

Layers

The Care and Feeding of a Successful Layer Operation



Layers

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Better Nutrition Means a Better Bottom Line

Whether you are a large commercial producer or have a small operation, your birds' nutrition is important to you. Overall health is determined in large part by meeting any animal's nutritional needs.

To be successful in the layer business, you have to remain updated on changes in nutrition and management. To help in these areas, your feed supplier has joined with other manufacturers in establishing Cooperative Research Farms (CRF) so that you may benefit from its worldwide feed research.

In its 50-plus years, CRF has conducted nearly 200 experiments with layers and layer breeders. Nutritional areas have included protein/amino acids, vitamins/minerals, energy, feeding programs, enzymes, ingredient evaluations, and the influence of breeder nutrition on progeny performance. Strain cross information has generally been included in most of the experiments. Medications, equipment evaluations, problem solving, physical characteristics of feed and birds, and management techniques are some of the other areas researched. There are two (2) basic sides to nutrition. One is the nutrient needs of the birds by age, health status and life cycle stage. The other side is the nutrient content of the diet (ingredients), which are digested and utilized by the bird.

CRF has used internal, member-owned research facilities as well as university and private research facilities. Battery cages, and modern layer production houses have been used to conduct experiments. Today, CRF's layer research is conducted in a scientifically advanced research operation in Quebec, owned by CRF member La Coop Federee.

Our ingredient and feed evaluations have progressed simultaneously with management and feeding programs. The result is a wealth of information that has been incorporated into this manual, designed to provide practical answers on nutrition, housing and modern layer management.

As a member of CRF, your feed provider has invested in the scientific research behind the feeds they sell. Behind every feed tag, you'll find solid science — technological and operational breakthroughs you'll get nowhere else.



Laying Hen Nutrition

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Needs of the birds

Poultry nutrition involves a large amount of time to conduct ingredient evaluations. This consists of both updating known ingredients and evaluating new ingredients or new forms of old ingredients. These ingredients are used to match the needs of the birds being fed. As knowledge advances, we know more of the life cycle needs for growth, reproduction, regeneration and the abilities of the diet to maintain a healthy bird in the presence of stress and health challenges.

Water

Water is the most important nutrient you supply your birds, and it is consumed in greater quantities than any other nutrient. Birds will die more quickly from lack of water than with a lack of any of the other nutrients. Additionally, water has the ability to be a carrier for a large number of substances. The ability of water to hold materials in suspension is of vital importance.

Birds should have free and convenient access to water. The amount of water required varies with age, health and the reproductive status of your birds. Consider also ambient temperature and type of feed. Watch for diarrhea or high urinary output, which may be due to high protein or salts intake. A reliable estimate of water needed is twice the amount of diet consumed. Therefore, a bird consuming a quarter-pound of feed per day would need a half-pound of water. A gallon of water weighs slightly more than eight pounds.

Water requirements also vary with water quality. Water treatment facilities are a vital part of our communities. However, much of agriculture does not have municipal water available for animal production. Without the existence of an agency as an oversight of water quality, it becomes an individual responsibility to see that birds and animals have clean, potable water.

Poor quality drinking water is often responsible for less-than-optimum performance. Have your water analyzed at least once a year. Spring is an excellent time for this annual appraisal, as runoff from rains may alter water quality. A change in the level of your water table can result in a change in water quality.

A livestock suitability water analysis is an economical management tool. Shown in the next column are elements analyzed for the livestock water analyses.

These are not all the elements you will find in water and not all the minerals, which can give birds problems. These are the more common ones, which can be of concern.

The analysis and interpretation provided here is by A & L Agriculture Laboratories.

Elemental Analyses (ppm)

Rating	NO3 Nitrate	Mg Magnesium	Ca Calcium	SO4 Sulfate	Na Sodium	Cl Chloride
No problem	0-45	30	50	75	30	0-70
Chance of problem	45-100	0-60	50-80	75-150	30-50	70-150
Likely problem	100-200	60-90	80-100	150-300	50-150	150-30
Avoid	>200	>90	>200	>300	>150	>300

When minerals are dissolved in water, it becomes able to conduct electricity. By measuring this conductivity, the total amount of dissolved solids can be calculated. This measurement can be expressed in parts per million (ppm) of dissolved solids as a means of measuring water quality.

