a flock from other especially older flocks and by avoiding mixed-aged-flocks on the same farm.

All the building interior, including the drinking, feeding, heating and ventilation systems as well as the cages or slats and also the attached service areas and equipment has to be cleaned, disinfected and dried properly.

After reinstalling the disinfected and dried equipments they have to be checked whether they work properly and are adjusted for the right height.

Traps or poison for mice and flies have to be placed inside the building out of reace of the birds. Windows have to be covered by nets to keep wild birds outside the building.

Once the farm is disinfected and ready for a new flock, the entrance of unauthorised people and vehicles has to be minimized.

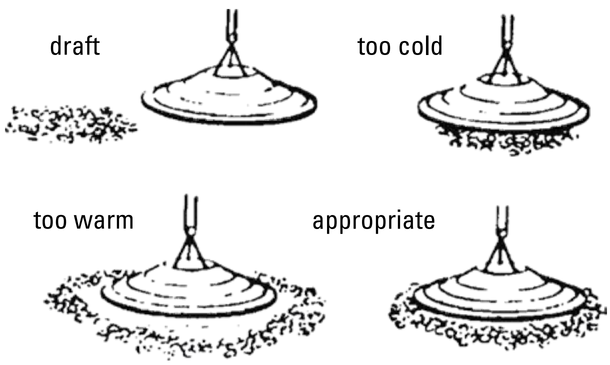
24 hours before delivery the following things have to be done:

- Start heating to reach the required temperature
- Check the drinking system and water temperature
- Prepare feed ready for the birds
- Check appropriate light intensity

Temperature

During the first 3 or 4 days chickens need 32-34 C° depending on the brooding system. To reach the required temperature heating has to be started 24 hours prior to placing the day-old flock. The behaviour of the chickens is the best indicator of the temperature especially during night. If the birds are calm and quiet and they spread out equally in the house it means they feel comfortable. As the chicks are growing the temperature can be reduced to 30-32 C° by the end of the first week. From the second week the temperature can be reduced by 2-3 C° weekly until reaching 20 C°. Always measure the temperature at the bird's level. Besides the temperature it is essential to maintain proper humidity as well especially if brooding in cages. Relative humidity has to be kept between 40-60% by evaporating water (floor brooding) or watering the walks (cage brooding) if necessary.

Brooding temperature		
Age	Floor Brooding	Cage Brooding
1-4	32-33 C°	33-34 C°
5-7	30 C°	32 C°
8-14	28 C°	30 C°
15-21	26 C°	27 C°
22-28	24 C°	24 C°
29-35	22 C°	22 C°
36-119	20 C°	20 C°



Behaviour of the chicks is the best indicator of the appropriate temperature

Stocking Rate

(a) Floor systems

Environmental factors, such as type of housing, ventilation and temperature, have a greater effect upon stocking rate than genetic make-up. Slatted floors, for example, will allow a tighter stocking rate than litter, while high temperature, especially if combined with high relative humidity, necessitates a more liberal stocking rate. The following recommendations are given as a guide for litter units with an average temperature of about 20°C (68°F) at bird height. These rates should be reduced by 2% for each 1°C (2°F) rise in temperature above 20°C (68°F).

Age (weeks)	Brown		White	
	Deep litter	Slats	Deep litter	Slats
	Birds/m²		Birds/m²	
0-8	15	16	17	18
9-18	10	12	12	14
>18	7	8	8	10

(b) Cage systems

Stocking rates in cage systems are mainly determined by body weight and temperature.

Age (weeks)	Brown		White	
	Birds/m²	Area per bird	Birds/m²	Area per bird
0-8	66	150	77	130
9-18	28	350	32	310
>18	13	750	13	750

Feeding Space

Insufficient feeding space during rearing will produce uneven birds at sexual maturity, and result in reduced egg output in lay. The following should be regarded as the minimum requirements for satisfactory performance.

(a) Floor systems

Age (weeks)	Brown		White	
	Feeder space per bird (cm)	Birds per 40 cm dia circular feeder	Feeder space per bird (cm)	Birds per 40 cm dia circular feeder
0-8	3.5	70	3.0	80
	plus extra feeders in first week			
9-18	7.0	35	6.0	40
>18	10.0	30	8.5	35

(b) Cage systems

Age (weeks)	Brown	White
	Feeder space per bird (cm)	Feeder space per bird (cm)
0-2	2	2
	plus extra feeders in 3-5 days	
3-8	4	3.5
9-18	8	7
>18	10	8.5

Drinking Space

Water is an essential nutrient by itself. It can also influence all other nutrient intakes by controlling feed intake. For example, a restriction on water intake will cause a voluntary reduction in feed intake. Therefore the provision of an adequate number of well distributed drinking points is a key factor in egg production. In hot climates the need for an adequate supply of drinkers is even more important, as at high temperatures evaporative cooling plays a dominant role in the maintenance of a normal body temperature.

The drinking space recommended below must be increased in hot climates, and when water control is practised. In these situations there will be abnormally heavy demands for water at certain times of the day. To ensure that all birds find water when initially housed there should be a minimum light intensity of 20 lux at bird level. This is especially important at day old and where a change of drinking system occurs when moving birds into the laying house. It is also recommended that extra drinkers are provided during the first week of life to minimize the incidence of non-starters or starve-outs.

(a) Floor systems

Age (weeks)	Brown		White	
	Birds per nipple	Trough space per bird (cm)	Birds per nipple	Trough space per bird (cm)
0-2	8	fountains	10	
	plus extra fountains (50 birds per fountain)			
3-8	8	2.5	10	2
>18	8	4.5	10	4

(b) Cage systems

It is recommended that nipple and cup drinkers are located so that each cage of birds has access to at least 2 drinkers.

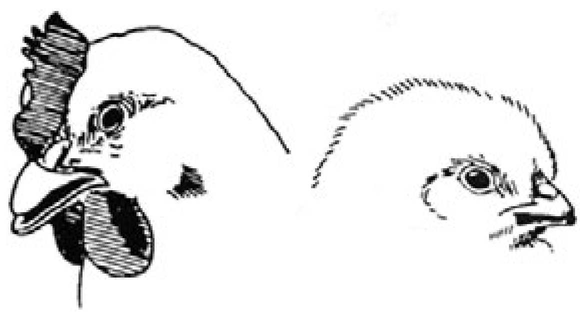
Age (weeks)	Brown		White	
	Birds per nipple	Trough space per bird (cm)	Birds per nipple	Trough space per bird (cm)
0-2	8	fountains	10	
	plus extra fountains (50 birds per fountain)			
3-8	8	2.5	10	2
>18	8	4.5	10	4

Beak Trimming

Beak trimming (often incorrectly termed debeaking) need not be carried out routinely when TETRA birds are kept in controlled environment housing. But if experience from previous flocks suggests that it is necessary, it will be worthwhile first checking all other aspects of management, before embarking on a program of beak trimming. The provision of more feeders and drinkers, more space per bird or improved ventilation may be the correct action. However, in open sided housing, routine beak trimming is recommended, as both bright light intensities and high temperatures may predispose undesirable behaviour. When essential, beak trimming is best performed with a precision machine between 6 and 8 days of age. Only healthy birds can be beak trimmed. Electrolytes and vitamin K should be used in the drinking water before and after the procedure as well as deeper feed in the feeders. Beak trimming, when done correctly, minimizes feed wastage and checks undesirable behaviour. It does not directly affect egg production. However, if performed incorrectly, it will reduce feed intake and, in turn, adversely affect egg output. Faulty techniques include trimming at the wrong age, cutting only one mandible, the removal of too much beak and unsatisfactory cauterization.

Care must be taken that all birds are correctly and uniformly beak trimmed. Each bird should mature with a rounded, but slightly shortened beak and well able to conduct normal feeding activity.

