The Incubator Company

The Egg Pack and the Successful Hatchery

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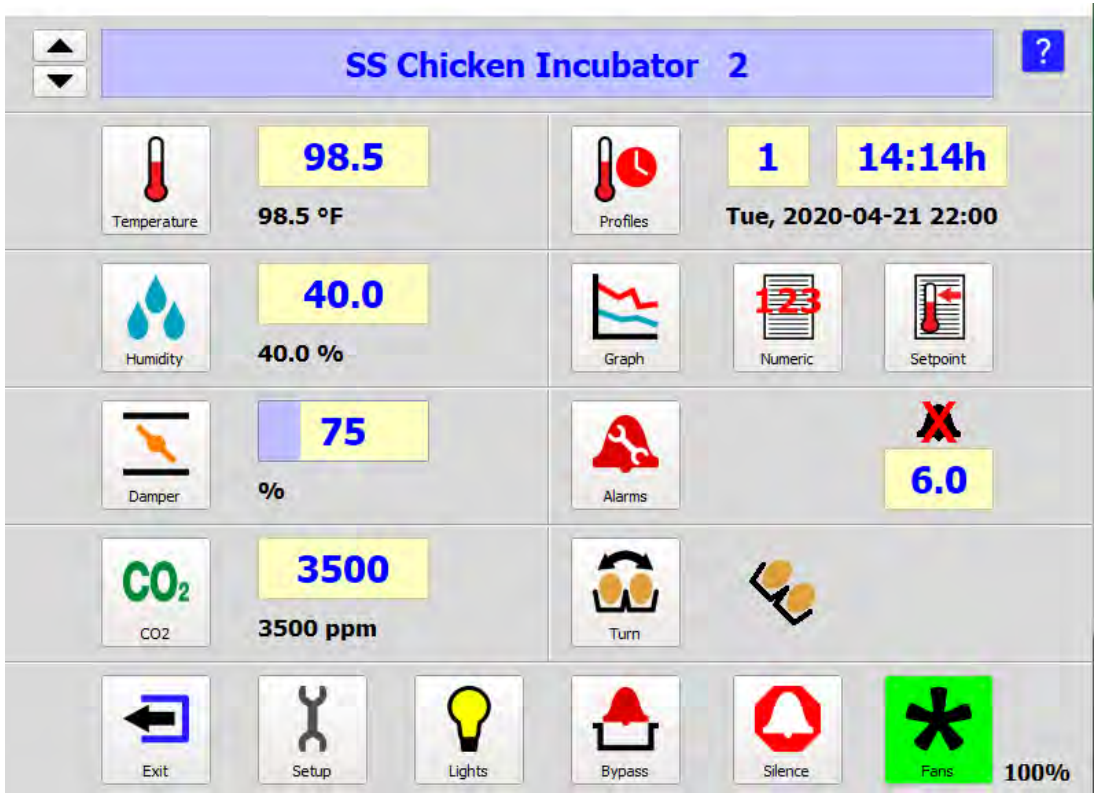
The Basics of Incubation

- Temperature
  - Controls embryo growth rate (faster or slower)
- Humidity
  - Controls moisture loss
- Ventilation (gas exchange)
  - Temperature & moisture exchange
- Turning
  - Embryo movement/development



The Basics of Incubation
What's Missing?

THE EGG!!

- We can not turn a '**BAD EGG**' into a '**GOOD EGG**'

- The hatching potential of each egg is determined at oviposition
  - We cannot improve the hatchability of an egg after it is laid, but we can reduce its hatching potential after lay.

- Egg pack = hatching egg quality (fertility, shell quality, egg handling, cleanliness, shape, etc)

What Do We Need to WIN?!

1. The best car (hatchery equipment)
2. A great driver (manager, personnel, maintenance)
3. The best fuel (eggs)

We need ALL of the above, to maximize our potential.