Effects of Total Dissolved Solids

Content of Water (ppm)	Comment
>500	Not recommended for human consumption
<1000	Should present no serious problem
1000-3000	May cause diarrhea
3000-5000	Will cause diarrhea and temporary refusal
>5000	Unfit for birds

Acidity and alkalinity are measured as pH. Values below 7.0 are acid and values above are alkaline. Most water supplies have a value between 6.5 and 8.0. This range is considered safe and should cause no problems. Acidic water will corrode pipes. Municipal water is usually at pH 8.2. Organic compounds such as chlorinated hydrocarbons, herbicides and pesticides are of concern but not a usual health threat. Chemical analysis for these compounds is expensive.

Purity of water refers to the presence (positive) or absence (negative) of bacteria presumed to be coliform. Water positive for coliforms should not be used as a water source without chemical treatment. Drinking water contaminated with coliform bacteria may cause diarrhea and can lead to serious health problems. The most common sources are runoff from feedlots, seepage from septic systems and faulty plumbing.

Water treatments are available in several kinds depending upon the problem. There are water-softening devices where sodium replaces calcium and magnesium. Chlorinating will destroy bacteria levels. Filtration will remove some organic and mineral particles. De-ionizing resins remove most all minerals from the water but are expensive. Water lines can be sources of lime, slime, rust and algae. They may also have a load of bacteria, fungi and viruses. Effective cleaning and sanitizing agents are vinegar, chlorine, iodine and ammonia.

Sampling water requires some preparation. A clean bottle, sterilized if being checked for purity, is needed. The sample needs to be kept cool and transported to the lab as fast as possible. To ensure you're drawing a representative sample, allow the water run before collecting the sample. For coliform bacteria samples, sterilize the tap with a flame before drawing the water sample. Many laboratories have special water sample bottles, which simplify the process.

Laying Hen Nutrition

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Energy

A constant supply of energy is necessary for all birds to sustain life. Energy for all the birds systems comes from the feed they eat or their body stores. The oxidation of nutrients is the process by which organic matter in the feed is converted to carbon dioxide and water, releasing the energy required to support life.

Fats and Oils

These are the most concentrated sources of energy. On a per-unit of weight basis, they have more than twice the energy which can be derived from a similar amount of carbohydrates (CHO) or protein. The energy is readily available to the bird whether growth or reproduction is the criteria measured. Fats and oils provide an essential fatty acid, linoleic acid. There are some physical properties which provide additional benefits. Because fats are typically applied as liquid there is a reduction in fines and dust. There is also a general palatability improvement with fat additions.

Carbohydrates

Carbohydrates are organic compounds composed of Carbon, Hydrogen, and Oxygen (CHO). As they make up $\frac{3}{4}$ of the dry weight of grains, carbohydrates are a large part of the bird's ration. They serve as a source of heat as well as energy in the bird's body. Finally, they can be transformed into fat, adipose tissue, and stored in the body. The insoluble and indigestible CHO from the structural portion is called fiber. The soluble and digestible CHO portion is labeled nitrogen-free extract (NFE). Glucose is stored in the liver as glycogen, which then regulates the level of glucose in the blood.

Protein (Amino Acids)

Amino acid requirements have been defined for each specie as well as age and function within each specie. Protein nutrition has precise amino acid levels, but the ingredients available don't always fit the precise needs of any bird. It is the level of the limiting amino acid which determines how much the bird will have at its disposal for growth, tissue replacement, feathers, eggs and other amino acid-based needs of the body. Another factor in formulating a ration is that the digestibility of amino acids from any ingredient is not 100 percent. Bear in mind, too, that genetic changes cause a change in amino acid requirements.

Today, the amount of waste and manure production has become regulated by governmental agencies, and therefore rations must be formulated to limit excess protein.

Minerals (Macro & Trace)

Macro-minerals are defined as those inorganic elements required by the bird as a percentage of the diet. Calcium and phosphorus are required for the skeleton. Sodium, potassium, and chloride help maintain the osmotic and pH relationships in the body.

