SPECIALISED BREEDERS AUSTRALIA

Genetics & Egg Size

2024

Phenotypic Expression

"Phenotypic expression is the results of a complex interplay between an organism's genes and its environment"

Phenotype = Genotype + Environment

The Four Pillars of Egg Size

- Genetics
- Body weight (and the composition of the body weight)
- Nutrition
- Lighting program

Genetics

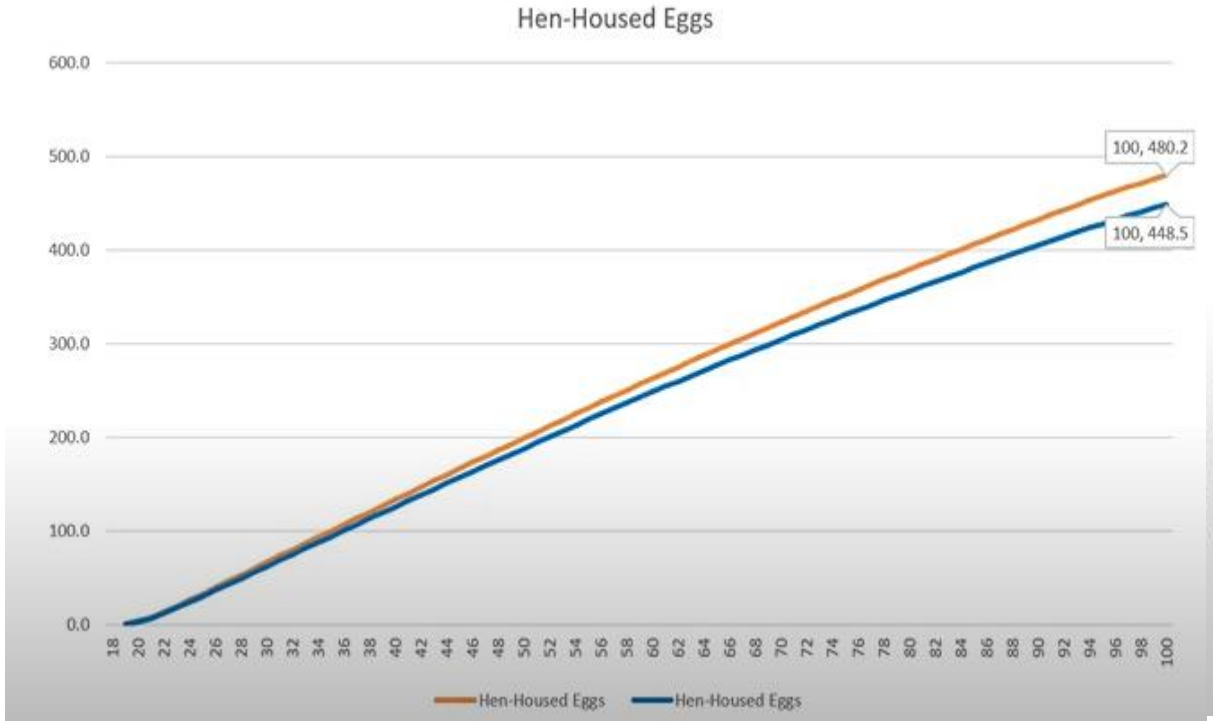
Genetics

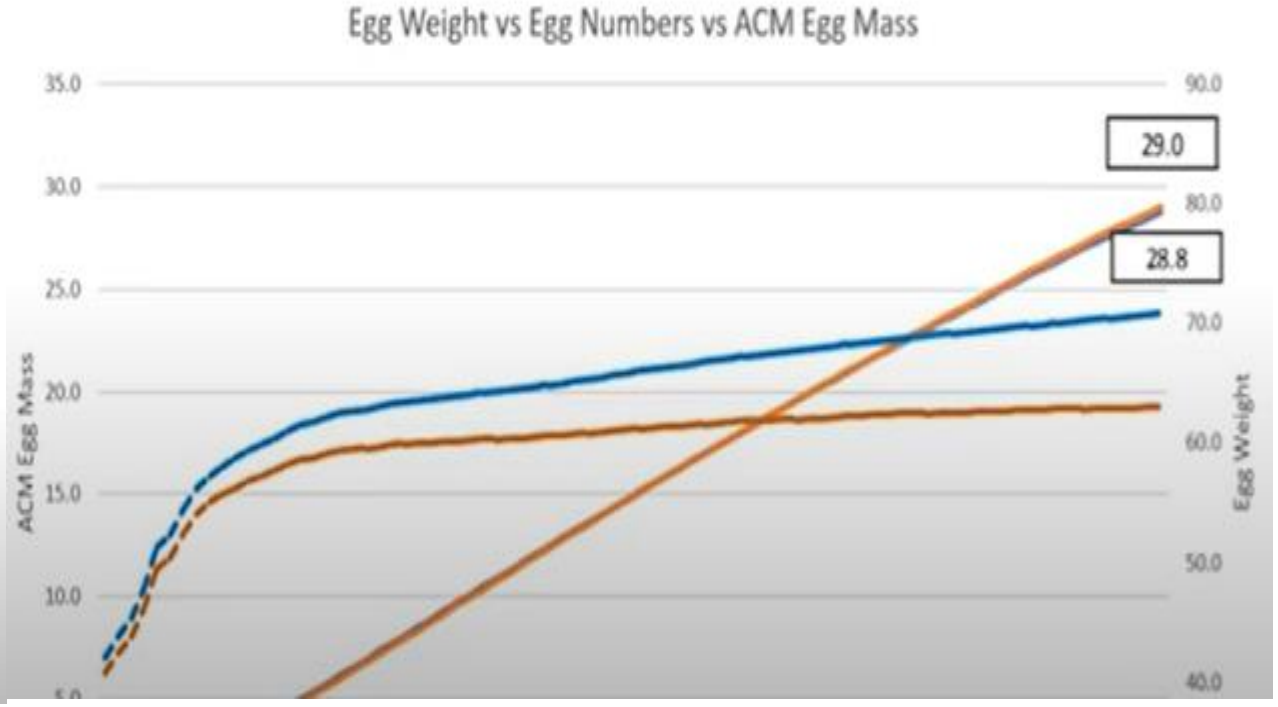
- Each Breed have different varieties that has genetically determined characteristics - egg size, egg numbers and egg color.
- Hyline: Brown –Classic, Plus, Max,
- White -W36, W80, Cream -Sonia, Pink.
- The environment (other factors excluding genetics) plays an important role in the expression of the egg characteristics.
- 60 % of egg size variation in a genetic variety is due to non-genetic factors (nutrition, management, etc.) that can be manipulated.

Genetics

- Tri factor : Egg size v/s Egg numbers v/s Egg Mass.
- Genetically a layer is “programed” to produce a certain amount of egg mass (kg) over her life.
- The egg mass will then be expressed in egg quantity (nr’s) and egg size (grams).
- Egg size and egg numbers are negative correlated.
- In the same genetic variety- as egg weight is changed, the egg numbers tend to change inversely to keep the egg mass constant.

Genetics





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Genetics

- Egg weight is a heritable trait (~40%) – respond well to genetic selection.
- Key goal in genetic selection = Increase early egg weights, hold mid-cycle egg weights constant and decrease late egg weights.

BUT

- Beware of the impossible “SUPERCHICK”