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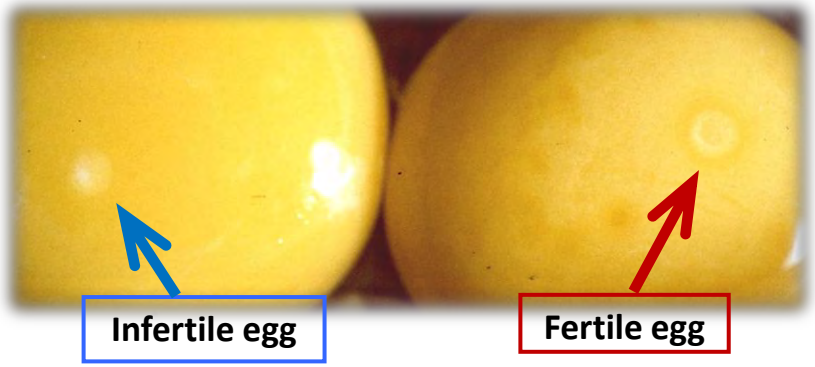
What Makes a Successful Hatchery?

1) An excellent breeder program.
2) Hatching egg management.
3) Well trained hatchery personnel.
4) Preventative maintenance progra
5) Incubator/hatcher management.
6) Chick handling and delivery.

Never forget sanitation throughout

1) An Excellent Breeder Program

- You can NOT hatch an infertile egg, EVER!
- When fertility drops, embryo mortality increases.
  - Reduced hatchability (fewer chicks)
  - Lower percent hatch of fertile
  - Reduced chick quality
  - Poor broiler performance

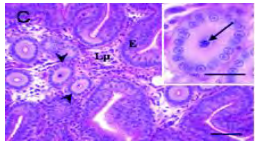


You can have a great breeder program and a bad hatchery, but…

You CAN NOT have a bad breeder program and a great hatchery!

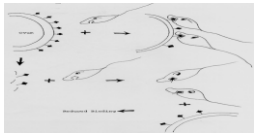
Fertilization Process

Sperm
Storage



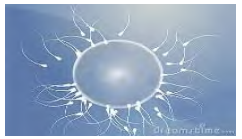
Sperm transport to
site of fertilization

Recognition of
sperm binding sites



Sperm acrosome
reaction and
penetration

Fertilization



Insemination
(Artificial or Natural)

Fertilization and Sperm-Egg Interaction

For successful fertilization, sperm must:

- Attach to perivitelline layer overlying the germinal disc
- Undergo an acrosome reaction and digest a pathway through the outer membrane

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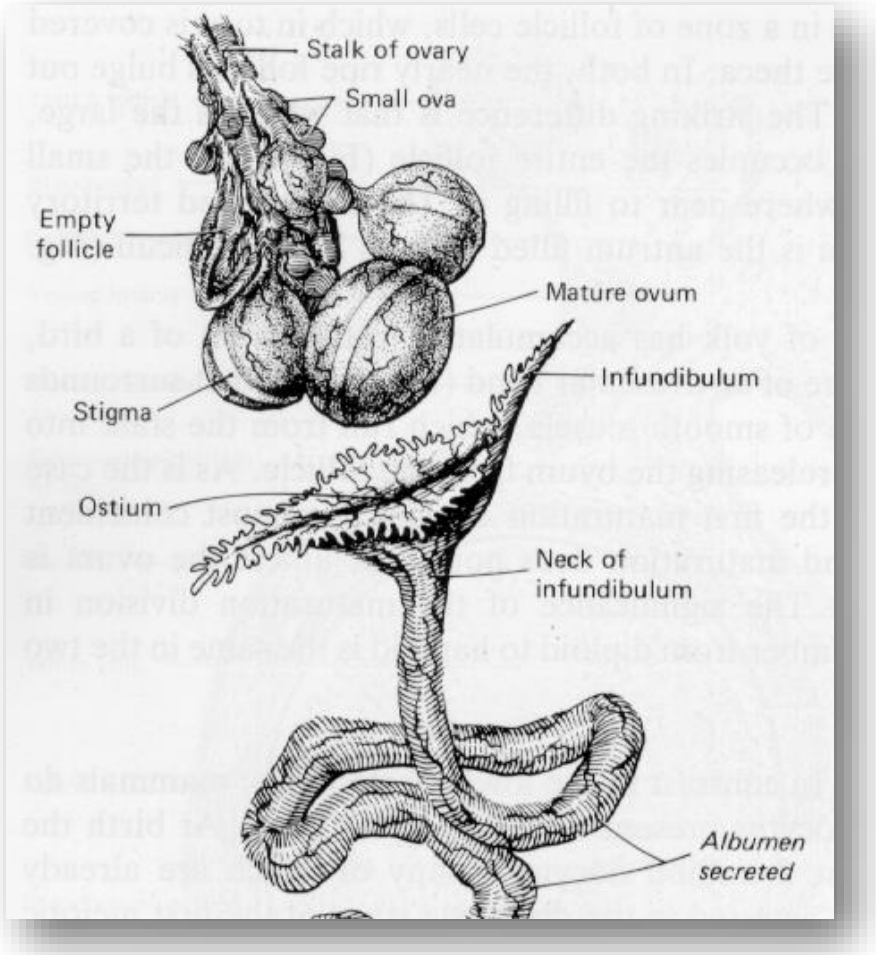
Fertilization Process