Trace minerals are listed in terms of parts per million (ppm) and function within the body processes. Poultry research has worked out digestibility and interaction data between the inorganic elements. Here again, environmental factors indicate that excretion of excess or indigestible minerals, such as phosphorus, copper, and zinc, can have a negative effect on the environment.

Vitamins

These are organic compounds, which are essential for health, growth and maintenance of the body. While they are needed in minute amounts, they must be supplied in the diet to avoid a deficiency disease or metabolic syndrome. There are a number of substances and conditions, which can interfere with vitamin absorption. Mycotoxins, cocci, and organisms, which cause enteritis, will result in failure of vitamin absorption and therefore a "vitamin deficiency."



Poult Management

The Care and Feeding of a Successful Layer Operation

Management

Management of the laying hen starts with the chick. The quality of the day-old chick is the foundation of a successful layer operation. CRF's research into feeding programs is designed to develop healthy and uniform birds that meet the breeder's body weight requirements. In order for the hen to produce eggs to her genetic capacity, her digestive tract needs to be a fully developed organ.

Chick placement

1. Prior to delivery of chicks, clean and disinfect the premises. Check all equipment to be sure it is working properly and in the correct position for the baby chicks. See that vermin controls are in place, isolated from the chicks.
2. Place feed in the building the day prior to delivery. Set heating to match type of pullet rearing system. Check and adjust water system, which has been properly disinfected and flushed.
3. On delivery day, check that all waterers are full and brooding temperatures are correct. Trigger water cups or nipples as chicks are placed. Feed should be placed on paper in cages or in shallow containers around full feeders. Keep light at high intensity for 22 hours the first two days.

Beak control

Beak trimming is not always necessary. However, with most management systems, it should be a part of the management plan to trim beaks. The most successful procedure is the use of a precision cam-activated trimmer. The proper hole size will provide the width of 2 mm between the nostrils and the cauterizing ring. Remember to use trained crews with healthy birds. The use of electrolytes in the water two days before and two days after beak trimming is recommended.

Lighting programs

Egg production is a function of day length. Know your local sunrise-sunset timetables, and use these basic guidelines:

1. Start chicks at 20-22 hours of light per day at 10 lumens. Reduce day length weekly to reach nine hours at eight weeks of age with an intensity of five lumens after the first week. If birds are exposed to more than nine hours of natural daylight, reduce as much as possible.
2. Provide light stimulation when body weight exceeds 1.4 kgs. (3 + lbs.). Depending upon the strain and the current length of light, a two-hour initial increase in light per day can be followed by 15-30 minute increases either weekly or bi-weekly. A total lighting period of 16 hours should be sufficient. Light intensity should be at 20 lumens.

3. Do not allow a decrease in day length or light intensity during egg production. The timing of light stimulation is dependent upon age, body weight, nutrient intake and a day length of less than 12 hours. Early stimulation of light results in small size eggs, which have little or no market value. Delaying light stimulation will effectively eliminate the peewee eggs. There are a number of lighting plans which can be utilized, such as intermittent lighting and midnight-feeding technique. With the use of natural daylight, custom programs can be adapted to fit the specific location.

Disease control and treatment

Disease elimination is not possible, however disease influence can be minimized. Specific diseases vary between locations, so it is imperative to identify and control those in your area. Biosecurity and eradication are the best way to avoid diseases. Biosecurity includes maintaining strict antiseptic procedures with people, vehicles, equipment, wild birds, animals and the chickens themselves. Some diseases, especially bacterial, are best controlled by eradication.

Diseases which may be transmitted from infected breeder to their progeny are the responsibility of the breeder. Vaccinations can control several, including Newcastle, bronchitis, IBD and AE. A typical program is as follows:

- | | |
|--------------|---|
| • Day one | Marek's Disease, HVT, SB-1 |
| • 18-20 days | IBD intermediate strain in water |
| • 25 days | Newcastle B-1 & bronchitis, mild Mass. in water |
| • 28-30 days | IBD intermediate strain in water |
| • 7-8 weeks | Newcastle B-1 & bronchitis, regular Mass. in water |
| • 10 weeks | Pox wingweb & AE wingweb, water or spray |
| • 14 weeks | Newcastle LaSota & bronchitis, mild Holland spray or Newcastle-bronchitis killed virus injection. |

Body weight schedules

Breeders provide body weight guides for their birds from hatch through two cycles of egg production. These are excellent targets to use in rearing pullets. It is important that pullets are uniform in body weight and have the correct frame to achieve their genetic potential. CRF has done a substantial amount of work establishing the nutritional requirements of different strains of table egg pullets and layers. We have been able to correlate pullet nutrition, which optimizes hens during egg production.