Advanced automatic equipment can beak-treat, inject, and count processed birds in the hatchery. The primary purpose of the machine is to treat poultry beaks. The beak treat process is accomplished by using a high intensity infra red light beam. Following the beak treat process, the injection module can be used to inoculate birds. When the beak-treat and inject processes have been completed, the machine then counts the birds as they are dropped into a box. The system can use a turret to drop a specified number of birds in each corner of the box.



It is also important that the operation is conducted in compliance with any welfare regulations, which may exist. In some countries the procedure may be prohibited.

Chick Starter 1 & 2 (0 - 8 weeks)

Essentially a Starter ration aims to produce a good skeleton, good organ development and help promote an active immune system. This is achieved by feeding the starter ad libitum with the correct balance and absolute levels of essential amino acids, and a minimum concentration (1.3%) of linoleic acid (starter 1) for growth, development of the immune system, feathering and skin condition.

Normally it is adequate to feed the Starter ration for 6 weeks, however, if for whatever reason body weight is substantially less than 500 grams at 6 weeks it is advisable to continue feeding Starter until body weight is on target.

Grower (9 - 16 weeks)

Whilst the Grower ration will be the lowest density ration that the bird receives, it is important that all nutrients are correctly included. Feed restriction is not recommended during this period as it may be difficult to achieve the correct body weight at first egg, particularly if early sexual maturity is desired. Feeding ab libitum is suggested but it is essential to monitor the body weights weekly during this period.

Body weight control

Body weight, especially prior to first egg, is a very important factor in determining the performance that will be achieved during the laying period. Therefore a regular body weight control is essential. At least 2% of a flock has to be measured not less than every two weeks. Birds have to be weighed in the morning hours and on the same day of the week before feeding. The growth of a flock is normal and the birds can be considered equal if the difference between the individual and average weight is not more than 10%.

At least 2% of a flock has to be measured

As TETRA pullets are not liable to overweight, ad libitum feeding can be used during the whole rearing period if the measured average bodyweight is close to the target (±5%) and the flock is uniform.

In case the measured average bodyweight despite the ad libitum feeding is under the target weight, the feed intake has to be increased by running the feeders more often or by using higher nutrient feed formula until the target is reached.

In case the measured average bodyweight is above the target, the feed intake should not to be increased until the target is reached. Never reduce the daily feed intake.

Grower feed can be used on the 8th week if the body weight of the pullets is around standard. Normally by the 15th week the average body weight of the pullets is around 1200 grams for Blanca and 1300 grams for Tetra-SL LL.

It is essential that TETRA Hybrids grows well from day one, as optimum skeletal development and adequate deposition of muscular and adipose tissues must be completed before the bird commences sexual maturation. It therefore follows that the shape of the body weight curve will depend on the anticipated age for sexual maturity. The bird must develop its reproductive organs in the period 15-20 days before it lays its first egg, irrespective of when maturity occurs. The ovary and oviduct will weigh about 100-150 grams, and this will be in addition to the 8-12 grams daily growth that takes place at about this age. Body weight at first egg will therefore increase by 80-90 grams for each 10-day delay in maturity.

Once an individual bird starts to lay it is quite normal for its body weight to plateau, or even fall, for several weeks after first egg. In the period when a flock is starting to produce there will be three types of bird, (a) birds that have yet to develop sexually and growing at 8-10 grams per day, (b) birds undergoing development of the reproductive system and growing at 15 grams per day and (c) birds that are in lay, and having little or no body weight gain. The effect that this has upon the main daily growth rate of a flock is shown in the graph describing the daily body weight gain before and after 50% rate of lay.

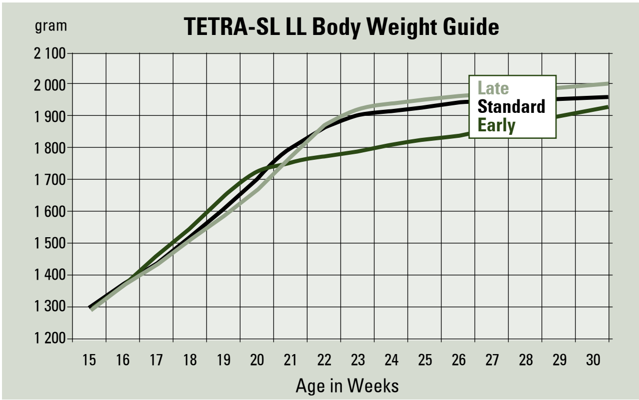
Body weight at first egg is a key factor in the determination of egg weight. The average egg weight in the laying year increases by 1.4-1.5 grams for each 100-gram increment of body weight.

It is a common phenomenon in egg laying birds that at about 15 weeks of age birds voluntarily reduce daily feed intake, and as a consequence reduce daily body weight gain. It follows therefore that body weights must be on target by this age if suboptimal weights are to be avoided. Birds, which commence egg production with body weights below optimum, frequently dip in egg production at or soon after peak rate of lay.

Oestrogen production by the ovary causes a retardation of skeletal growth. It is therefore extremely important that the skeleton has been allowed to develop optimally before the bird commences lay. Failure to permit satisfactory bone growth during the rearing period will predispose both skeletal disorders and shell quality problems during adult life.

The importance of obtaining the correct body weights for given ages and stages of sexual development dictates that sample body weighing of the flock is conducted at regular intervals during the rearing period. It is particularly important that the body weight is on target before a flock is changed from the Chick Starter to the Grower ration. It is also vital that early maturing flocks are fed ad libitum throughout the rearing period if the extra body weight gain necessary for these birds is to be achieved.

It will be seen from the TETRA-SL LL Body Weight Guide that early maturing flocks will initially have a faster body weight gain than later maturing flocks. Because individual body weights tend to plateau as soon as birds come into production and sexually immature birds continue to gain weight, the flock body weight averages cross over. As a result the earlier maturing birds then become lighter than later maturing birds. The body weight differences will persist throughout the life of the flock.



Pre-Lay (17 - 19 weeks)

In the 2-3 weeks before first egg enormous physiological changes take place within the bird. During this time the bird is depositing medullar bone, which will be involved in shell calcification once the bird is in lay. It is vital, therefore that calcium intake is optimal at this stage if shell quality and bone strength is to be maximized later in the laying cycle. There is also an increased demand for energy and amino acids to furnish the development of the ovary and oviduct. Individual daily body weight gain will increase from about 10 grams per day to as much as 15 grams per day in the period 3-15 days before first egg. As the brown body weight has to be between 1500-1550 g before starting of lay, it is most important that feed intake is ad libitum whilst this ration is being fed, and that management factors, which depress feed intake are avoided or their consequences minimized as much as possible.

Because reproductive development and medullar bone deposition have a temporal relationship to sexual maturity, any change in flock maturity must be matched by a similar change in the introduction of the Pre-Lay ration.

Layer 1 (20-35 weeks)

Early in the laying cycle feed intake is often relatively low, yet the demands for egg mass output and the continued increase in body weight will be at peak. Layer 1 ration must therefore be adequately formulated to satisfy the large demand for nutrients, when brown daily feed intake is probably less than 114 grams.

It is important that a layer ration includes a source of calcium, which is hard and relatively 'large', e.g. oyster shell, to provide calcium during the part of the day when the bird is not feeding. This will be in addition to a more soluble form of calcium carbonate, e.g. limestone flour, which will be more readily absorbed across the gut wall. Both forms of calcium are required in the ration to maximize shell quality.

Where it is not possible to feed a Pre-Lay ration Layer 1 may be introduced 3 weeks before anticipated start of egg production.

Layer 2 (36-60 weeks) & Layer 3 (>60 weeks)

In the later stages of the laying cycle egg mass output is decreasing, body weight gain is almost completed and feed intake is adequate. At this stage it is possible to minimize feed costs by feeding a lower nutrient density by controlling the ratio of the components.

TETRA-SL LL Feed Intake

Feed intake is greatly influenced by environmental factors. Changes in consumption levels, without changes in formulation, will result in changes in egg output. Laying hens primarily alter their daily feed intake to accommodate changes in their requirement for energy. Therefore factors such as ambient temperature, which alter the bird's demand for energy, automatically alter the bird's intake of feed. If there has been no modification of the ration formulation, changes in daily intake will result in changes in all nutrient intakes, and changes in the intake of amino acids, vitamins, minerals, yolk colorants, anticoccidials etc. will correspondingly affect bird performance.