Genetics

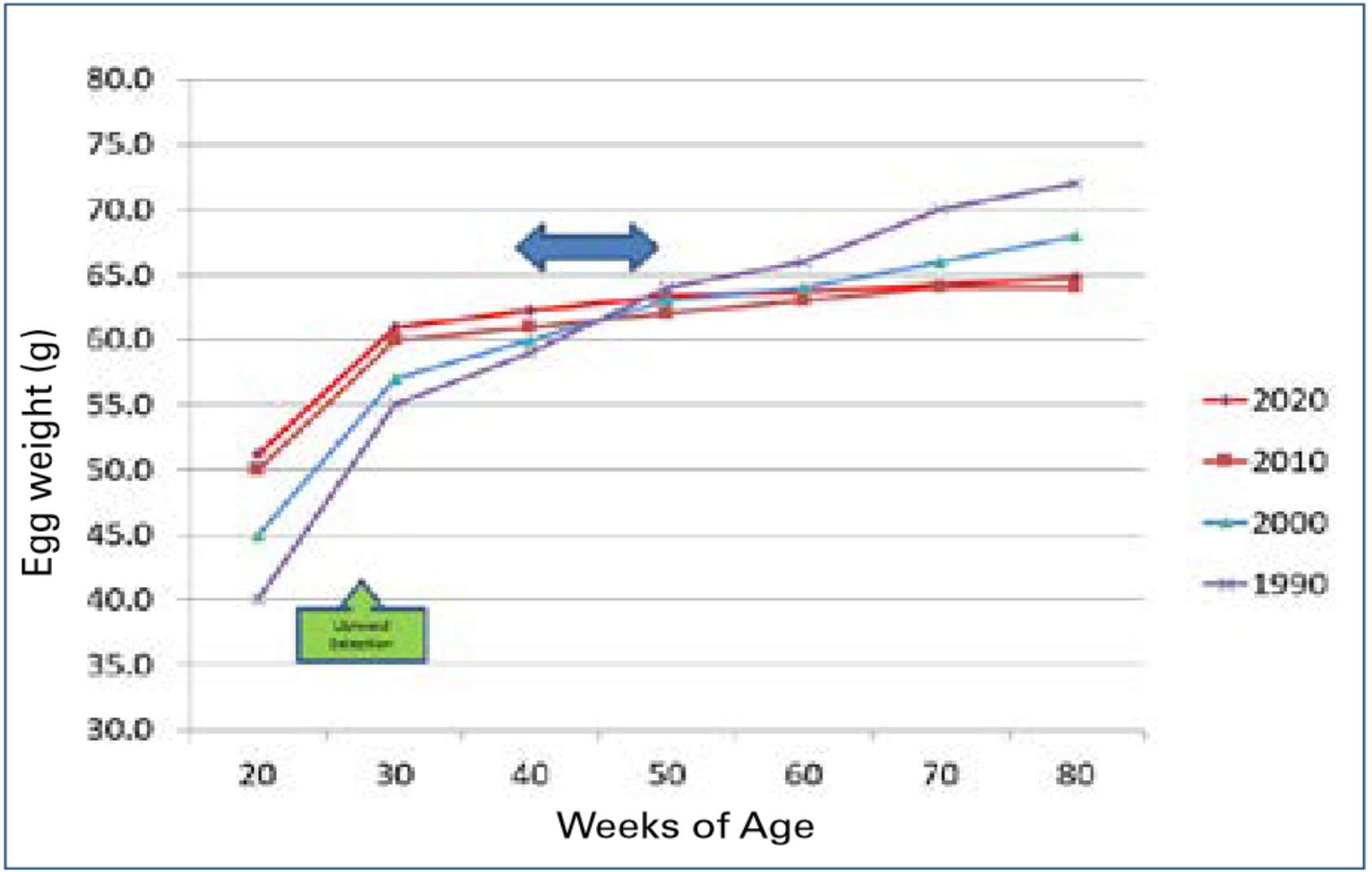


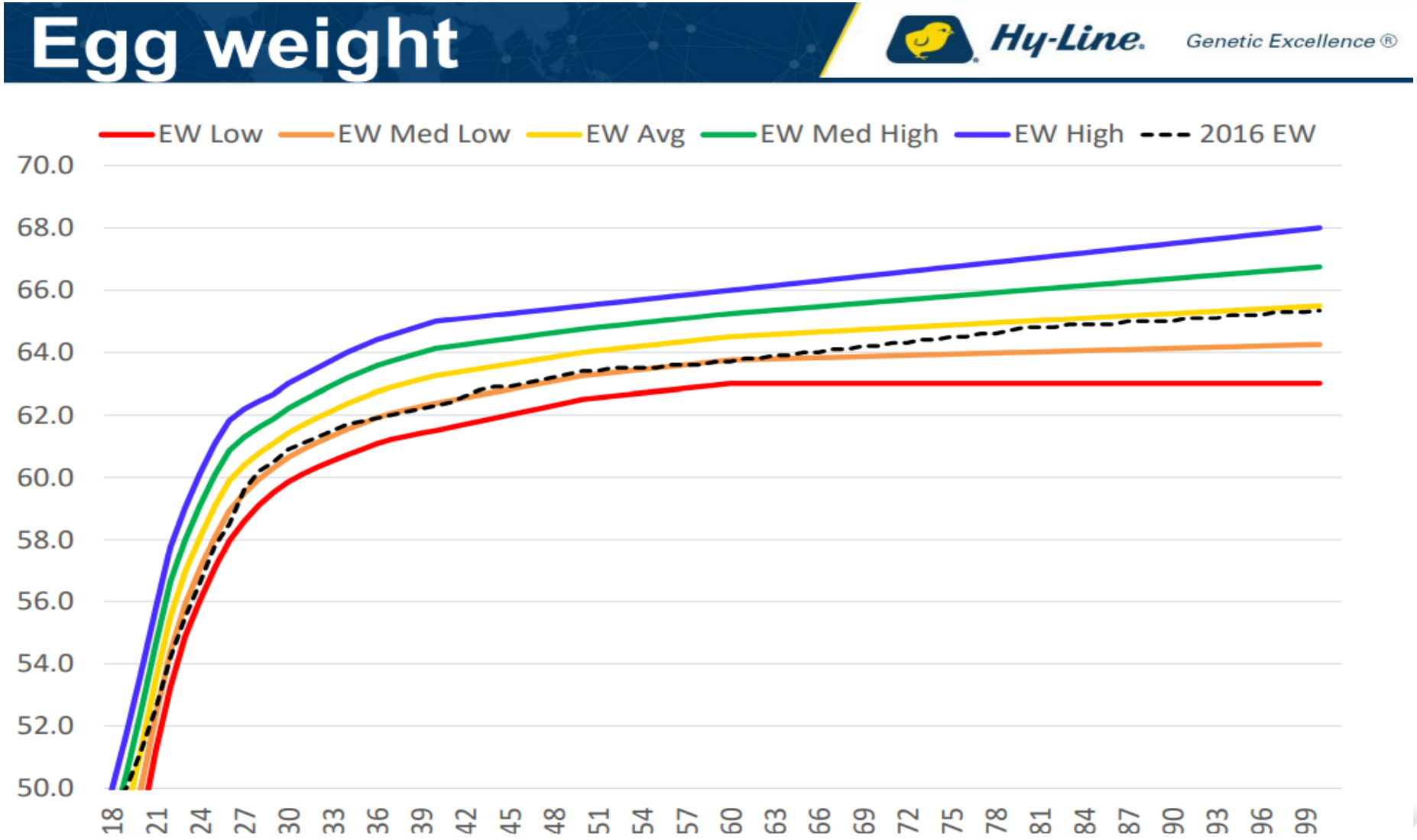
Figure 1. Egg weight changes for Hy-Line Brown, 1990–2015.

Genetics

- 60 % of egg size variation in a genetic variety is due to non-genetic factors (nutrition, management, etc.) that can be manipulated.

Phenotype = Genotype + Environment

Genetics



SBA
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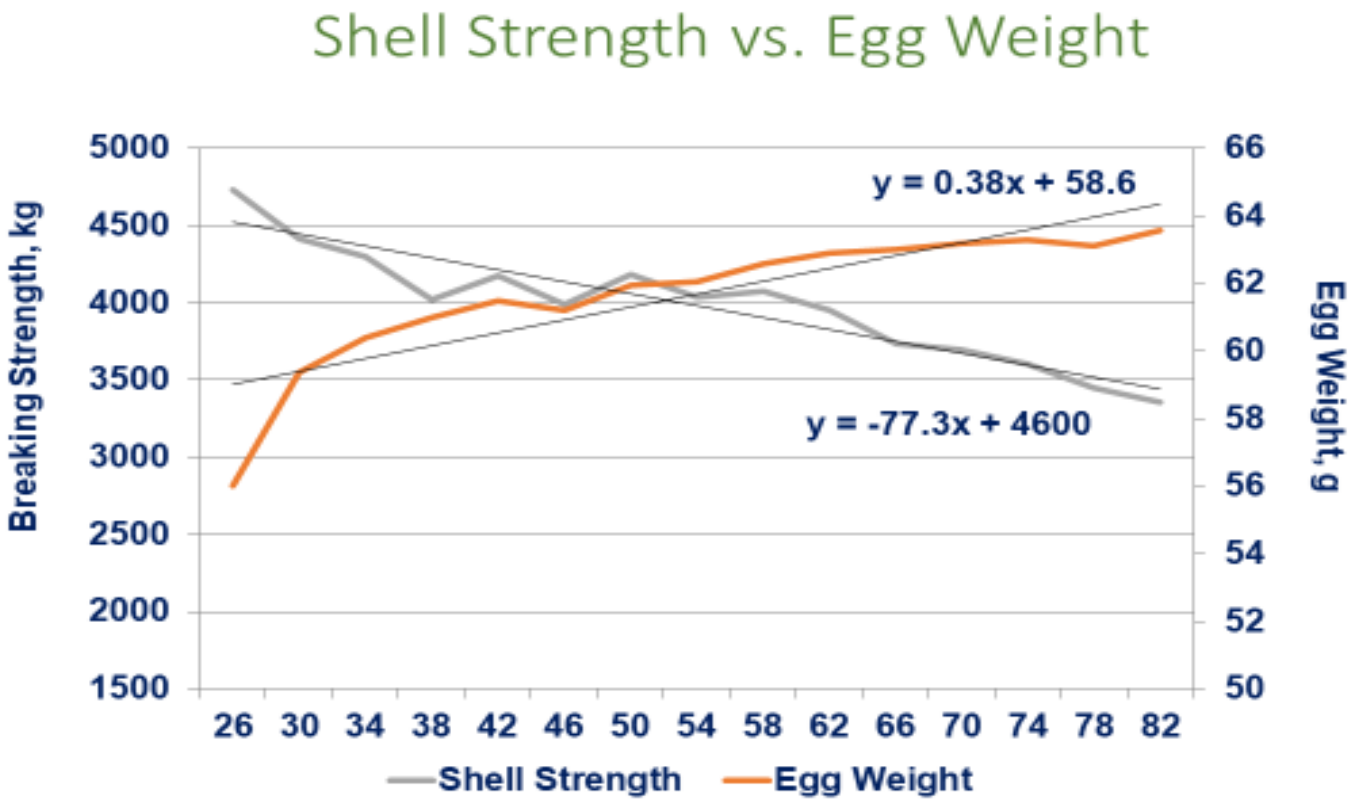
Genetics