Table 1 shows the expected growth and feed consumption of lightweight leghorn pullets, which will maximize performance in the laying house. Table 2 shows the type of growth which allows those strains laying larger eggs to maximize their subsequent laying performance.

Feeding

Key nutrients

Table 3 provides the current recommendations for feeding pullets. The starter diet is fed from hatch to six weeks of age. More accurately, the starter diet should be fed until pullets attain the breeder guideline weight at six weeks of age. If weather or health conditions do not allow the pullet to equal or exceed the recommended body weight at six weeks of age, continue on the starter diet until the six-week weight is obtained. Then feed the pullets the grower ration. Use the same principle with the grower diet. Feed to 12 weeks of age or until the 12-week guideline is achieved. The developer diet can be fed up to the point where light stimulation is introduced.

While all of the nutrient recommendations are important, the critical value is energy. Energy drives the biological system and is a key balancing nutrient. However, too much energy can lead to fat deposition and lowered performance in egg production. A key advantage with the metabolizable energy (ME) values shown is sufficient level of fiber. Fiber helps the digestive tract to grow. Fiber provides bulk to physically extend the tract and serve as a nutrient source for gut flora. These factors result in the development of an efficient digestive tract.

Vitamin & Mineral Levels

Table 4 lists the vitamin and trace mineral additions which are required for growing pullets.

Table 5 shows protein and energy intakes for three strains of pullets raised to 18 weeks of age. These levels of protein and metabolizable energy allowed these leghorns to maximize their performance during egg laying.



Layers

Body weight schedules

The transition from pullet to layer is typified by a dramatic change in the bird's body. The skeletal frame has been established, and organs have reached their adult size. The onset of comb and waddle growth is an outward sign of the growth of the oviduct. While these changes are taking place, it is also important that the bird stores some abdominal fat as a ready source of energy and nutrients to meet the needs of the egg and oviduct.

Many producers feel a pre-lay or intermediate feed between the pullet developer and the peak lay diet is needed. If pullets are on schedule and lighting is delayed to skip peewee egg production, the need for a pre-lay diet is negligible. However, an intermediate step in calcium (limestone) can help birds from "backing off" feed during hot weather.

Feed program

As the pullet comes into egg production, there still some need to support growth. However, this requirement is small compared to the nutrient needs for egg production. The CRF guidelines for hens are given in Table 3 in terms of egg production. Studies have shown that feeding to egg production will meet the hen's needs in the most efficient manner.

Once egg production has peaked, diet changes can occur monthly or even weekly to match total egg production output. The practice of defining nutrients by feed intake within a level of production can be cost effective when egg size is taken into the equation. It is always a good practice to transition from one diet to another. This reduces the chance of the feed change having a negative effect on feed consumption. As with the pullet diets, ME is the key nutritive value. Within the post-peak and mid-cycle recommendations, energy can be transitioned toward the next diet.

Table 6 shows the body weight guide for the HyLine W-36 during the first lay cycle. Also provided are some actual body weights, feed intakes, egg production values and egg weights. The values for egg production are hen day values collected during the four weeks prior to the age listed. The feed intake is the daily average for those four weeks, while the egg weights are those recorded at that age date.

Table 7 shows the body weight guide and obtained values with the Bovan White hen. The W-36 and the Bovan are comparable in body weight and egg weights. Table 8 lists the HyLine W-98 body weight guidelines and obtained performance.

Interactions

Management / Nutrition Interactions

There are some management problems which can be induced or alleviated by dietary changes.