The energy level of the ration itself will influence feed intake. TETRA-SL LL will reduce feed intake when the energy concentration of the ration is increased, and conversely increase intake when the energy level is decreased.

The laying hen does not totally adjust intake at the extremes of temperature or dietary energy. At high temperatures or with high-energy concentrations it tends to reduce energy intake too much and egg output suffers. At very low ambient temperatures, or on very low energy rations, the bird does not take in enough energy, and egg output is again reduced. Energy/amino acid ratios should be kept constant when the energy level of the ration is changed to ensure a satisfactory intake of protein, and amino acid concentrations should be increased when increasing temperatures result in lower daily feed intakes. Depth of feed in the trough, number of feeding per day.

Depth of feed in the trough, number of feeding per day and texture of feed affect feed intake. Consumption levels are positively correlated with depth of feed in the trough and feeding per day. Increasing depth of feed and number of times per day that feed is given to the birds will help maintain feed intake during hot weather. Birds also tend to eat more feed when it is given in a crumbed or pelleted form.

Boredom and copy feeding are factors, which tend to increase the feed intake of birds kept in cages. This is ironic, as caged birds require less energy for body temperature maintenance and activity than birds kept under extensive systems.

Feed intake is correlated with day length. TETRA-SL LL will consume about 1.5 grams more per day feed for each extra hour of light. This will not be totally wasted as egg numbers will be increased (about 3 eggs to 72 weeks) and average egg weight increased (about 0.1 grams per egg).

Feed consumption is also influenced by changes in sexual maturity. The combined effect of daylength (which is involved in determining age at first egg) and sexual maturity is shown in the following table.

Effect of age at first egg and daylenght on daily feed intake (% change from 150 days and 12 hours)

Early maturing birds have smaller body weights during the laying year and produce less total egg output than later maturing birds, both factors reduce nutrient demand.

TETRA-SL LL Body Weight Guide

Age (weeks)	Sexual maturity		
	Early (g)	Standard (g)	Late (g)
1	70	70	70
2	125	125	125
3	195	195	195
4	280	280	280
5	380	380	380
6	480	480	480
7	585	585	585
8	690	690	690
9	790	790	790
10	885	885	885
11	975	975	975
12	1060	1060	1060
13	1140	1140	1140
14	1220	1220	1220
15	1295	1295	1295
16	1375	1370	1370
17	1455	1440	1440
18	1555	1520	1515
19	1655	1610	1585
20	1725	1725	1670
21	1750	1800	1770
22	1770	1870	1870
23	1790	1900	1935
24	1810	1920	1955
25	1830	1930	1965
26	1840	1940	1975
27	1860	1945	1985
28	1880	1950	1990
29	1900	1955	1955
30	1920	1960	2000

FEEDING PROGRAM (STANDARD MATURITY)

Age (weeks)	TETRA-SL LL			HARCO			BLANCA			Type os ration
	Body Weight (g)	Feed (g/day)	Cumulative Feed (kg)	Body Weight (g)	Feed (g/day)	Cumulative Feed (kg)	Body Weight (g)	Feed (g/day)	Cumulative Feed (kg)	
1	70	11	0.077	70	11	0.077	65	13	0.091	Starter 1.
2	125	18	0.203	125	18	0.203	110	18	0.217	
3	195	24	0.371	195	24	0.317	175	25	0.392	
4	280	30	0.581	280	30	0.581	255	31	0.609	Starter 2.
5	380	35	0.826	380	35	0.826	330	36	0.861	
6	480	39	1.099	480	39	1.099	420	40	1.141	
7	585	43	1.400	585	44	1.407	510	43	1.442	
8	690	47	1.729	690	48	1.743	605	46	1.764	
9	790	51	2.086	790	51	2.100	705	48	2.100	Grower
10	885	55	2.471	885	55	2.485	805	51	2.457	
11	975	58	2,877	975	58	2,891	890	53	2,828	
12	1060	61	3,304	1060	61	3,318	965	55	3,213	
13	1140	64	3,752	1140	65	3,773	1045	57	3,612	
14	1220	67	4,221	1220	68	4,249	1115	58	4,018	
15	1295	71	4,718	1300	72	4,753	1180	60	4,438	
16	1370	74	5,236	1390	75	5,278	1125	62	4,872	
17	1440	77	5,775	1470	79	5,831	1265	64	5,320	Pre-Layer
18	1520	81	6,342	1560	83	6,412	1300	66	5,782	
19	1610	Ad libitum feeding		1660	Ad libitum feeding		1340	Ad libitum feeding		
20	1725			1775			1380			Layer 1.

The feed quantities given in the table assume the use of rations, which have specifications similar to those detailed on page 12, feed intake and body weight gain resulting from it is affected by many nutritional and environmental factors (see Feed Intake section, page 9) As a result, feeding the quantities and types of rations described in the schedule will not necessarily produce the body weights desired. If body weights vary significantly from those given in the guide on page 10, appropriate changes should be made to the daily feed allocation.

If a non-standard maturity is chosen, the quantities of feed given above will need adjusting to produce the desired body weights. Early maturing birds will need more feed and late maturing birds will need less feed

Ratio Age in Weeks	Starter 1 0-3	Starter 2 4-8	Grower 9-16	Pre-lay 17-19	Layer 1 20-35	Layer 2 36-60	Layer 3 >60
Met. Energy, MJ/kg	12.35	12.00	11.50	11.70	11.70	11.50	11.35
Met.Energy, kcal/kg	2 950	2 870	2 750	2 800	2 800	2 750	2 715
Crude Protein. %	20.0	18.0	15.5	17.5	17.5	16.5	16.0
Amino acids. total							
Lysin, %	1.15	1.00	0.75	0.80	0.85	0.80	0.75
Methionine, %	0.48	0.42	0.35	0.40	0.42	0.39	0.36
Methionine+cystine, %	0.84	0.74	0.61	0.70	0.74	0.69	0.63
Threonine, %	0.73	0.63	0.50	0.60	0.62	0.57	0.52
Tryptophan, %	0.22	0.19	0.16	0.19	0.21	0.20	0.18
Amino acids. digestible							
Lysin, %	1.01	0.89	0.67	0.71	0.74	0.70	0.65
Methionine, %	0.44	0.39	0.32	0.37	0.39	0.36	0.34
Methionine+cystine, %	0.73	0.65	0.53	0.61	0.65	0.59	0.54
Threonine, %	0.64	0.54	0.43	0.51	0.53	0.48	0.44
Tryptophan, %	0.18	0.16	0.14	0.16	0.17	0.16	0.15
Linoleic Acid, %	1.30	1.15	1.00	1.50	1.75	1.50	1.30
Calcium, %	1.00	1.00	1.00	2.50	3.80	3.90	4.10
Phosphorus. available, %	0.48	0.45	0.40	0.42	0.40	0.38	0.36
Sodium, %	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Chloride, %	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Added Vitamins							
Vitamin A. IU/kg	12000		10000	12000			
Vitamin D3. IU/kg	3000		2500	3000			
Vitamin E. mg/kg	30		20	25			
Vitamin K. mg/kg	3		2	2			
Vitamin B1 mg/kg	2		2	2			
Vitamin B2 . mg/kg	6		4	6			
Vitamin B6 . mg/kg	4		2	3			
Vitamin B12 . mcg/kg	20		10	20			
Panthotenic Acid. mg/kg	12		8	8			
Niacin, mg/kg	40		30	30			
Biotin, mcg/kg	100		100	100			
Folic Acid. mg/kg	2		1	1			
Choline. mg/kg	400		300	400			
Vitamin C*				50-100*			
Added Trace Minerals							
Iron. mg/kg	50		50	50			
Mangenese. mg/kg	100		100	100			
Copper. mg/kg	8		8	8			
Zinc. mg/kg	80		80	80			
Iodine. mg/kg	1		1	1			
Cobalt. mg/kg	1		1	1			
Selenium. mg/kg	0.3		0.3	0.3			

* Vitamin C recommended in stress conditions

Thanks to their genetic potential Tetra Hybrids are capable of a high performance and to produce optimal size eggs. These characteristics are closely related to maturity.