- Location - Infundibulum
- Funnel shaped – acts to engulf ovum



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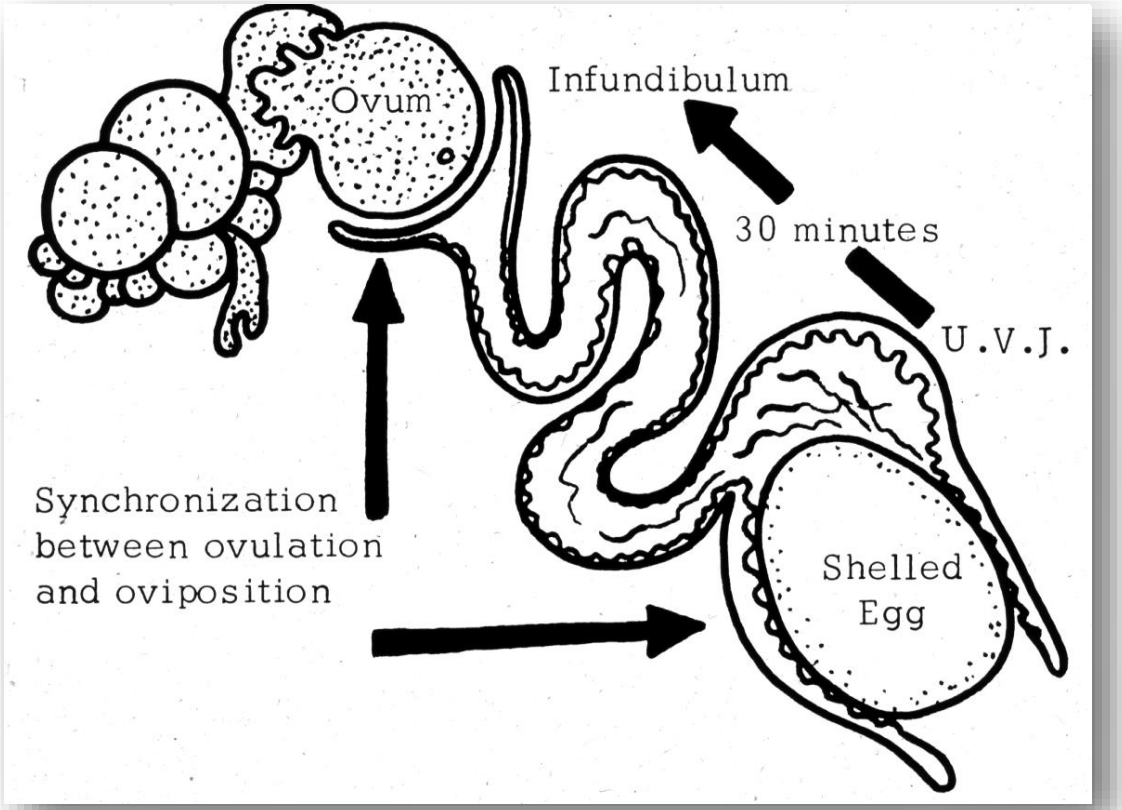
Fertilization Process