- **Blowouts and pickouts**

There can be several causes that which are not feed related. Certain strains are more susceptible to having double yolk eggs at the onset of egg production. This can be caused by lighting, usually that it is too bright or such that the hen can not readily adjust its laying cycle. Improper beak trimming and high temperatures/poor ventilation can also be the cause, as can lightweight birds trying to lay large eggs. Poor feathering can lead to hens “learning” to pick.

- **Cage layer fatigue**

This seems to affect hens receiving insufficient phosphorus, calcium, and/or absorbed vitamin D. Causative factors include low uniformity in body weights and overcrowding. Vitamin D addition to the water and improved uniformity of pullets can eliminate this possibility.

- **Fatty Liver Syndrome**

The incidence of fat in the liver has been attributed to dietary imbalances, notably low protein and high-energy diets. It may also be strain-related. Mycotoxins have also been implicated in fatty liver. Laying hens have 40 percent fat in the liver under normal egg laying conditions.

- **Feather loss**

Feather loss is generally a function of molt or low amino acids, particularly the sulfur amino acids. The addition of methionine or a higher protein level will alleviate the feather picking. Feather loss due to feather picking may be due to overcrowding, strong lighting or extreme temperature changes. The correction of any husbandry problem and the addition of methionine or a higher protein level will alleviate the feather picking if this is not already a behavioral problem.

- **Hysteria**

This condition occurs infrequently but is generally serious. Methionine or tryptophan, both of which have a sedative-like effect, can be added to the water.

- **Production drops**

Major causes are disease, poor record-keeping, change in the environment, management changes, stress and poor nutrition. The biggest nutrition problem is a lack of feed or water. While all potential causes are being investigated, focus first on the feed.

- **Shell quality**

Most shell problems occur as birds are nearing the end of their lay cycle. Often, it is a case of the oviduct needing rest, repair and replacement. When shell problems occur before the end of egg production, there are several areas to check. Insure that calcium supply is adequate and is from a highly available source. Check to see that manganese intake is adequate. Check for enteritis conditions, which can decrease nutrient absorption. Check the balance of calcium and phosphorus. Add vitamin D through the water.

Molting

Maintenance requirements for non-laying hens

There is a better way to molt hens besides starvation. CRF has developed a feeding program which will successfully accomplish molting hens with little mortality and a successful additional egg production cycle.

Hens are given light stimulus at 14 days before start of molt, day 0. At seven days prior to molt start, light is reduced to nine hours (or as much as possible). Hens are given additional oyster shell or large particle limestone with their last laying feed prior to day 0 of molt. The addition of 15 – 25 percent is sufficient to ensure the last eggs have adequate shells. For optimum results at day 0, hens are fasted for two to four days. This allows hens to adjust to the difference between their laying diet and the initial low-ME molt diet.

Table 9 lists the nutrient levels for the molt diets. The initial molt diet is designed to be fed ad libitum. Research indicates that hens consuming 35 grams per day of the Initial Molt Diet will stop egg production, their oviducts will regress and all other body functions will continue normally. Following 12 to 14 days on the Initial Molt Diet, birds will have attained the body weight when they were ~18 weeks of age. At this time, change the feed to Molt Diet A. This change is best accomplished by transitioning the feed 50:50 with a blend of the Initial Molt Diet and Molt A.

Approximately a week before hens are to be light stimulated for another lay cycle, place them on molt diet B. With light stimulation, place the hens on a post-peak Molt Diet. The key is to feed this diet for three to four weeks, and then move to a mid-cycle diet. This will allow sufficient nutrients for egg production and limit the potential for egg size to become too great.

Feed to the need

Hens can be fed to maximize egg production and egg size. Some markets do not have any premium over a set egg weight. It can be economical to adjust the diet to attain the desired egg size. Conversely, there can be sufficient premium, which will be cost effective to feed for maximum egg weight. Economics can also be a stimulus on feed costs per egg. With excellent markets, higher feed costs can give an economical return in eggs sold.