Early maturity is influenced partly by genetic and partly by environmental factors, and out of these latter ones feeding and lighting program are the most important.

Tetra Hybrids are able to produce excellently under a wide range of lighting programs.

The principle function of a lighting program is to influence the age at which the flock becomes sexually matue. At the outset of the production the most important factor is the body weight of the hens, which affects the outset. Egg numbers decrease by 3-4 eggs for each 10-day delay in age at first egg, but the average egg weight will increase by 1,4 g in the laying cycle. In order to make the maximum use of the genetic potential of the Tetra Hybrids it is important to know and keep the main principles:

- Keep the birds at a constant lighting program
- Never decrease the duration of lighting periods during the laying cycle.

Lighting program under controlled environment (normal maturity)

We can apply this program only if we exclude all chances of natural light infiltration. During the first 2 days we need to apply 23 hours of light per day with an intensity of 20-30 Lux. The chicks need this light for the initial development.

From day 3 until the end of week 7 reduce the light duration gradually to 10 hours and the intensity to 5-10 Lux. Until the end of week 16 use a permanent 10 hours of light with an intensity of 5-10 Lux. In one step, at the age of 17 weeks increase light duration by 2 hours. The following week increase light period with one further hour. Following that, weekly increase by 0,5 hours until we reach the duration of 16 hours per day. Keep the 16 hours period during the whole laying cycle. Under ideal conditions at the age of 16-17 weeks transfer the hens to the laying house before we increase the duration of the light period. If we want to reach an earlier maturity then decrease light duration more quickly during the first part of the rearing period until we reach the constant value. In this case we shall increase the light period by 3 hours in one step at the age of 17 weeks. As a consequence, we can expect that the flock becomes mature a week earlier, but the egg weight will decrease by 1 g. The stimulation of early maturity can be applied only if the hens reached the target body weight. In case the house is not properly controlled the filtering light can affect sexual maturity. As a consequence, the production of flocks with an outset in autumn may differ from normal rates.

Different lighting programs
To obtain huge egg weight (late maturity) and more eggs produced (early maturity)

The Tetra Hybrid reaches sexual maturity at the age of 19-20 weeks even if we do not increase the duration of the light period. So it is not possible to delay sexual maturity by the increasing the hours of light at a later stage. In order to delay sexual maturity keep the birds at a decreasing light period during the first phase of the pre-rearing. The length of the delay depends on the time necessary for reaching the minimum light. Every further week during which we apply decreasing light will lead at a later stage to a one-day delay in sexual maturity. It is important to remember that the delay of sexual maturity achieved by the impediment of weight gain will not cause the increase of egg weight. Tetra hybrids can be put into production at an earlier phase than usual in case we start to increase the hours of light at a younger age. As at the outset of production egg quantity is influenced by egg weight it is extremely important that we feed the early matured birds ad libitum, especially during the increase of the light period. It is not suggested however to increase the daylength before the age of 15 weeks. If we increase the light period, which will offset sexual maturity, then we should apply this at one step rather than by weekly increasements. The advantage of this solution is that the feed intake is stimulated in a period when the need for feed grows abruptly.

Maximal lighting

Increasing the daily hours of light during production the number of eggs will grow by 3 pieces per hen and the average egg weight will increase by 0,1 g after each hour of light. Moreover, the feed intake will also increase by cca 1,5 g. Too much light duration will deteriorate shell quality and will increase mortality, so we suggest a 17 hours longer period of light.

Lighting program of open houses

During the first 7 weeks apply the program of controlled environment. From week 8 on rear the hens at a permanent light which corresponds to natural light. The optimal hatch date should be determined according to the geographical conditions. Light intensity should not be over 10 Lux. At 17 weeks of age increase light duration by two hours, and the intensity to 20 Lux. From week 18 start with one hour and then with 30-30 minutes of increase until we reach the duration of 17 hours. The increase of light hours should be done equally in the morning and in the evening. According to some observations we can increase egg weight if we extend the period of light of the morning. It is very important that during the laying cycle the duration of light cannot decrease, so the decrease of natural light should be euqalized by setting the switcher correctly in a way to compensate the missing duration in the evening .
*In case our aim is the early maturity egg weight is important as well in a later stage, so we can increase light duration by 1 weekly hour until we reach 16 hours.

Comparison of lighting programs (hour/day)				
Weeks of age	Sexual maturity			
	Early	Normal	(Lux)	Late
0-2. day	23	23	20-30	23
3-4. day	22	22	20-30	21
5-7. day	20	22	20-30	20
8-11. day	19	21	20-30	19
12-14. day	18	20	10-20	19
15-18. day	17	19	10-20	18
19-21. day	16	18	10-20	18
22-25. day	15	17	5-10	17
26-28. day	14	16	5-10	17
29-32. day	13	15	5-10	16
33-35. day	12	14	5-10	16
36-39. day	11	13	5-10	15
40-42. day	11	12	5-10	14
43-46. day	11	11	5-10	13
47-49. day	11	10	5-10	12
8	11	10	5-10	11
9	11	10	5-10	10
10	11	10	5-10	10
11	11	10	5-10	10
12	11	10	5-10	10
13	11	10	5-10	10
14	11	10	5-10	10
15	11	10	5-10	10
16	11	10	5-10	10
17	14	12	20	10
18	14	13	20	12
19	14	13.5	20	13
20	14	14	20	13.5
21	14.5	14.5	20	14
22	15	15	20	14.5
23	15.5	15.5	20	15
24	16	16	20	15.5
25	16	16	20	16

Isolation of the house is vitally important to reduce the possibility of introducing a disease organism into a clean house environment. People traffic constitutes the largest threat to isolation and introduction of disease causing agents. Ideally, shower facilities and farm clothing are available for all employees and necessary visitors. If this is not possible, visitors should be limited to those that are necessary and they should be required to wear clean coveralls, new plastic or cleaned rubber boots, and hair covering. Disinfectant footbaths should be present at the entranceway to each house and should be replenished with fresh disinfectant daily. Doors should be kept locked at all times to prevent unwanted, improperly attired visitors from entering. "No Trespassing" signs should be prominently displayed on the doors and "Bio-security Zone" signs should be displayed at the farm entrance to warn visitors that they are entering a bio- secure area. Remembering that people spread many diseases from farm to farm will help to encourage less people traffic to and from farms.

Sanitation should begin with removal of all organic matter from the previous flock. Organic matter includes live and dead chickens, rodents, manure, feathers, etc. Growing birds on built-up litter is not recommended at any time. Dry cleaning should be done as soon as possible after the old flock is removed. Down time is very beneficial in allowing pathogens to die naturally. The dry cleaning should include the walls, rafters, ceiling, feed bins and other feed equipment, fans, vents, watering system, cages, etc. After dry cleaning has been completed, all surfaces should be washed with high-pressure washing and an approved surfactant containing detergent. Following this wash down, apply a sanitizing agent approved for use in poultry houses. The sanitizing agent chosen should be broad spectrum in its activity and used according to manufacturer's directions. If allowed, fumigation of the house using an approved fumigant can also be used after returning all equipment to the house. Any equipment removed should be cleaned and disinfected prior to replacement.