- Egg shell breaking strength have a negative correlation with late egg weights.

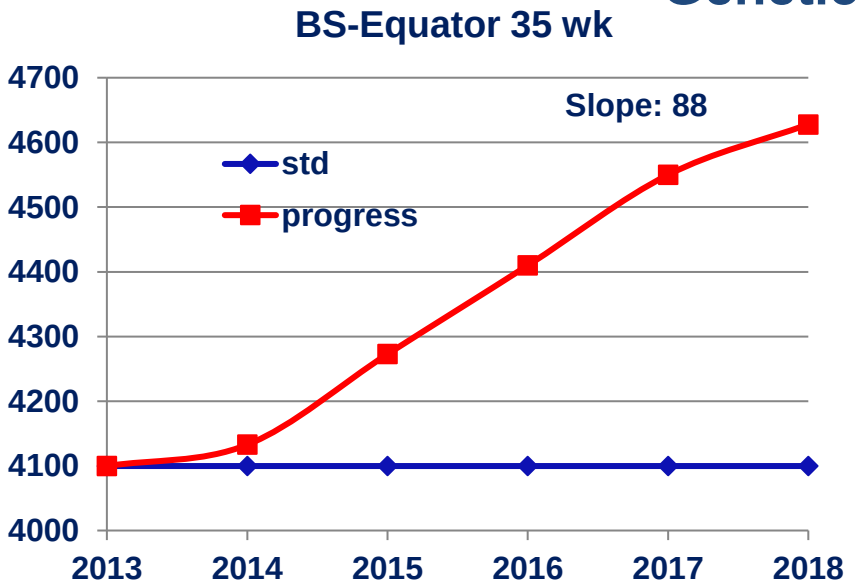
- Continues selection for reduced egg weight late in life to ensure sufficient egg size and egg mass is available in the genetic potential of the birds.

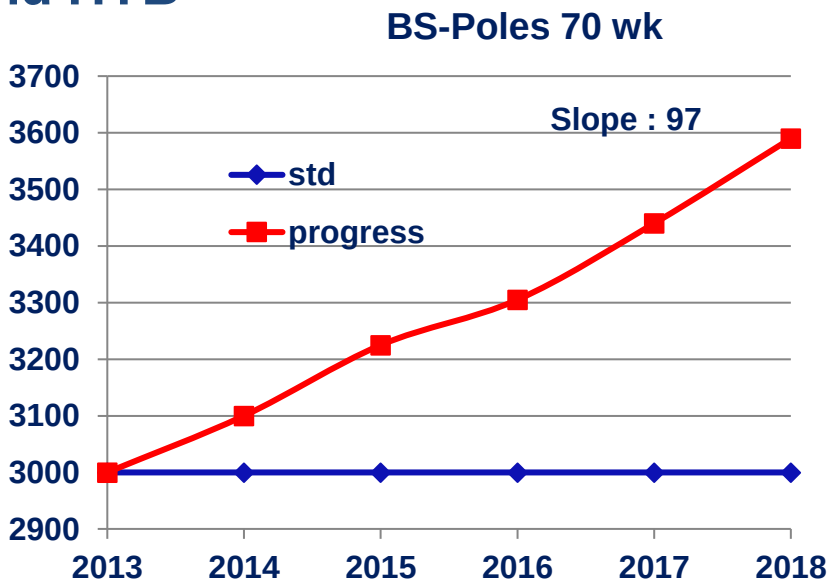
Genetics

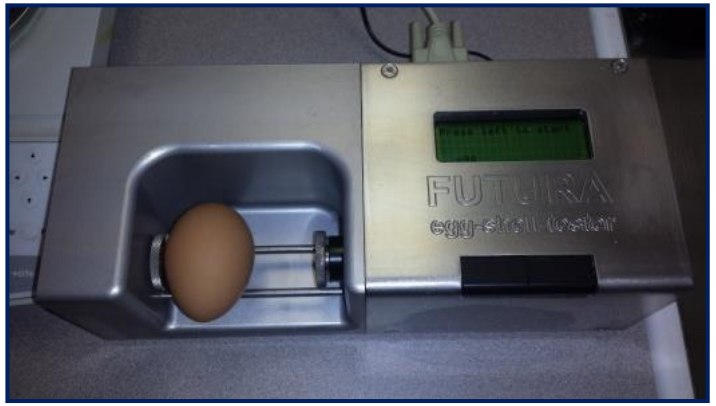


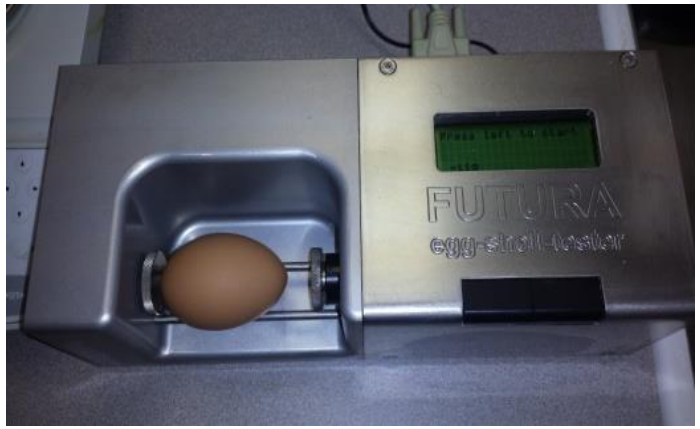
Hy-Line Internal Data

HL Brown Egg Shell Quality Improvements
Breaking Strength : Equator & Poles
Genetic Trend HYB









Note: Year indicates hatch of GGP generation.