Data

Breeder guidelines

- Hendrix Poultry Breeders – www.hendrix-poultry.nl
- Hy-Line International – www.hyline.com
- Lohmann Teirzucht – www.ltz.de
- ISA Layers – www.hubbard-isa.com

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Tables

Table 1: Pullet Weights – Light Weight Leghorns

Table 2: Pullet Weights – Large Egg Size Birds

Table 3: CRF Nutrient Requirements

Table 4: CRF Vitamin and Trace Mineral Additions

Table 5: Performance Comparison at 18 Weeks of Age

Table 6: Expected and Measured Performance – HyLine W-36

Table 7: Expected and Measured Performance – Bovan White

Table 8: Expected and Measured Performance – HyLine W-98

Table 9: Molting Diets – Requirements

Table 1: Pullet Weights – Light Weight Leghorns

Age in Weeks	Body Weight		Feed kg/wk	Accumulated	
	kg.	lbs.		kgs.	lbs.
1	0.072	0.15	0.09		
2	0.120	0.26	0.11		
3	0.186	0.41	0.14		
4	0.256	0.56	0.20		
5	0.364	0.80	0.26		
6	0.450	0.99	0.28	1.08	2.37
7	0.545	1.20	0.30		
8	0.636	1.40	0.32		
9	0.720	1.59	0.34		
10	0.830	1.83	0.36		
11	0.920	2.02	0.37		
12	0.980	2.16	0.38	3.15	6.93
13	1.045	2.30	0.40		
14	1.130	2.49	0.41		
15	1.160	2.56	0.42		
16	1.210	2.66	0.43		
17	1.250	2.75	0.44		
18	1.290	2.84	0.45	5.70	12.54

Table 2: Pullet Weights – Large Egg Size Birds

Age in Weeks	Body Weight		Feed kg/wk	Accumulated	
	kg.	lbs.		kgs.	lbs.
1	0.078	0.17	0.100		
2	0.134	0.29	0.120		
3	0.207	0.45	0.145		
4	0.294	0.65	0.200		
5	0.402	0.88	0.270		
6	0.500	1.10	0.300	1.14	2.51
7	0.608	1.34	0.320		
8	0.716	1.58	0.340		
9	0.825	1.82	0.365		
10	0.900	1.98	0.380		
11	0.985	2.17	0.385		
12	1.075	2.37	0.400	3.33	7.33
13	1.150	2.54	0.410		
14	1.200	2.64	0.420		
15	1.250	2.75	0.430		
16	1.280	2.82	0.440		
17	1.310	2.89	0.450		
18	1.340	2.95	0.460	6.00	13.20

Tables

The Care and Feeding of a Successful Layer Operation

Table 3: CRF Nutrient Requirements

Criteria	Pullets			Peak	Post Peak	Midcycle	Layers
	Starter	Grower	Developer				Late Cycle
ME* Kcal/kg	2915	2860	2816	2926	2860 +	2860 -	2816
ME Kcal/lb	1325	1300	1280	1330	1300 +	1300 -	1280
Crude Protein %	20.0	17.5	15.0	18.0	17.5	16.5	15.0
Lysine %	1.03	0.83	0.58	0.88	0.82	0.78	0.73
Methionine %	0.36	0.32	0.25	0.42	0.40	0.38	0.35
TSAA** %	0.69	0.61	0.50	0.70	0.67	0.63	0.60
Calcium %	0.95	0.95	0.95	3.85	3.85	3.90	4.00
NP*** Phosphorus %	0.45	0.40	0.37	0.42	0.35	0.32	0.28
Sodium %	0.20	0.20	0.20	0.20	0.18	0.18	0.18
Chloride %	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Choline g/kg	1.65	1.10	0.88	1.65	1.32	1.10	0.88
Weeks in feed	0-6	6 to 12	12 to 18				
Kg of feed Intake	1.1	2.0	2.6	% Egg Production			
				> 90%	85-90%	80-85%	<80%

*Metabolizable Energy

**Total Sulfur Amino Acids

***Non-Phytate

Table 4: CRF Vitamin and Trace Mineral Additions

VITAMINS, per Kg/feed	Pullets	Layers
Vit A, IU	7480	3742
Vit D3, IU	3000	1540
Vit E, IU	13.2	6.6
Vit K (menadione), mg	2.2	1.14
Riboflavin, mg	4.4	2.2
Niacin, mg	22	11
Panth Acid, mg	8	11
Choline, mg	1100	575
MINERALS, Mg per Kg/feed	Pullets	Layers
Zinc	105	105
Manganese	60	60
Iron	20	20
Iodine	1.5	1.5
Copper	10	10
Cobalt	0.025	0.025
Selenium	0.3	0.3