- Fertilization occurs < 5 minutes after ovulation
- Capture of ova is not necessarily a result of ovulation
- Ova present ~ 15 minutes (in chickens)



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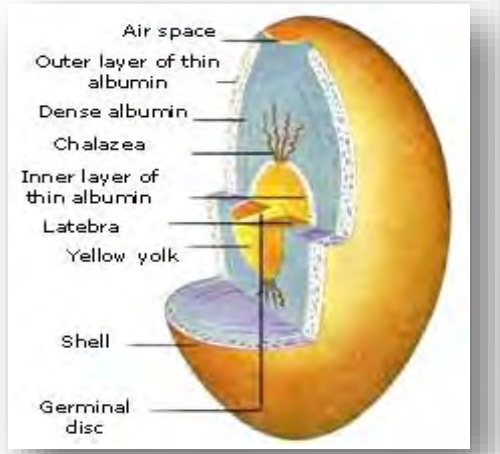
Fertilization Process

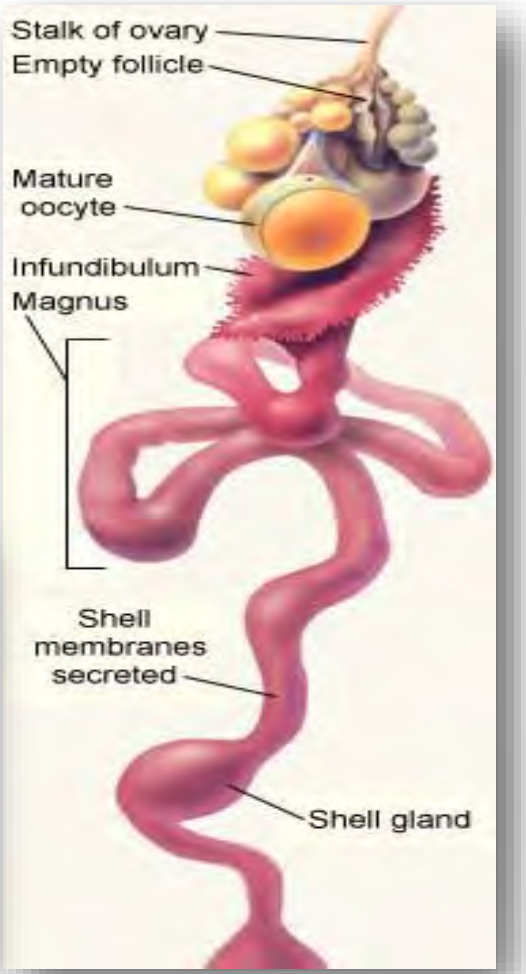
- Shell formation:

  24-26 hours to complete

- Hen's body temperature:

  40 - 41° C





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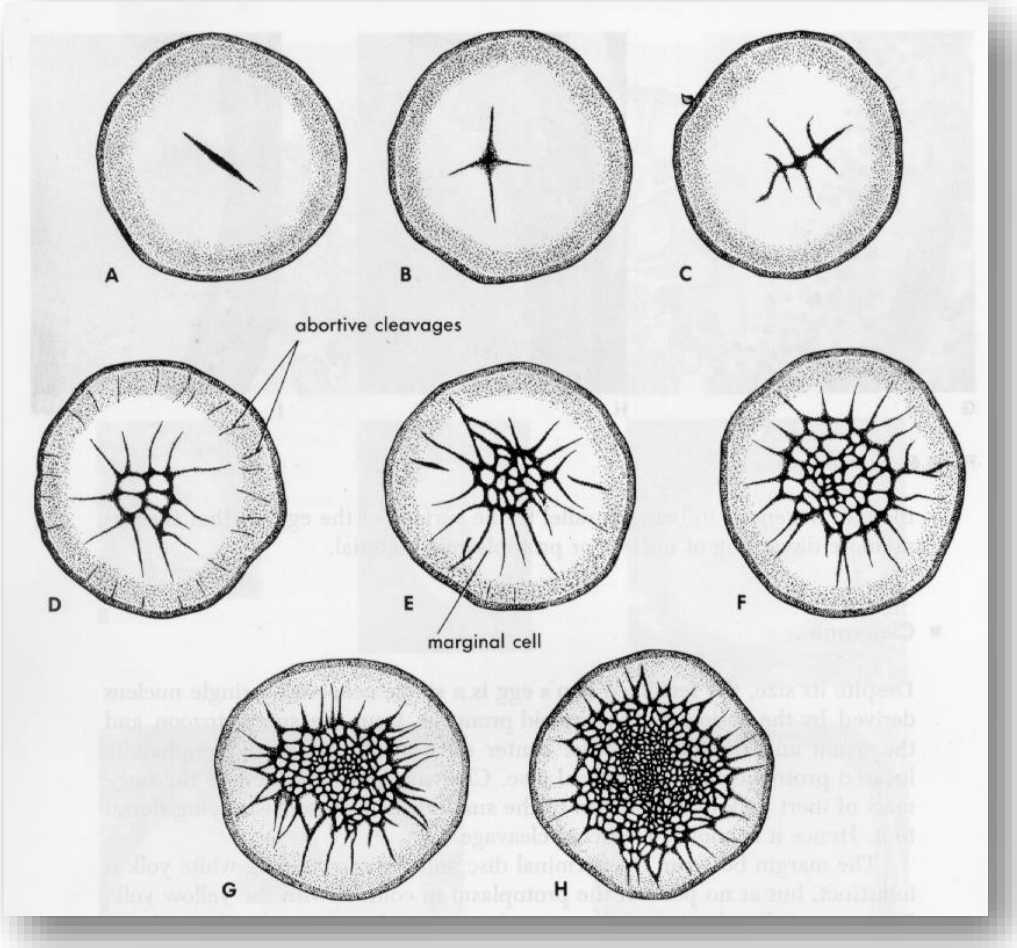
Fertilization Process

- Fertilization occurs within 5 minutes after ovulation
- Shell formation takes 24-26 hours to complete
- Hen's body temperature 40 - 41° C (104 - 105 F)
- Laid egg represents 1 days embryonic growth (up to 60,000 cells)