Body weight

Body Weight

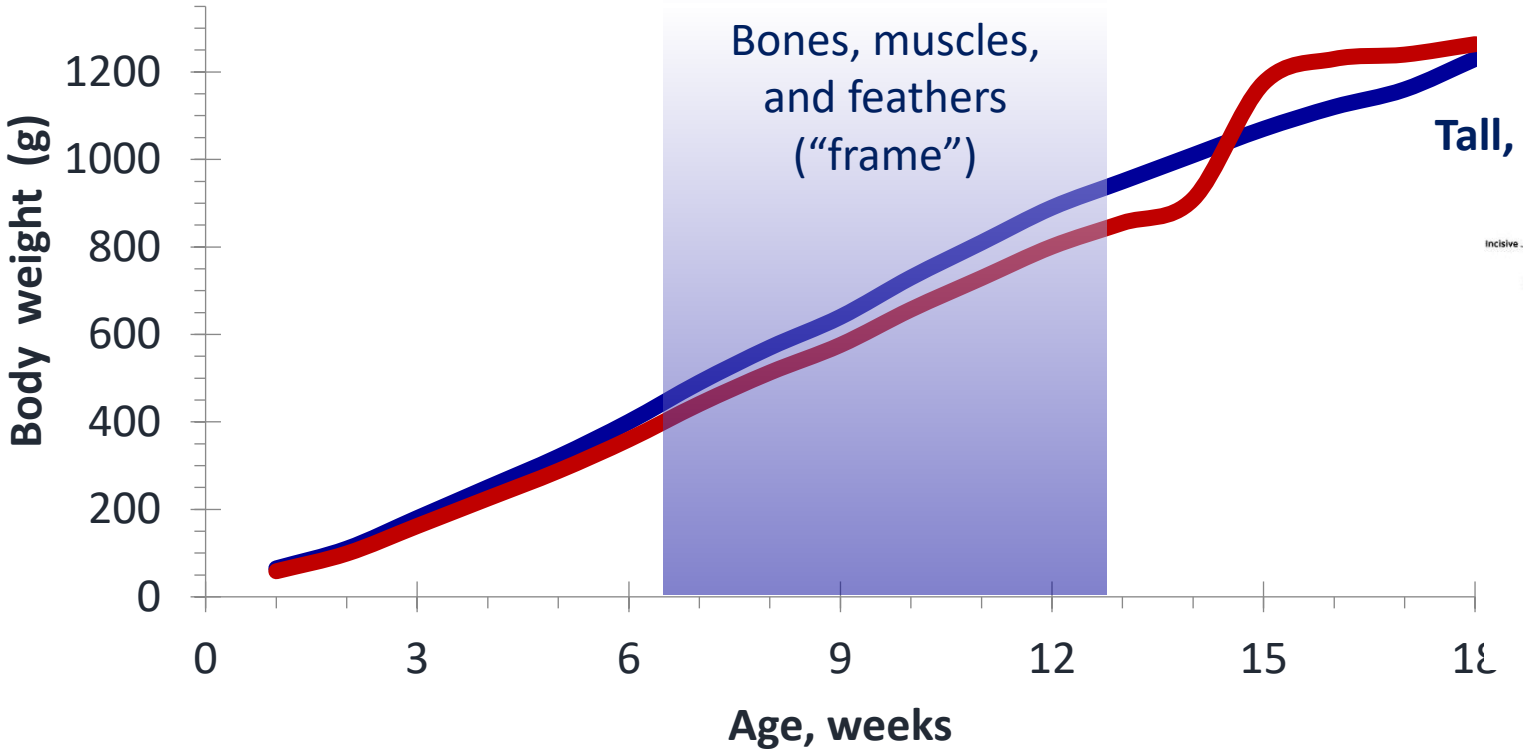
- An important factor in egg weight expression and egg production is the *pullets body weight and composition at maturity*.
- Body weight is affected by many factors eg.
  - Nutrition
  - Light program
  - Vaccination program
  - Disease status
  - Transfer
  - Stocking density
  - Flock uniformity
- Achieving target body weight and flock uniformity is critical for egg size management.

Body Weight

- During rearing there are key development phases that will impact egg weight and production performance later in lay.
- Sexual maturity is affected by fat free body mass
  - Reproductive growth at 14-15 weeks requires a critical quantity of fat free mass (Kwakkel, 1994)
  - Protein restriction delays sexual maturity
- 18 week body weight is not a reliable indicator of subsequent laying performance when considered in isolation from growth leading to that weight (Wells, 1980)

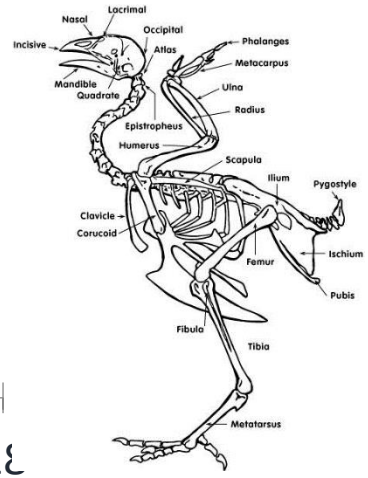
Body Weight

A quality pullet is not just about the right weight at transfer



Short, round 'fat' hen

Tall, lean hen



Compensatory growth is not desirable in laying pullets = fat gain!

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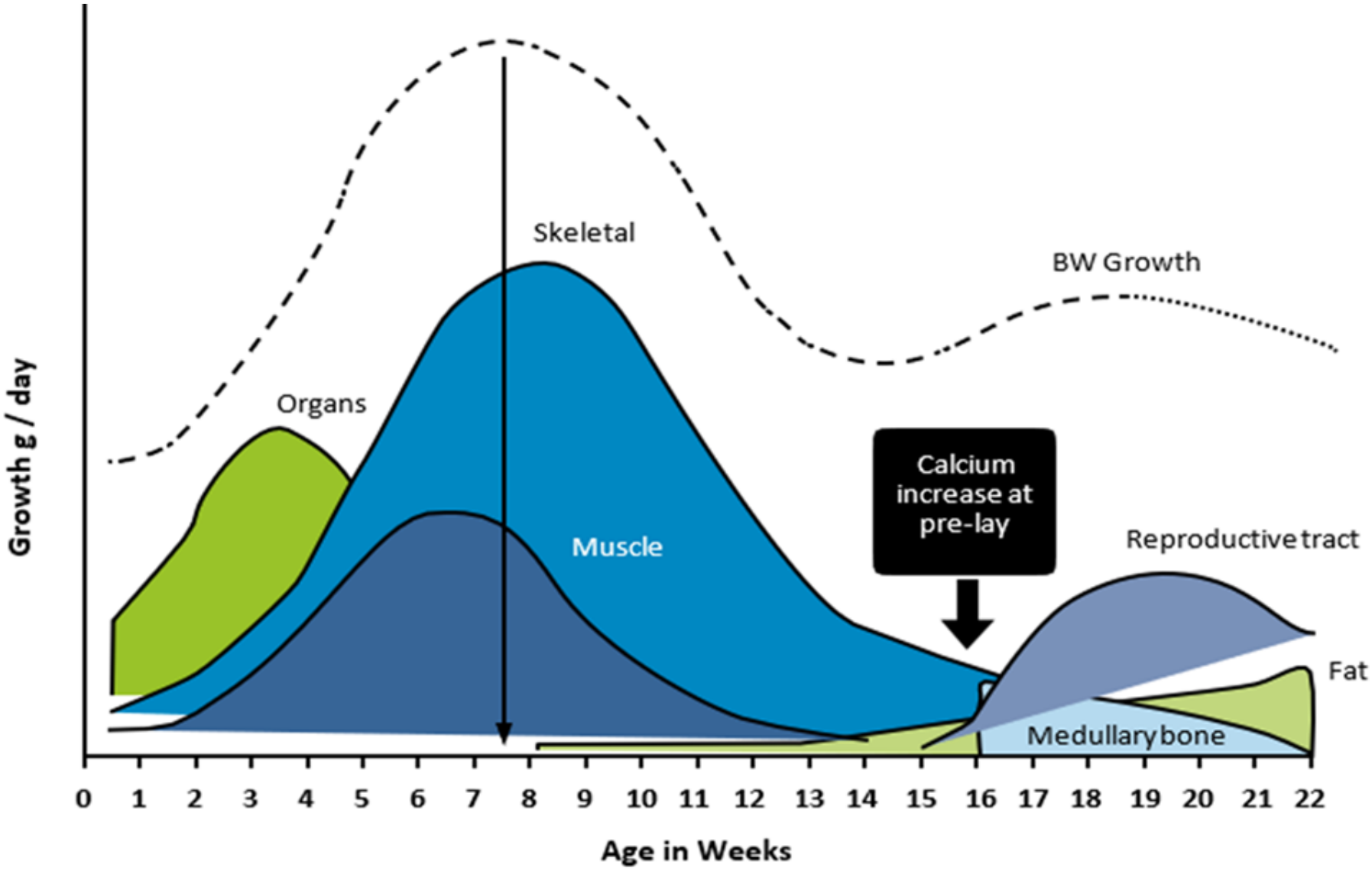
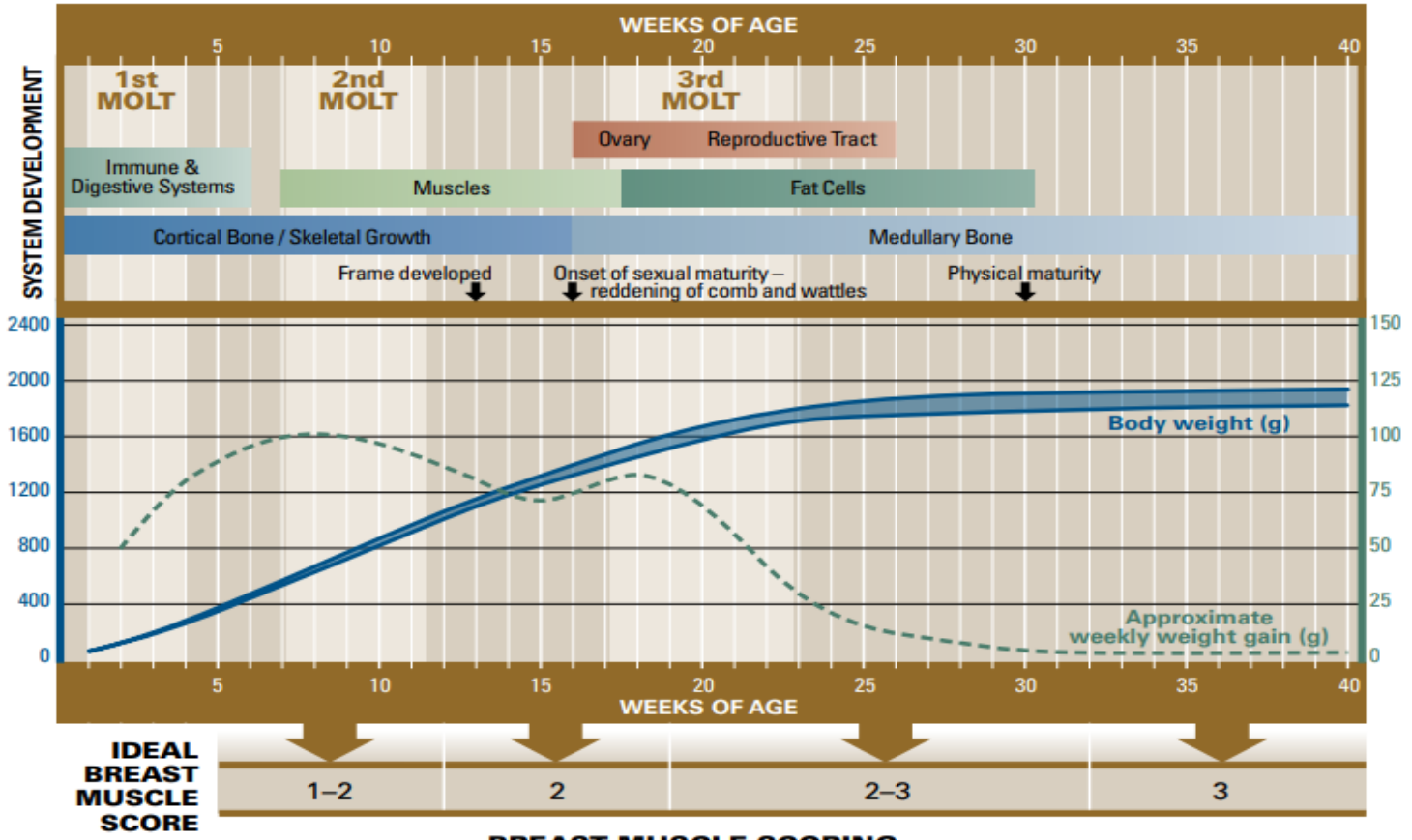
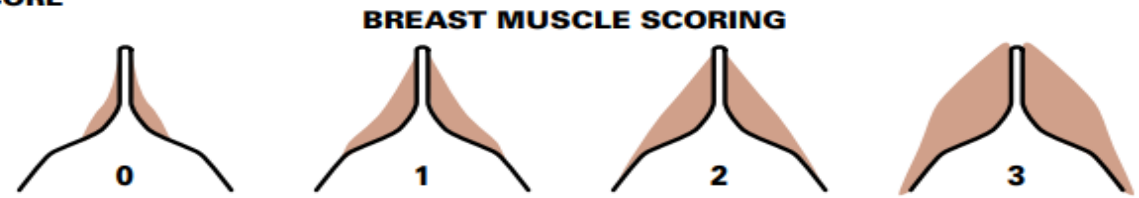