Table 5: Performance Comparison at 18 Weeks of Age

Strain	Body Weights		Protein Intake grams	Body Weight To Protein		Caloric Efficiency (kcal)	
	lbs.	grams		Intake	cal.	Per g. Body Wt.	Per g. Protein.
Bovan - W	2.87	1303	1045	1.25	17022	13.06	16.29
W-36	2.84	1290	996	1.30	16189	12.55	16.25
W-98	2.95	1339	1023	1.31	17437	13.02	17.04

Table 6: Expected and Measured Performance – HyLine W-36

Body Weight Guide			Measured				
Age in Weeks	Body Weight		Body Weights		Eggs	Feed Intake / day	Egg Weights.
	kg.	lbs.	kg.	lbs.	% Hen Days	grams	grams
20	1.36	3.00	1.44	3.17			
24	1.47	3.24	1.54	3.40	58.1	77.8	53.0
28	1.50	3.32	1.58	3.49	92.1	90.2	57.4
32	1.52	3.35	1.60	3.53	92.4	96.1	59.7
36	1.53	3.37	1.62	3.57	92.2	93.9	60.6
40	1.54	3.39	1.64	3.62	87.9	92.9	60.9
44	1.54	3.41	1.68	3.70	86.2	96.0	61.8
48	1.55	3.43	1.67	3.67	83.9	88.1	62.1
52	1.56	3.44	1.67	3.68	80.3	90.3	62.6
56	1.56	3.45	1.68	3.71	79.7	98.9	65.4
60	1.57	3.45	1.68	3.70	77.7	97.3	65.6
64	1.58	3.48	1.67	3.69	77.2	99.2	66.2
68	1.58	3.48	1.69	3.71	75.7	100.2	66.4

Table 7: Expected and Measured Performance – Bovan White

Body Weight Guide			Measured				
Age in Weeks	Body Weight		Body Weights		Eggs	Feed Intake / day	Egg Wts.
	kg.	lbs.	kg.	lbs.	% Hen Days	grams	grams
20	1.30	2.87	1.45	3.19			
24	1.53	3.38	1.47	3.24	84.2	90.5	51.9
28	1.58	3.49	1.52	3.35	95.5	97.6	55.8
32	1.60	3.53	1.57	3.46	96.3	92.2	57.9
36	1.61	3.56	1.58	3.48	95.9	93.3	58.1
40	1.62	3.58	1.61	3.54	95.6	94.0	58.9
44	1.63	3.60	1.64	3.61	95.2	100.7	60.7
48	1.64	3.61	1.66	3.67	91.4	101.1	61.8
52	1.64	3.62	1.67	3.68	90.1	104.5	61.9
56	1.65	3.63	1.68	3.71	88.7	109.8	62.1
60	1.65	3.64	1.65	3.64	87.3	114.1	62.3
64	1.66	3.65	1.66	3.66	84.4	115.8	62.7
68	1.66	3.66	1.65	3.63	82.6	119.1	63.0

Table 8: Expected and Measured Performance – HyLine W-98

Body Weight Guide			Measured				
Age in Weeks	Body Weight		Body Weights		Eggs	Feed Intake / day	Egg Wts.
	kg.	lbs.	kg.	lbs.	% Hen Days	grams	grams
20	1.45	3.20	1.56	3.45			
24	1.56	3.44	1.66	3.66	71.9	95.3	54.9
28	1.60	3.52	1.68	3.70	94.0	95.6	59.0
32	1.61	3.55	1.68	3.70	92.7	93.1	60.2
36	1.62	3.57	1.70	3.74	92.5	92.9	61.3
40	1.63	3.59	1.72	3.80	91.0	92.7	62.0
44	1.64	3.61	1.81	4.00	89.5	101.1	64.0
48	1.65	3.63	1.85	4.08	87.4	101.2	65.1
52	1.65	3.64	1.87	4.12	86.4	105.4	66.2
56	1.66	3.65	1.89	4.17	85.8	111.1	67.3
60	1.66	3.66	1.89	4.16	85.1	119.0	68.4
64	1.66	3.67	1.89	4.16	82.1	122.3	68.0
68	1.67	3.68	1.89	4.16	79.0	125.1	67.8