Prior to chick arrival

1. All equipment, including cages, brooders, interior surfaces of the building, and any other equipment used should be thoroughly cleaned and disinfected.
2. All mechanical equipment, feeders, fans, curtains, etc. should be tested and brought into good working condition.
3. Rodent control programs should be strictly enforced when the house is cleaned and empty. The use of baits, tracking powders, and any other control method available should be implemented.
4. Feed from previous flock should be removed and the feed bins, troughs, hoppers, and chains or augers cleaned and dried before the delivery of new feed.
5. Raise the house temperature to 29-32 °C (85-90 °F) at least 24 hours prior to chick arrival to ensure the equipment is also warm. The desired relative humidity should be greater than 60%. This humidity level should be maintained for at least three weeks.
6. Set light clocks to 23 hours day length with a light intensity as high as possible. If shadows are being cast onto any drinkers/nipples, the use of droplights is suggested to eliminate these shadows.
7. Trigger nipples to ensure that they are in working order and set at the proper height. Nipples should be at the chick's eye level and bell drinkers should be on the floor. Supplemental drinkers should be used in floor brooding and removed slowly once the chicks are established and are clearly using the main drinking system.

Recommendation for Vitamin Treatments

Age	Vitamin	Method
4-6. Day	A-, D_3-, E- and B-vitamin complex	Drinking Water
4. Week	A-, D_3-, E- and B-vitamin complex	Drinking Water
7. Week (after selection)	A-, D_3-, E- and B-vitamin complex	Drinking Water
12. Week	A-, D_3-, E- and B-vitamin complex	Drinking Water
19. Week (after housing)	A-, D_3-, E- and B-vitamin complex	Drinking Water
In every 4-6 weeks during laying period	A-, D_3-, E- and B-vitamin complex	Drinking Water

For different location a different vitamin treatment and vaccination program has to be designed considering the maternal immunities, local disease exposures, available vaccines and local veterinarian regulations.

TETRA Hybrids has been bred to produce an extremely high number of eggs. Egg production, however, is a character, which has relatively low heritability. This means that environmental factors such as health, nutrition, lighting and temperature have a large effect upon the number of eggs actually produced.

Egg output is influenced by both dietary energy and protein. Increasing the protein concentration of the ration, and ensuring that amino acids are correctly balanced, will minimize, but not prevent, reductions in rate of lay when high temperatures cause a drop in feed intake.

Egg output is the product of egg numbers and egg weight, and has a curvilinear relationship with nutrient intake, in particular the daily intake of protein. For each additional increment of protein the bird progressively produces more egg output, until an optimum protein intake is reached, at which point egg output plateaus. Conversely for each incremental reduction in protein intake the bird will produce progressively less egg output. Initially when the supply of protein is limiting TETRA Hybrids will respond by reducing egg numbers and egg weight equally, but when protein intake is more than 10% below optimum the major response will be a reduction in rate of lay. The response to changes in nutrient intake will be the same whatever the cause. Factors, which affect nutrient intake, include disease, nutrient concentrations in the ration, feed palatability, temperature, day length, light intensity and age at first egg.

TETRA-SL LL will reduce its daily intake of energy by 15-20 kJ (3.6-4.8 kcals) for each 1°C (1.8°F) rise in ambient temperature between 20 and 26°C (68 - 79°F). Above 26°C (79°F) the bird changes to a predominantly evaporative type of cooling and the rate of reduction in energy intake progressively increases to around 50 kJ (12 kcals) per 1°C (1.8°F) rise. Each gram of egg requires 28 kJ (6.7 kcals) of energy, therefore, reductions in energy availability for egg production will result in lower rates of lay. Increasing the energy concentration of the ration will not increase daily energy intake; instead it will reduce daily feed intake and depress egg production by limiting further the bird's intake of protein.

The following chart shows the combined effects of age at first egg (50% rate of lay) and daylength in the laying period on number of eggs produced to 72 weeks of age.

Light (hours)	Age at 50% rate of lay (days)		
	140	144	148
8	309	305	301
10	315	311	307
12	321	317	313
14	327	323	319
16	333	329	325

TETRA-SL LL increases it's egg numbers by about 3 eggs for each one hour increase in daylength. It must be remembered, however, that longer daylengths also result in larger feed intakes; daily feed intake will increase by approximately 1.5 grams for each extra hour of light per day. Advances in sexual maturity will increase egg numbers by about 3-4 eggs to 72 weeks of age for every 10-day younger age at first egg. Earlier sexual maturity, achieved through modifications of the lighting program, also increases daily feed intake and reduces average egg weight. It is, therefore, very important that a full analysis of feed costs and egg prices is performed before a decision is made regarding the lighting schedule.

TETRA-SL LL RATE OF LAY (STANDARD MATURITY)

Age	Egg Production (Hen-Housed)			Egg Production (Hen-Day)		
Weeks	H.H. (%)	Weekly	Cum.	H.D. (%)	Weekly	Cum.
19	10.0	0.70	0.7	10.0	0.70	0.7
20	34.9	2.44	3.1	35.0	2.45	3.1
21	59.9	4.19	7.3	60.1	4.21	7.4
22	79.8	5.59	12.9	80.2	5.62	13.0
23	89.8	6.29	19.2	90.4	6.33	19.3
24	92.8	6.50	25.7	93.6	6.55	25.9
25	93.8	6.57	32.3	94.7	6.63	32.5
26	94.3	6.60	38.9	95.3	6.67	39.2
27	95.3	6.67	45.5	96.5	6.75	45.9
28	95.0	6.65	52.2	96.3	6.74	52.6
29	94.7	6.63	58.8	96.1	6.73	59.4
30	94.4	6.61	65.4	95.9	6.71	66.1
31	94.1	6.59	72.0	95.7	6.70	72.8
32	93.8	6.57	78.6	95.5	6.68	79.5
33	93.5	6.55	85.1	95.2	6.67	86.1
34	93.2	6.52	91.7	95.0	6.65	92.8
35	92.9	6.50	98.2	94.8	6.63	99.4
36	92.6	6.48	104.6	94.5	6.62	106.0
37	92.3	6.46	111.1	94.3	6.60	112.6
38	92.0	6.44	117.5	94.1	6.58	119.2
39	91.7	6.42	124.0	93.8	6.57	125.8
40	91.4	6.40	130.4	93.6	6.55	132.3
41	91.0	6.37	136.7	93.2	6.53	138.9
42	90.6	6.34	143.1	92.9	6.50	145.4
43	90.2	6.31	149.4	92.5	6.48	151.8
44	89.8	6.29	155.7	92.2	6.45	158.3
45	89.4	6.26	161.9	91.9	6.43	164.7
46	89.0	6.23	168.2	91.5	6.41	171.1
47	88.6	6.20	174.4	91.2	6.38	177.5
48	88.2	6.17	180.5	90.8	6.36	183.9
49	87.8	6.15	186.7	90.5	6.33	190.2
50	87.4	6.12	192.8	90.1	6.31	196.5
51	87.0	6.09	198.9	89.8	6.28	202.8
52	86.6	6.06	204.9	89.4	6.26	209.0
53	86.2	6.03	211.0	89.1	6.24	215.3
54	85.8	6.01	217.0	88.7	6.21	221.5
55	85.4	5.98	223.0	88.4	6.19	227.7
56	85.0	5.95	228.9	88.0	6.16	233.8
57	84.6	5.92	234.8	87.7	6.14	240.0
58	84.2	5.89	240.7	87.3	6.11	246.1
59	83.8	5.87	246.6	87.0	6.09	252.2
60	83.4	5.84	252.4	86.7	6.07	258.3
61	82.9	5.80	258.2	86.3	6.04	264.3
62	82.4	5.77	264.0	85.8	6.01	270.3
63	81.9	5.73	269.7	85.4	5.98	276.3
64	81.4	5.70	275.4	85.0	5.95	282.2
65	80.9	5.66	281.1	84.6	5.92	288.1
66	80.4	5.63	286.7	84.1	5.89	294.0
67	79.9	5.59	292.3	83.7	5.86	299.9
68	79.4	5.56	297.9	83.3	5.83	305.7
69	78.9	5.52	303.4	82.9	5.80	311.5
70	78.4	5.49	308.9	82.4	5.77	317.3
71	77.9	5.45	314.3	82.0	5.74	323.0
72	77.4	5.42	319.8	81.6	5.71	328.7
73	76.9	5.38	325.1	81.1	5.68	334.4
74	76.4	5.35	330.5	80.7	5.65	340.1
75	75.9	5.31	335.8	80.3	5.62	345.7
76	75.4	5.28	341.1	79.8	5.59	351.3
77	74.8	5.24	346.3	79.3	5.55	356.8
78	74.2	5.19	351.5	78.7	5.51	362.3
79	73.6	5.15	356.7	78.2	5.47	367.8
80	73.0	5.11	361.8	77.6	5.44	373.2
81	72.3	5.06	366.8	77.0	5.39	378.6
82	71.6	5.01	371.8	76.3	5.34	384.0
83	70.9	4.96	376.8	75.7	5.30	389.3
84	70.2	4.91	381.7	75.0	5.25	394.5
85	69.4	4.86	386.6	74.2	5.20	399.7
86	68.6	4.80	391.4	73.5	5.14	404.9
87	67.8	4.75	396.1	72.7	5.09	410.0
88	67.0	4.69	400.8	71.9	5.04	415.0
89	66.2	4.63	405.5	71.2	4.98	420.0
90	65.4	4.58	410.0	70.4	4.93	424.9