Growth g / day
Skeletal
BW Growth
Organs
Muscle
Calcium increase at pre-lay
Reproductive tract
Fat
Medullary bone
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Age in Weeks



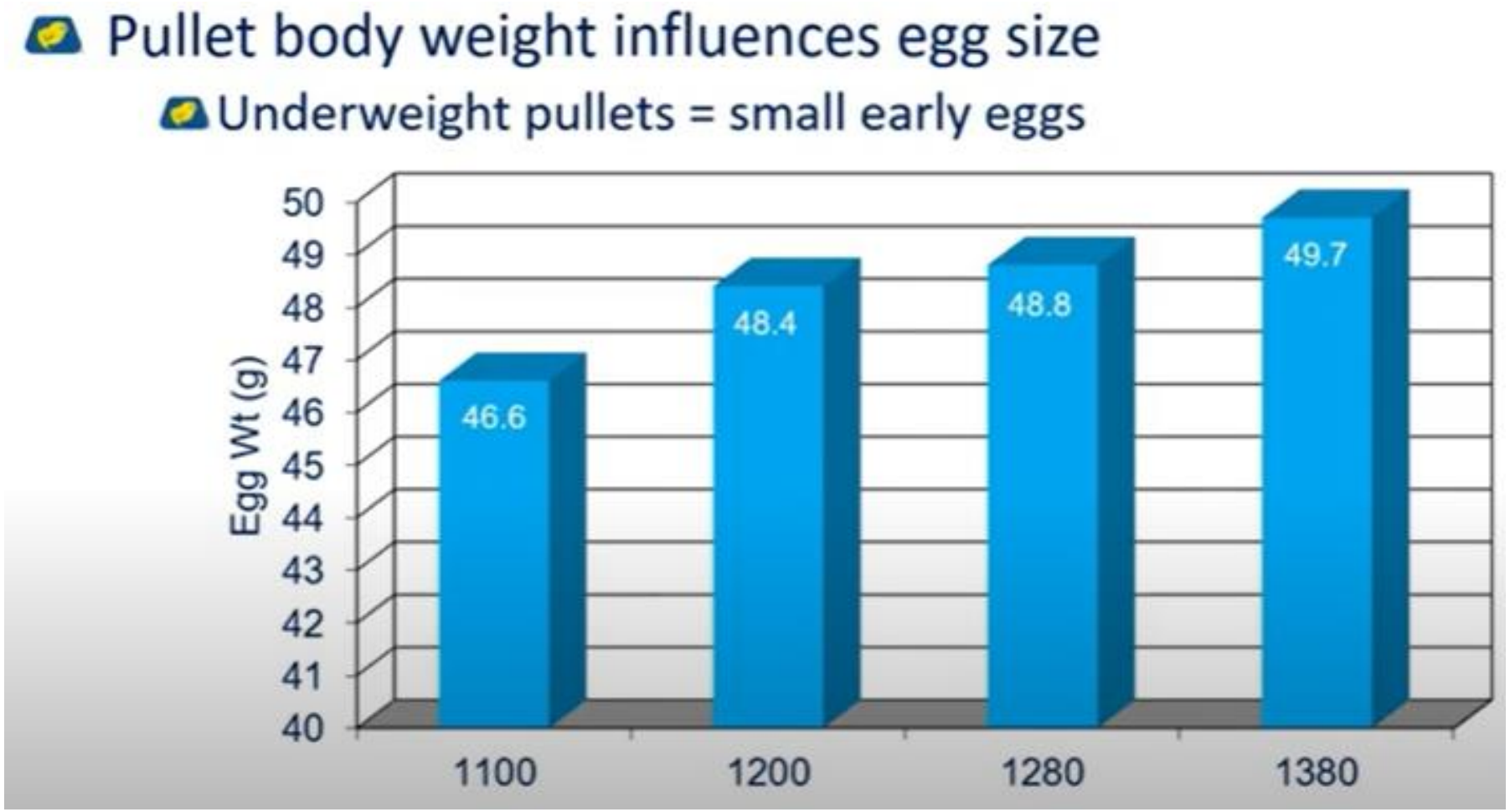


Hens with good muscle development are better able to sustain high egg production

Body Weight

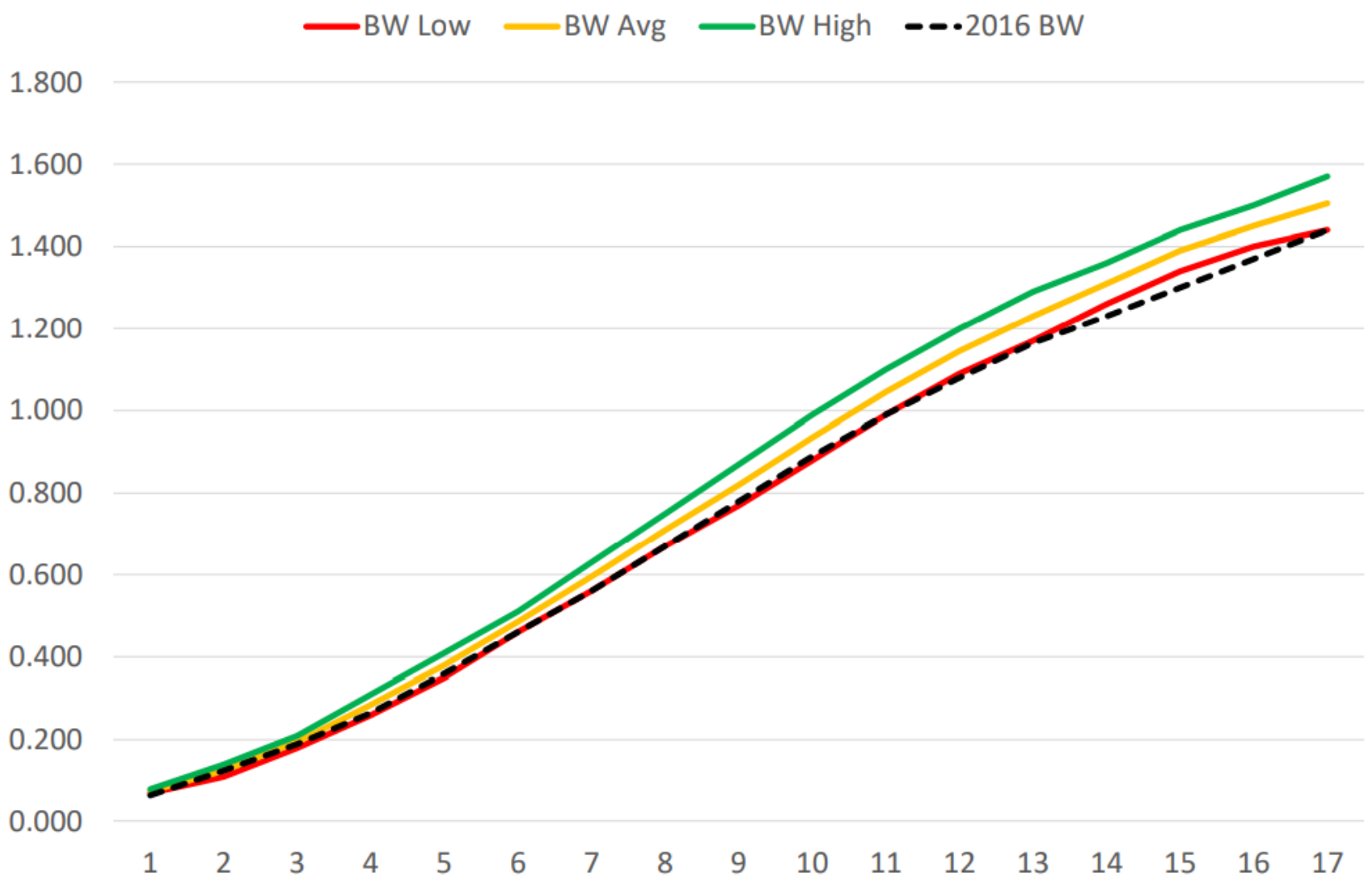
KEY TARGET BODY WEIGHT	
WEEK	Target
1	2 x DOP BW
5	10 x DOP BW
12	3 x 5wks BW
18	4 x 5wks BW

Pullet body weight (18 weeks) v/s Egg weight



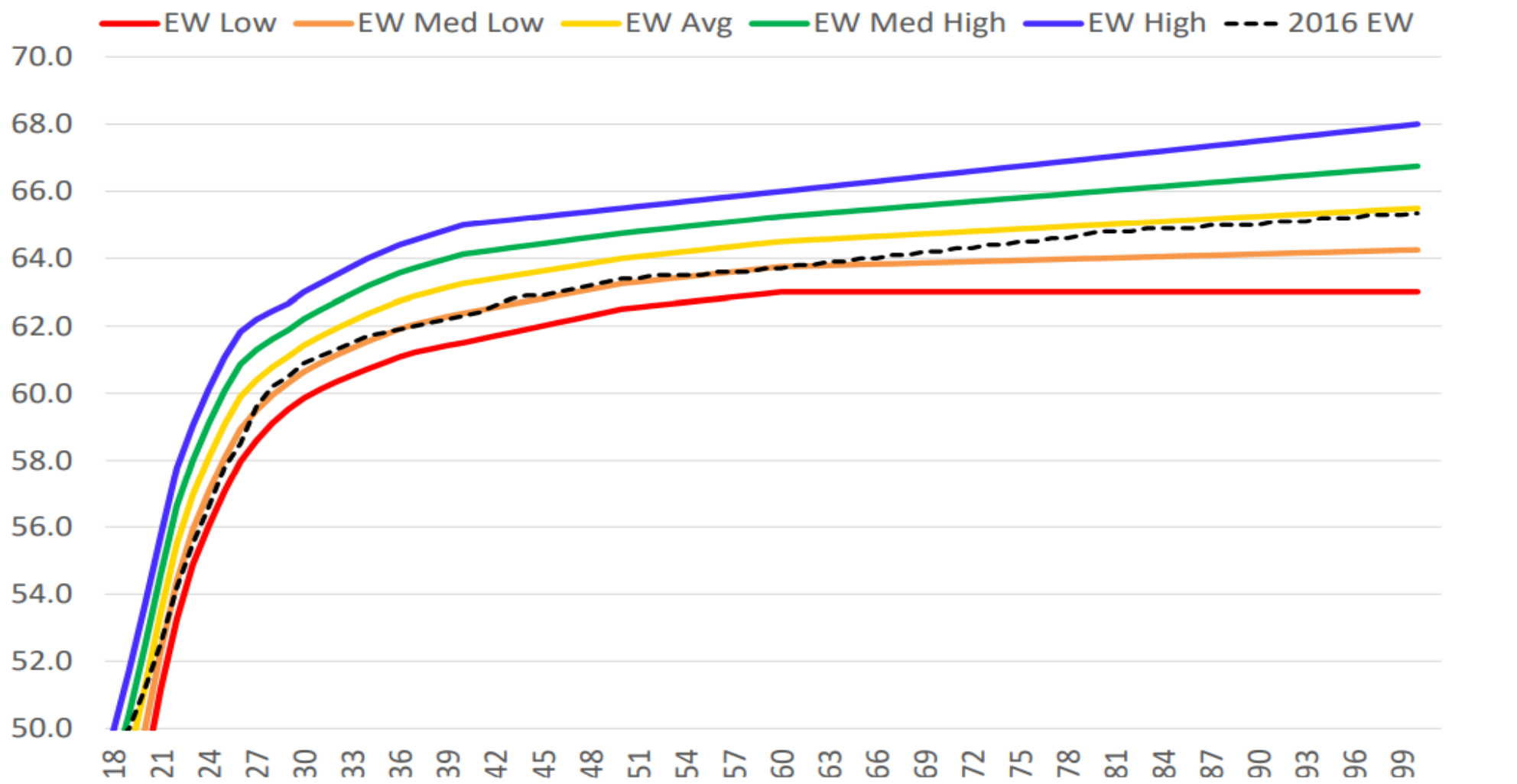
Body Weight - pullet

Hy-Line Genetic Excellence ®



Egg weight

Hy-Line Genetic Excellence ®



SBA – PS Female body weight v/s Egg weight

Hyline	Karee 3		Pinerow 1		Difference	
Age	Female weight	Egg weight	Female weight	Egg weight	Female weight	Egg weight
20	1843	45.5	1759	43.2	-84	-2.3
22	1901	50.2	1826	49.6	-75	-0.6
24	1921	54.4	1882	53.6	-39	-0.8
26	1950	57	1887	55.8	-63	-1.2
28	2006	58.8	1945	57.6	-61	-1.2
30	2003	59.9	1946	58.5	-57	-1.4
32	2043	60.7	1977	59.4	-66	-1.3
34	2061	61.5	1985	60.2	-76	-1.3

Karee Farm PS Flock – Placement Day Old Chick weight 40.8 grams

Pinerow PS Flock - Placement Day Old Chick weight 41.7 grams