Table 9: Molting Diets – Requirements

Criteria	Initial Diet		Molt Diets	
	Minimum	Maximum	Molt A	Molt B
ME* Kcal/Kg	1584	1650	2772	2783
ME Kcal/lb.	720	750	1260	1265
Crude Protein %	9.2	9.8	15.0	15.5
Lysine %			0.72	0.76
Methionine %	0.25		0.39	0.39
TSAA** %	0.35		0.66	0.66
Tryptophan %			0.175	0.175
Calcium %	1.30	1.33	2.0-2.1	2.75-2.80
Total Phosphorus %	0.50			
NP*** Phosphorus %			0.33	0.33
Sodium %	0.22		0.175	0.175
Chloride %	0.20	0.31	0.16	0.16

*Metabolizable Energy **Total Sulfur Amino Acids ***Non-Phytate

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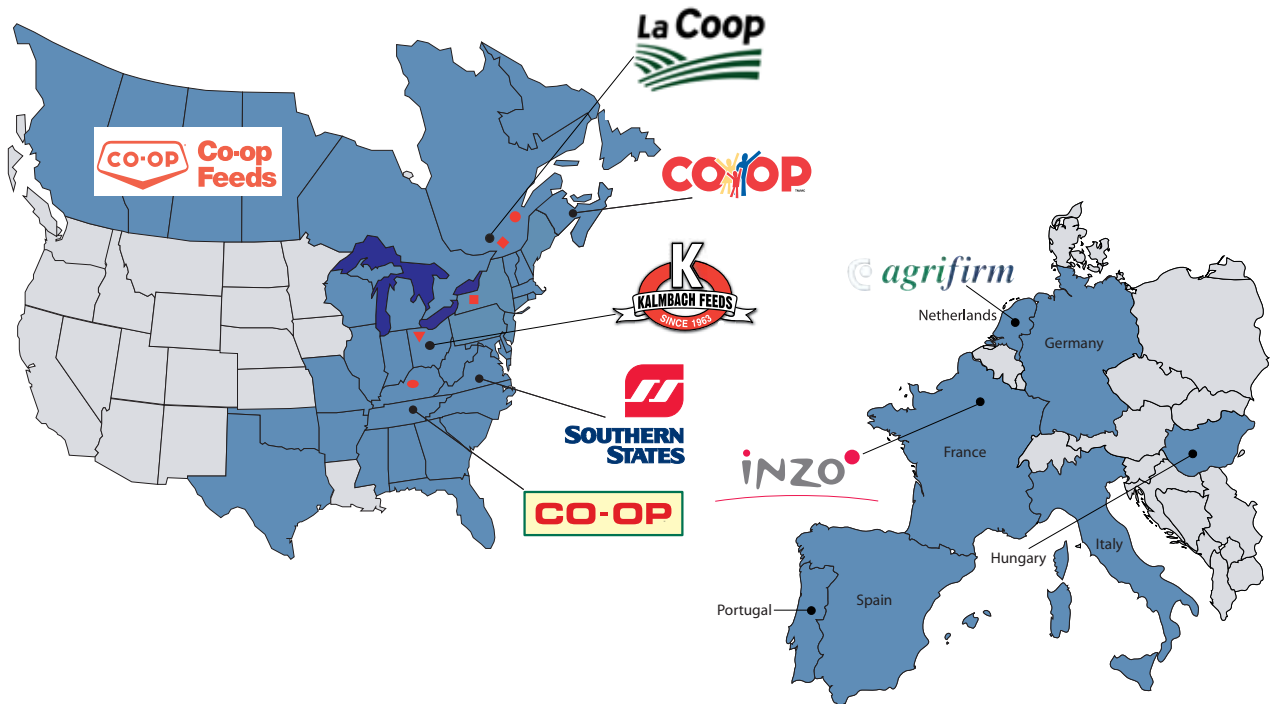
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