HARCO
RATE OF LAY
(STANDARD MATURITY)

Age Weeks	Egg Production (Hen-Housed)			Egg Production (Hen-Day)		
	H.H. (%)	Weekly	Cum.	H.D. (%)	Weekly	Cum.
19	1.0	0.07	0.1	1.0	0.07	0.1
20	13.0	0.91	1.0	13.0	0.91	1.0
21	39.0	2.73	3.7	39.1	2.74	3.7
22	65.0	4.55	8.3	65.3	4.57	8.3
23	85.0	5.95	14.2	85.6	5.99	14.3
24	92.0	6.44	20.7	92.8	6.50	20.8
25	94.0	6.58	27.2	94.9	6.64	27.4
26	94.0	6.58	33.8	95.0	6.65	34.1
27	94.5	6.62	40.4	95.6	6.69	40.8
28	93.5	6.55	47.0	94.8	6.64	47.4
29	93.2	6.52	53.5	94.6	6.62	54.0
30	92.8	6.50	60.0	94.3	6.60	60.6
31	92.4	6.47	66.5	94.0	6.58	67.2
32	92.0	6.44	72.9	93.6	6.55	73.8
33	91.6	6.41	79.3	93.3	6.53	80.3
34	91.2	6.38	85.7	93.0	6.51	86.8
35	90.8	6.36	92.1	92.6	6.48	93.3
36	90.4	6.33	98.4	92.3	6.46	99.7
37	90.0	6.30	104.7	91.9	6.43	106.2
38	89.9	6.29	111.0	91.9	6.43	112.6
39	89.3	6.25	117.2	91.4	6.40	119.0
40	88.6	6.20	123.4	90.7	6.35	125.3
41	88.0	6.16	129.6	90.2	6.31	131.7
42	87.3	6.11	135.7	89.5	6.27	137.9
43	86.7	6.07	141.8	89.0	6.23	144.2
44	86.1	6.03	147.8	88.4	6.19	150.3
45	85.4	5.98	153.8	87.7	6.14	156.5
46	84.8	5.94	159.7	87.2	6.10	162.6
47	84.1	5.89	165.6	86.5	6.06	168.6
48	83.5	5.85	171.4	86.0	6.02	174.7
49	82.9	5.80	177.2	85.4	5.98	180.6
50	82.2	5.75	183.0	84.8	5.94	186.6
51	81.6	5.71	188.7	84.2	5.89	192.5
52	80.9	5.66	194.4	83.5	5.85	198.3
53	80.3	5.62	200.0	83.0	5.81	204.1
54	79.7	5.58	205.6	82.4	5.77	209.9
55	79.0	5.53	211.1	81.8	5.73	215.6
56	78.4	5.49	216.6	81.2	5.68	221.3
57	77.7	5.44	222.0	80.5	5.64	226.9
58	77.1	5.40	227.4	80.0	5.60	232.5
59	76.5	5.36	232.8	79.4	5.56	238.1
60	75.8	5.31	238.1	78.8	5.52	243.6
61	75.2	5.26	243.3	78.2	5.47	249.1
62	74.5	5.22	248.6	77.6	5.43	254.5
63	73.9	5.17	253.7	77.1	5.40	259.9
64	73.3	5.13	258.9	76.5	5.36	265.3
65	72.6	5.08	263.9	75.9	5.31	270.6
66	72.0	5.04	269.0	75.3	5.27	275.9
67	71.3	4.99	274.0	74.7	5.23	281.1
68	70.7	4.95	278.9	74.2	5.19	286.3
69	70.1	4.91	283.8	73.6	5.15	291.4
70	69.4	4.86	288.7	73.0	5.11	296.5
71	68.8	4.82	293.5	72.4	5.07	301.6
72	68.1	4.77	298.3	71.8	5.03	306.6
73	67.5	4.73	303.0	71.2	4.98	311.6
74	66.9	4.68	307.7	70.7	4.95	316.6
75	66.2	4.63	312.3	70.0	4.90	321.5
76	65.6	4.59	316.9	69.4	4.86	326.3
77	64.9	4.54	321.5	68.8	4.82	331.1
78	64.3	4.50	326.0	68.2	4.77	335.9
79	63.7	4.46	330.4	67.7	4.74	340.7
80	63.0	4.41	334.8	67.0	4.69	345.3

BLANCA
RATE OF LAY
(STANDARD MATURITY)

Age Weeks	Egg Production (Hen-Housed)			Egg Production (Hen-Day)		
	H.H. (%)	Weekly	Cum.	H.D. (%)	Weekly	Cum.
19	12.4	0.87	0.9	12.4	0.87	0.9
20	30.0	2.10	3.0	30.1	2.11	3.0
21	61.4	4.30	7.3	61.6	4.31	7.3
22	80.5	5.64	12.9	81.0	5.67	13.0
23	89.0	6.23	19.1	89.7	6.28	19.2
24	92.2	6.45	25.6	93.1	6.52	25.8
25	93.6	6.55	32.1	94.6	6.62	32.4
26	94.6	6.62	38.8	95.7	6.70	39.1
27	95.0	6.65	45.4	96.3	6.74	45.8
28	94.6	6.62	52.0	96.0	6.72	52.5
29	94.3	6.60	58.6	95.8	6.71	59.2
30	94.0	6.58	65.2	95.6	6.69	65.9
31	93.7	6.56	71.8	95.4	6.68	72.6
32	93.4	6.54	78.3	95.2	6.66	79.3
33	93.0	6.51	84.8	94.9	6.64	85.9
34	92.5	6.48	91.3	94.5	6.62	92.5
35	92.0	6.44	97.7	94.0	6.58	99.1
36	91.5	6.41	104.1	93.6	6.55	105.7
37	91.0	6.37	110.5	93.2	6.52	112.2
38	90.5	6.34	116.8	92.7	6.49	118.7
39	90.0	6.30	123.1	92.3	6.46	125.1
40	89.5	6.27	129.4	91.8	6.43	131.6
41	89.0	6.23	135.6	91.4	6.40	138.0
42	88.5	6.20	141.8	91.0	6.37	144.3
43	88.0	6.16	148.0	90.5	6.34	150.7
44	87.5	6.13	154.1	90.1	6.31	157.0
45	87.0	6.09	160.2	89.6	6.27	163.2
46	86.4	6.05	166.3	89.1	6.24	169.5
47	85.9	6.01	172.3	88.6	6.20	175.7
48	85.4	5.98	178.2	88.2	6.17	181.9
49	84.9	5.94	184.2	87.7	6.14	188.0
50	84.3	5.90	190.1	87.2	6.10	194.1
51	83.8	5.87	196.0	86.7	6.07	200.2
52	83.3	5.83	201.8	86.3	6.04	206.2
53	82.8	5.80	207.6	85.9	6.01	212.2
54	82.2	5.75	213.3	85.3	5.97	218.2
55	81.7	5.72	219.1	84.8	5.94	224.1
56	81.2	5.68	224.7	84.4	5.91	230.0
57	80.7	5.65	230.4	83.9	5.87	235.9
58	80.1	5.61	236.0	83.4	5.84	241.8
59	79.6	5.57	241.6	82.9	5.80	247.6
60	79.1	5.54	247.1	82.5	5.78	253.3
61	78.6	5.50	252.6	82.1	5.75	259.1
62	78.0	5.46	258.1	81.6	5.71	264.8
63	77.5	5.43	263.5	81.2	5.68	270.5
64	77.0	5.39	268.9	80.7	5.65	276.1
65	76.5	5.36	274.2	80.3	5.62	281.7
66	76.0	5.32	279.6	79.9	5.59	287.3
67	75.5	5.29	284.8	79.5	5.57	292.9
68	75.0	5.25	290.1	79.1	5.54	298.4
69	74.5	5.22	295.3	78.6	5.50	303.9
70	74.0	5.18	300.5	78.2	5.47	309.4
71	73.4	5.14	305.6	77.7	5.44	314.9
72	72.8	5.10	310.7	77.1	5.40	320.3
73	72.2	5.05	315.8	76.6	5.36	325.6
74	71.6	5.01	320.8	76.1	5.33	330.9
75	71.0	4.97	325.8	75.5	5.29	336.2
76	70.4	4.93	330.7	75.0	5.25	341.5
77	69.8	4.89	335.6	74.4	5.21	346.7
78	69.2	4.84	340.4	73.9	5.17	351.9
79	68.6	4.80	345.2	73.3	5.13	357.0
80	68.0	4.76	350.0	72.8	5.10	362.1