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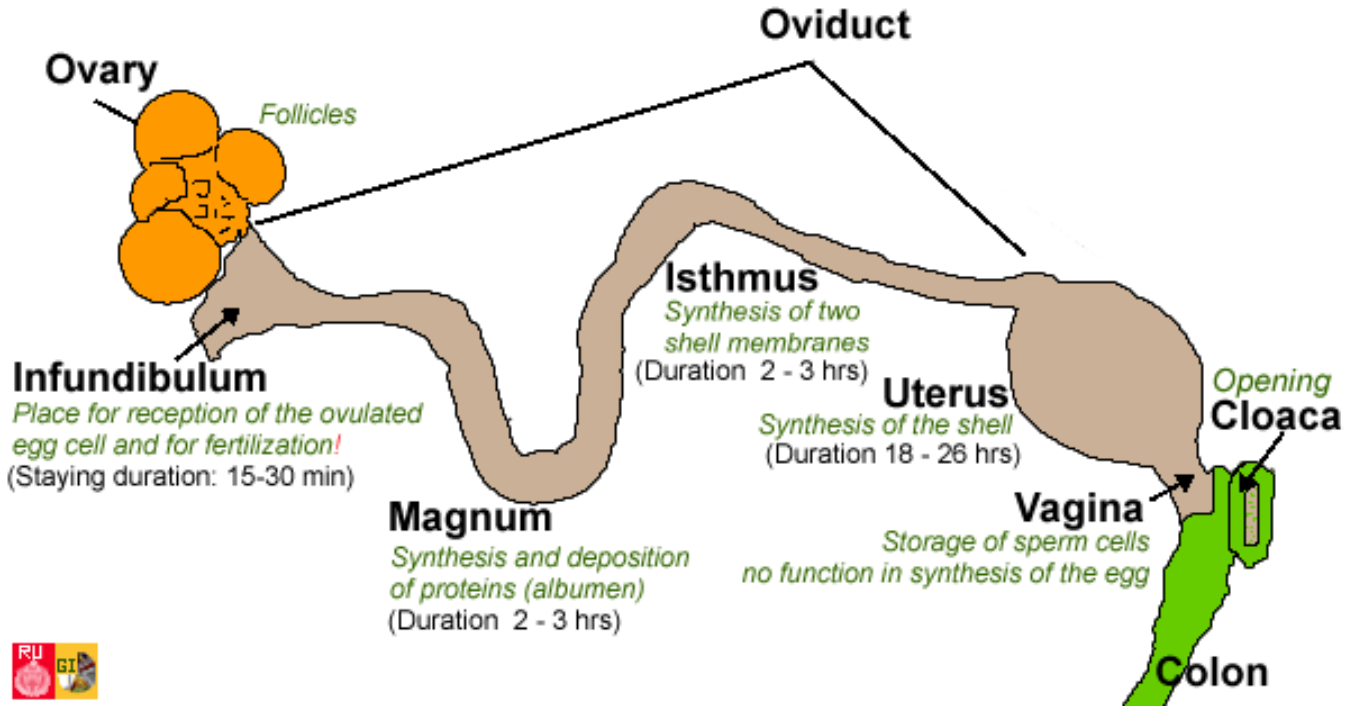
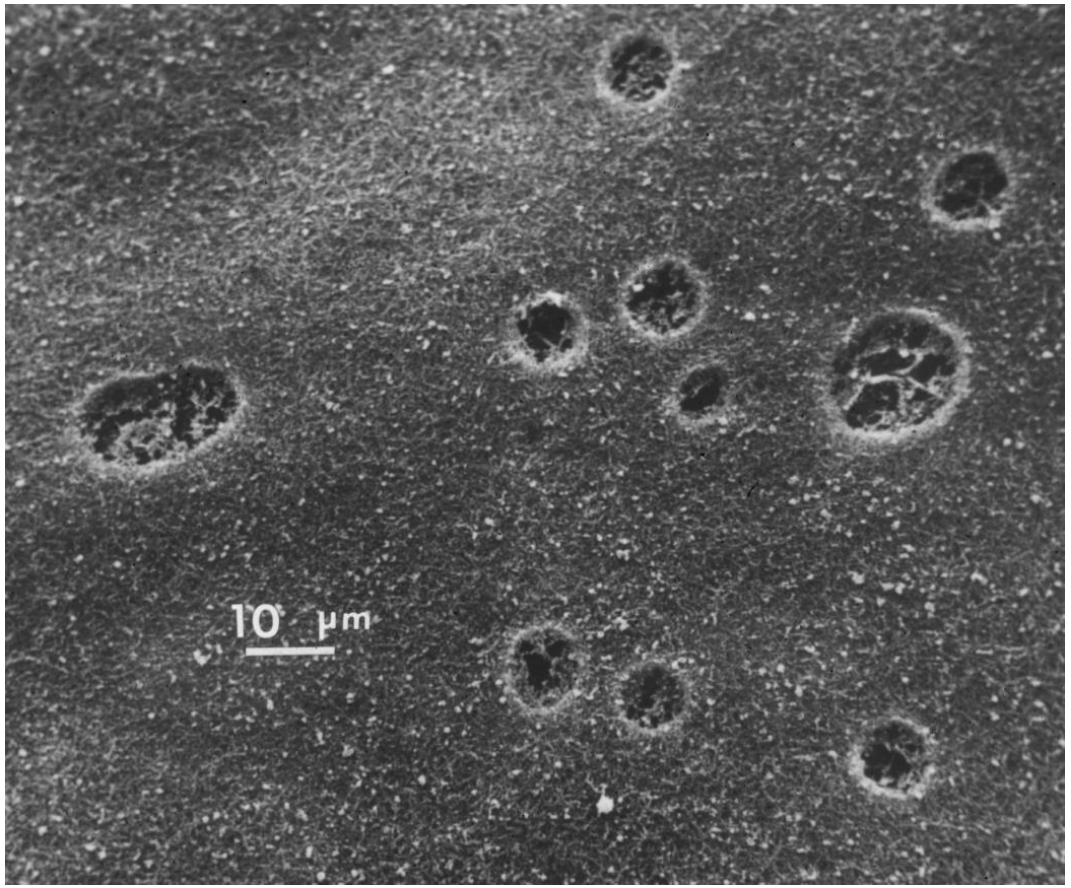
Infertile vs Fertile Eggs