SBA - Female body weight v/s Egg weight

Lohmann	K4		K1		Difference	
Age	Female weight	Egg weight	Female weight	Egg weight	Female weight	Egg weight
20	1843	45.9	1736	41.4	-107	-4.5
22	1896	52.5	1787	49	-109	-3.5
24	1931	53.4	1813	52	-118	-1.4
26	1927	55	1831	53.2	-96	-1.8
28	1935	57.6	1880	54.7	-55	-2.9
30	1937	57.3	1897	54.5	-40	-2.8
32	1954	59.8	1909	56.5	-45	-3.3
34	1969	60.2	1917	56.9	-52	-3.3

Kamarooka Farm K4 PS Flock – Placement Day Old Chick weight 39.5 grams

Kamarooka Farm K 1 PS Flock - Placement Day Old Chick weight 39.7 grams

Light Program

Light Program

- Chickens are responsive to changes in day length, and this has a significant effect on egg production and egg size.
- Light program have a direct and indirect impact on eggs size and production.
- Two key areas :

- Lighting step down program after placement during rear (0-15 weeks)
- Light stimulation in rear just before onset of production (17-22 weeks)

Light Program

- Step-down programs effect on egg size:

  - A slow step-down lighting program during rearing provides the pullet with more light to eat and grow. The same time a slow step down can also delay maturity and increase egg size.