As a result of many generations of selective breeding TETRA-SL LL possesses excellent egg weight characteristics. However, the demands of egg markets worldwide are both varied and changeable. This means that the modern laying hen must be adaptable and responsive to management manipulations designed to change it's primary egg weight characteristics. TETRA Hybrids is extremely versatile, and well able to respond to the various lighting and nutritional treatments used to change egg weight.

The single most influential factor, which can change egg weight, is age at sexual maturity; delays in maturity increase egg weight and advances in maturity reduce egg weight. However, it is important to note that egg weight is only affected when changes in sexual maturity are effected by alterations to the lighting program (see Lighting section, page 14). Maturity, which is retarded by controlling feed intake, will not improve egg weight. This is because it is the larger body weight, and not older age, of sexually delayed birds, which increases egg weight. Therefore control of nutrient intake during the rearing period cannot affect egg weight, because there is no increase in body weight at first egg. Average egg weight over the laying year is increased by about 1.4 grams for each 10 day delay in age at first egg, and correspondingly decreased by about 1.4 grams for each 10 day advance in maturity. When lighting programs are used to alter sexual maturity it is most important that the flock is fed ad libitum, because birds brought into lay at an early age require nutrients to develop the ovary and oviduct at a younger age, and birds held back, to increase egg weight, must start lay at a heavier body weight (see Body Weight Guide, page 11). Often birds will take about two weeks to settle into production, and during this period they will lay eggs slightly smaller than birds already in lay - this is perfectly normal.

Once in lay the number of hours of light each day will also influence egg weight. There will be an increase of about 0.1 grams in average egg weight for each extra one hour of light per day, but this will be linked to a 1.5 grams per day increase in feed intake.

The following chart shows the combined effects of age at first egg (50% rate of lay) and daylength in the laying period on average egg weight to 72 weeks of age.

Light (hours)	Age at 50% rate of lay (days)		
	140	144	148
8	60.9	62.3	63.8
10	61.1	62.5	63.9
12	61.3	62.8	64.2
14	61.6	63.0	64.4
16	61.9	63.3	64.7

Egg weight changes can be effected by modifications of the layer ration. Maximum daily egg output will require the bird to consume about 1000 mg total Lysine and 500 mg total Methionine per day, but such intakes of amino acids are unlikely to be economic, due to the law of diminishing returns. Practical intakes to obtain the most economic egg weight will be about 950 mg total Lysine and 450 mg total Methionine per day. Linoleic Acid intake is also important for maximizing egg weight, but again it is unlikely that the amounts necessary to give the best response biologically are economically justified. A minimum inclusion rate of 1.3% is recommended for satisfactory egg weight (see Nutrition section, page 12).

When egg prices and raw materials costs suggest that a reduction in protein is economically desirable, reductions in egg numbers are likely to be greater than reductions in egg weight, especially when the resulting amino acid intake falls below 90% of that necessary for maximum egg output.

EGG WEIGHT AND SIZES (STANDARD MATURITY)

Age (weeks)	Average Egg Weight (g)		
	Tera-SL LL	Harco	Blanca
19	45.4	44.0	45.5
20	48.9	47.1	47.0
21	51.7	49.7	48.6
22	54.3	52.1	50.8
23	56.3	53.9	52.6
24	57.5	55.3	54.1
25	58.6	56.5	55.1
26	59.4	57.5	56.1
27	60.0	58.3	56.7
28	60.4	59.0	57.5
29	60.9	59.6	58.1
30	61.4	60.1	58.7
31	61.7	60.5	59.0
32	62.0	60.9	59.4
33	62.2	61.3	59.7
34	62.5	61.7	60.1
35	62.6	62.0	60.4
36	62.8	62.3	60.7
37	62.9	62.6	61.0
38	63.1	62.9	61.3
40	63.3	63.4	61.6
42	63.5	63.8	62.0
44	63.6	64.2	62.2
46	63.7	64.6	62.3
48	63.9	64.9	62.5
52	64.1	65.4	62.8
56	64.4	66.0	63.2
60	64.6	66.3	63.4
64	64.7	66.6	63.7
68	65.0	66.7	63.9
72	65.2	66.9	64.3
76	65.3	66.9	64.7
80	65.5	67.1	65.1
84	65.7		
87	65.8		
90	65.9		

Egg Weight (g)	Egg Sizes (% of all Eggs)			
	XL - Extra Large >73g	L - Large 63-73g	M - Medium 53 - 63 g	S - Small <53 g
45.0	-	0.0	0,6	99,4
46,0	-	0.0	1,5	98,5
47,0	0.0	0,0	3,4	96,6
48,0	0.0	0,0	6,8	93,2
49,0	0.0	0,0	12,2	87,8
50,0	0,0	0,0	19,6	80,4
51,0	0,0	0,0	28,7	71,2
52,0	0,0	0,0	39,1	60,8
53,0	0,0	0,4	49,6	50,0
54,0	0,0	0,9	59,6	39,6
55,0	0,0	1,9	67,9	30,2
56,0	0,0	3,7	74,1	22,2
57,0	0.0	6,6	77,6	15,8
58,0	0,0	10,6	78,2	10,9
59,0	0,0	16,6	76,0	7,3
60,0	0,1	23,7	71,5	4,8
60,5	0,2	27,6	68,4	3,8
61,0	0,2	31,7	65,0	3,0
61,5	0,4	36,0	61,2	2,4
62,0	0,6	40,3	57,2	1,9
62,5	0,8	44,6	53,1	1,5
63,0	1,2	48,8	48,8	1,2
63,5	1,6	52,8	44,6	0.9
64,0	2,2	56,6	40,5	0,7
64,5	3,0	60,0	36,4	0,5
65,0	3,9	63,1	32,6	0,4
65,5	5,1	65,6	29,0	0,3
66,0	6,5	67,7	25,6	0,2
66,5	8,1	69,3	22,4	0,2
67,0	10,0	70,3	19,5	0,1
67.5	12,2	70,7	16,9	0,1
68,0	14,7	70,6	14,6	0,1

TETRA Hybrids have undergone rigorous selection for improvement in all internal and egg shell quality traits. However, egg quality is very complex and much research is still required to fully understand the biological mechanisms involved to egg formation. Many factors are known to affect shell quality in addition to the genetic make-up of the bird; age of bird, position of egg within the sequence, egg weight, bird behaviour, lighting regime, nutrition, disease, drugs, temperature, housing/egg collection system and feeding patterns.