  - Faster step-down lighting program during rearing provides fewer light hours and slower growth. The same time a faster step-down can also result in earlier sexual maturity with smaller egg size.

Light Program

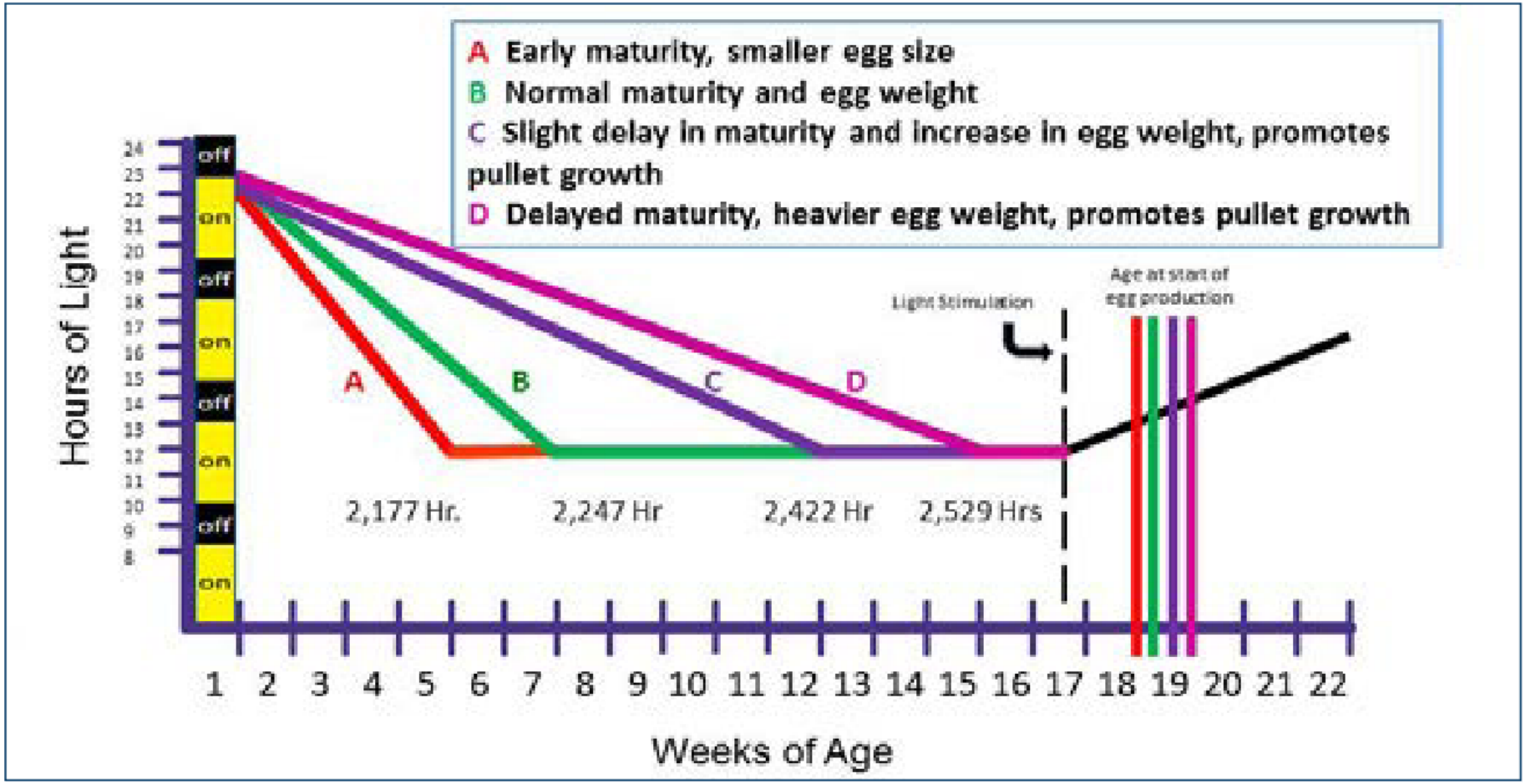


Figure 2. Effect of different lighting programs on total hours of light, age of sexual maturity, and egg weight.

Light Program

➢ Light stimulation just before on set of production:

- Age of light stimulation AND body weight are interacting factors that help determine the onset egg production AS WELL AS egg size.
- Light stimulation should be done based on the flock's body weight and uniformity.

- Generally:
  - ❖*Early stimulation at lighter body weights will accelerate maturity and decrease egg size.*
  - ❖*Later stimulation at heavier body weights will delay maturity and increase egg size.*

Nutrition

Nutrition

- Nutrition during the rearing and laying period has a critical important role in egg weight.
- Proper nutrition allows for the hen to achieve or exceed the standard body weights.
- Changing rearing diets based on attaining body weight standards (and not bird age) will best match the diet to the actual nutritional need of the pullet.
- During the lay period, the specification of diets can be used to manage/ manipulate egg size.
- Energy, methionine/cystine, digestible amino acids, linoleic acid and total fat can directly affect the egg size.

Nutrition

- Protein content of diets should be balanced to ensure the amino acids are utilized efficiently.
- Unbalanced protein can result in poor utilization of amino acids and impacting egg size negatively.

- Diet amino acid levels are normally gradually reduced after peak to prevent excessive large eggs and weak shells.
- Management for larger egg size should included nutritional consideration in rear for subsequent shell quality and bone strength.

Nutrition

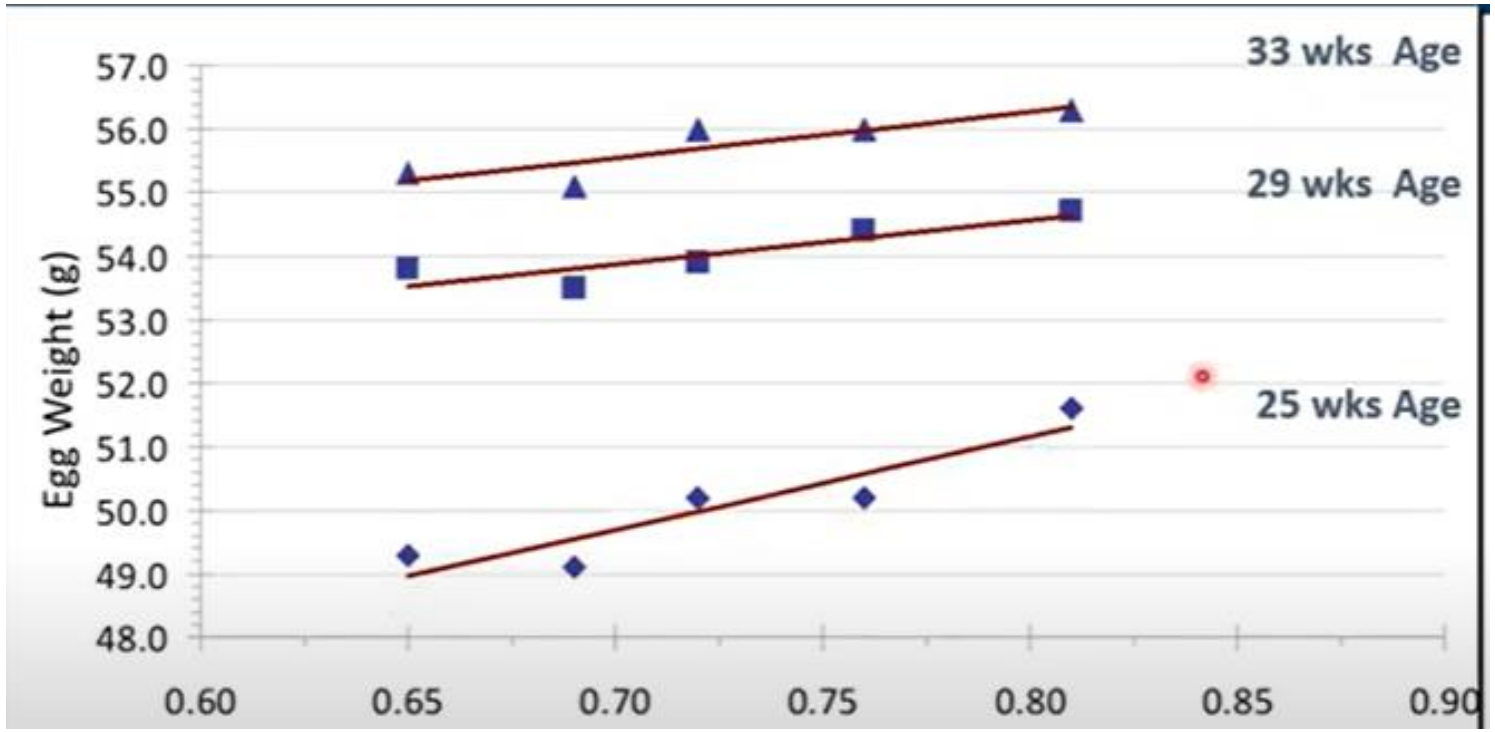
- Egg weight during lay phase can be regulated through phase feeding – various diets with different nutrient levels.
- Optimal egg weight will be easier to achieve when formulating feed according to egg weight or egg mass.
- Diet formulas must be constantly be updated to ensure diets deliver on the nutrient parameters – raw materials do change in quality.
- Be aware that not only nutritional levels, but all aspects of nutrition management can affect egg size – feed particle size, water intake, water temperature, feed schedule.

Nutrition

- Heat stress can depress egg weight !
- High environmental temperatures above 33 degrees has a depressing effect on the bird's feed intake and therefore nutrient intake.
- That can result in a shortfall in nutrients like protein (amino acids) and energy = lower egg weights.
- Appropriate adjustments in feed formulation is required to match the actual intake of birds to ensure proper nutrient intake.
- See breed feed and nutrient recommendations.

Nutrition

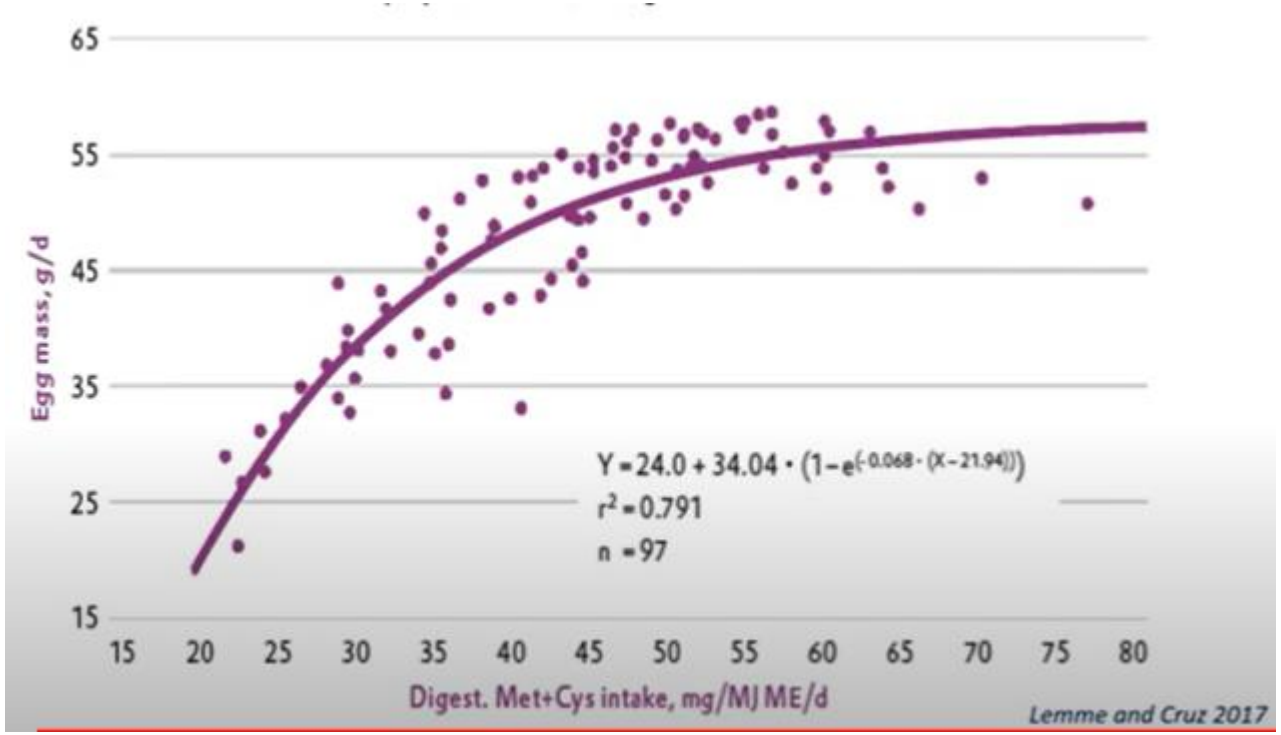
Pre Peak



Met & Cys %

Nutrition

Nutrient levels v/s egg weight



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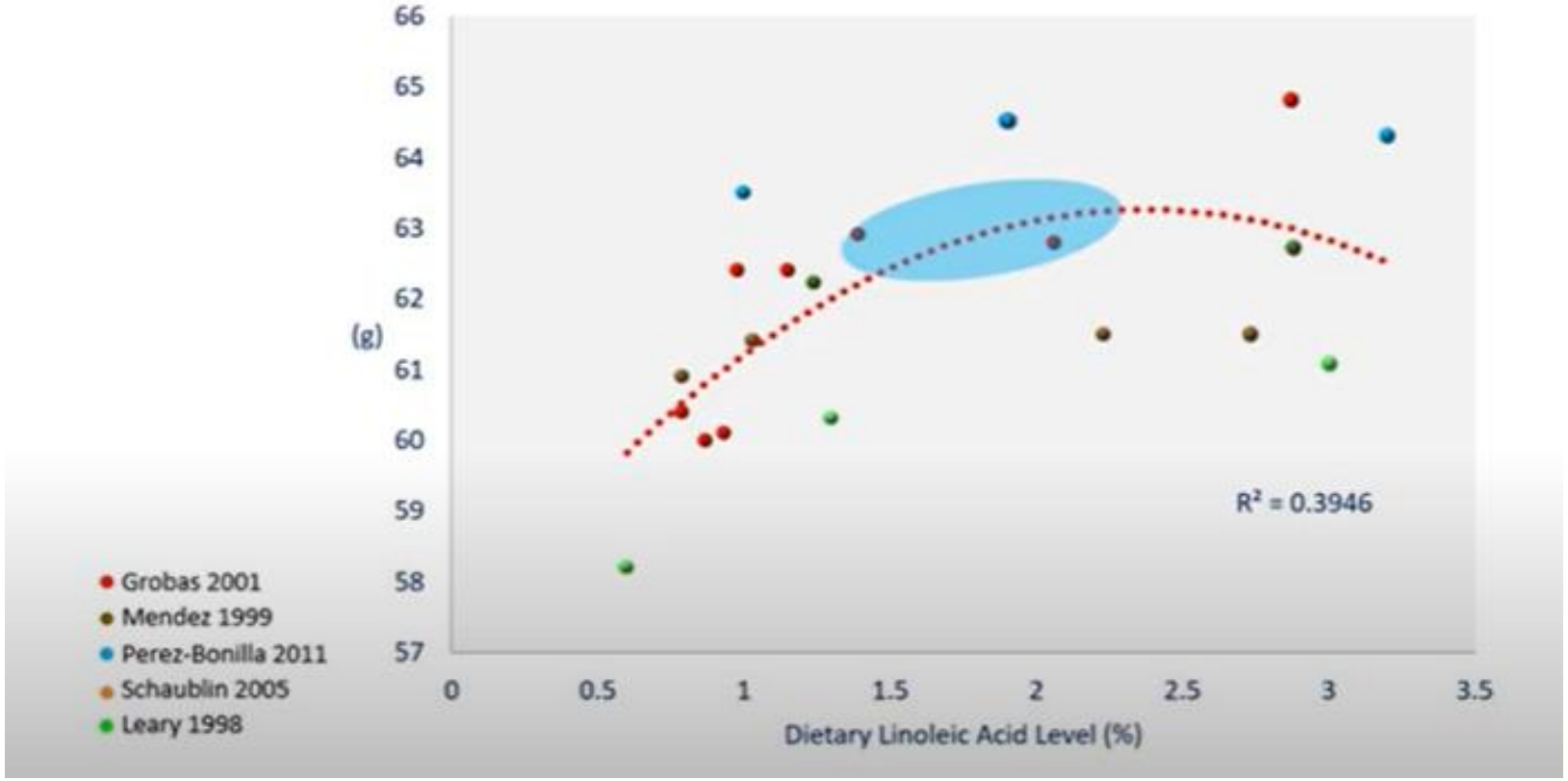
Nutrition

Linoleic Acid levels v/s egg weight



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Summary

- Egg weight v/s Egg nr's v/s Egg Mass – relationship.
- Egg weights are impacted by various factors.
- These factors can be manipulated to change egg weight with in the genetic egg weight range.
- Understand the interaction and correlation between the factors and what is negatively correlated.
- The genetic potential is there, the key is how to unlock it and manage it correctly to deliver on the preferred result.
- What we aim for in egg weight must make economical sense.

Thank you