The egg shell is not a uniform layer of calcium carbonate, but a complex multilayer structure. Defects on the shell surface can be the result of a poorly formed mamillary layer, this is the layer of cones which form the foundation of the shell structure, and / or an unsatisfactorily constructed palisade layer.

Calcium is the main mineral involved in shell deposition, but other nutrients play part too. These include Chlorine, Sodium, Potassium, Phosphorus, Vitamin D, Manganese, Magnesium, Fluorine and Zeolite A (a sodium alumino silicate compound). It is important to have the right balance of minerals as well as the correct absolute quantities. The Calcium:Phosphorus ratio, for example, needs to be widened as the flock ages, however, if too wide there may be adverse effects on rate of lay. Calcium particle size affects transit time in the gut, and absorption into the blood stream. Ideally at least half of the calcium carbonate in the ration should have a large particle size.

In the 15-20 days before an individual hen lays its first egg medullar bone will be deposited in the long bones of the skeleton. Medullar bone comes partly from the ration and partly from trabecular bone, and is the source of calcium for shell formation. It is vital therefore that the ration fed to the birds during the period approaching sexual maturity that calcium levels in the ration are increased (see Nutritional Recommendations, page 12).

Poor shell quality may be improved by modifications of the lighting regime. Ephemeral lighting programs (e.g. 28 hour light-dark cycles), and repeating short cycles (e.g. a repeating 3-hour light, 3-hour darkness cycle) will increase shell weight and thickness. It is possible to interchange between these types of non-24 hour lighting and conventional lighting without any problems. However, when ephemeral and short cycle repeating patterns are used in the first half of the laying period there will be a reduction in rate of lay, but a compensatory increase in egg weight.

Recent research has indicated that long daylengths may be detrimental to shell quality. Shell weight appears to decrease with increasing daylengths, and when combined with the larger egg weight observed under long photoperiods, reduces shell thickness. Long photoperiods also increase the incidence of bodychecked eggs. These are caused by contractions of the uterus (shell gland), when the shell of the egg is fragile, cracking the shell round the equator. Calcification then takes place on top of the cracks to form the typical equatorial bulge. Manipulations of the lighting program to minimize activity at the end of the light period will help alleviate this problem.

Shell quality will be reduced by high ambient temperatures, especially over 32°C (90°F) and high relative humidity. Any attempt to maximize nutrient intake will help to minimize the decline in quality; however, the problem is not only caused by low calcium intakes. A reduction in blood flow to the uterus caused by vasodilatation and a decrease in bicarbonate availability due to respiratory alkalosis will aggravate the problem.

In the open house system of poultry keeping practised in tropical climates it is not possible for the TETRA Hybrids to express its genetic potential fully. However, there are various modifications to the management recommendations for controlled environment conditions, which will minimize the loss of performance.

The two main problems encountered when keeping birds at high temperatures are the difficulties of getting enough nutrients into the bird and the change in method of heat loss used by the bird to maintain its body temperature after panting begins at about 28°C (82°F). Laying hens reduce their intake of energy as ambient temperatures rise because of the lower demand for heat production at higher temperatures. The difficulty for the egg producer is that voluntary energy intake falls curvilinearly whilst heat production falls linearly, resulting in less energy being available for egg production at high temperatures, particularly above 28°C (82°F).

°C	BROWN		WHITE		Egg energy (kJ/d)
	ME intake (kJ/d)	Heat loss (kJ/d)	ME intake (kJ/d)	Heat loss (kJ/d)	
20	1260	953	1145	838	307
22	1232	915	1120	803	317
24	1198	876	1089	767	322
26	1156	838	1051	733	318
28	1105	800	1005	700	305
30	1043	761	948	666	282
32	968	723	880	635	245
34	879	685	799	605	194
36	774	647	704	542	162

The table clearly illustrates the peak availability of energy for egg production at 24°C (75°F), and the decline in energy available for egg production after about 28°C (82°F).

There are two approaches to minimizing performance losses, (a) reducing the temperature of the bird's microclimate, and (b) maximizing nutrient intake. The first method ideally requires consideration before the poultry unit is built, as house design is involved. However, existing units can be modified to reduce the effects of solar radiation. Obviously with open housing little can be done to reduce air temperature within the house. The second approach is probably the easier to implement, as alterations to ration specification and lighting schedules are already part of normal stock management.

Housing

1. Use roofing materials, which have good insulation properties and reflect solar radiation. Natural materials like palm thatch usefully reduce penetration of solar heat. Where metal roofs are unavoidable they can be painted with a solar reflective product, or be fitted with a sprinkler along the ridge to reduce the heat radiated through to the house interior. Where water is at hand premium sprinkler systems can incorporate a recycling pump.

2. Roof overhangs should be long enough to prevent direct sunlight falling on the birds, at least in the hottest part of the day. Ridge outlets should be fitted to permit bird heat to escape, ideally these should open away from the sun. Roofs should be as high as possible to minimize the temperature at bird level and maximize the natural airflow to the ridge.

3. Mount fans vertically to create horizontal air movement at bird's level (Safety guards must be fitted). At air speeds of 2m/sec direct heat is doubled (plumage will be ruffled at this speed). This type of cooling must not be used when ambient temperature exceed 40°C (104°F).

4. Fogging the inside of the house with fine water droplets will reduce the air temperature and moisten the fleshy parts of the bird's head, so improving heat loss. Nozzle size should be small enough to ensure that the water droplet size is not too big; nozzles working at 140 kPa (20 Ibs/in) will use 3.4 litres (0.75 gallons) per hour and produce a smoke-like mist.

5. Vegetation and trees may be planted around the buildings to provide shade and reduce the amount of sunlight reflected from the ground. Care must be taken not to restrict the natural airflow into the house.

Bird management

1. Radiative heat transfer between birds will be reduced by providing the birds with more space. Stocking rates should be reduced by 2% for each 1°C (2°F) rise in temperature above 20°C (68°F).

2. Natural daylengths in tropical areas vary seasonally from 11-13 hours. An extension of the daylength into the cooler part of the day with artificial lighting will have two beneficial effects upon feed consumption. Firstly, feed intake is positively related to daylength, and secondly it is negatively correlated with temperature. It is, however, undesirable to have daylengths longer than 17 or 18 hours. If the provision of extra light is started before the birds start egg production, the increase in daylength will act as a stimulator of sexual maturity. The timing of this light increase should be carefully considered as early maturity will reduce egg weight, and reduced egg weight will already be anticipated because of high temperatures and low energy intakes.

Nutrition

1. Use any management technique, which stimulates feed intake; for example frequent feed deliveries. Avoid stale or unpalatable feed.

2. One of the major nutrients for consideration is water. Restrictions on water intake, whether caused by physical means, insufficient drinkers, high water temperature or poor quality, will adversely affect feed intake. This will obviously result in a reduction in all other nutrients. Water requirements increase curvilinearly with temperature (see table for an adult layer).

Air temp °C/°F	BROWN		WHITE	
	Water intake (ml/bird/day)	Water to energy ratio (ml/MJ)	Water intake (ml/bird/day)	Water to energy ratio (ml/MJ)
20/68	210	165	180	165
25/77	250	210	220	210
30/86	320	305	280	305
35/95	420	505	365	505
40/104	535	1050	465	1050

Obviously any factor, which restricts water intake, should be avoided. Water-cooling may be considered if feasible.

3. While temperatures are below 28°C (82°F) the concentration of metabolizable energy in the feed may be increased in proportion to the decline in feed intake. Beyond 28°C (82°F) energy levels in the ration should be reduced to encourage feed intake and facilitate inclusion of protein.

4. Protein requirements for egg production may be regarded as being independent of temperature. Rations should therefore be formulated to provide the amino acid intake required for the egg output potential made possible by the energy intake/heat production surplus (1 gram of egg requires 6.69 kJ energy).

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