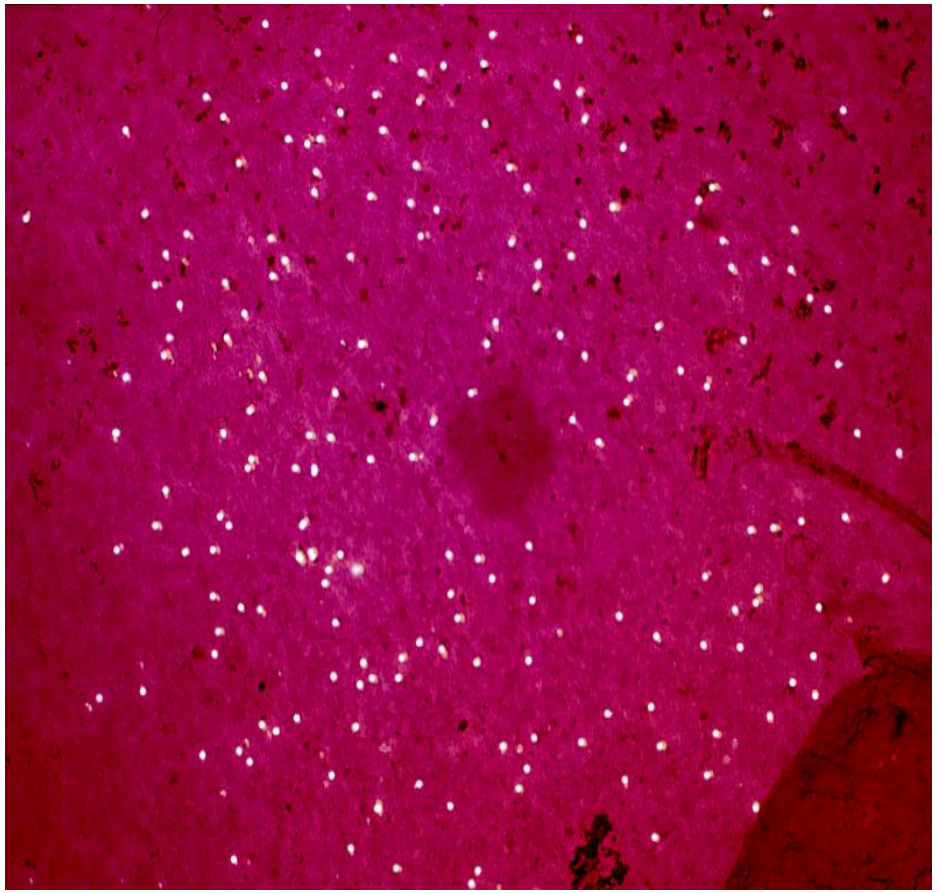
Sperm Cell Storage

- A biological necessity to produce fertile eggs in the avian system



A simple quantitative technique was developed for evaluating sperm attachment and penetration of the PL applicable to both in vitro and in vivo investigations.

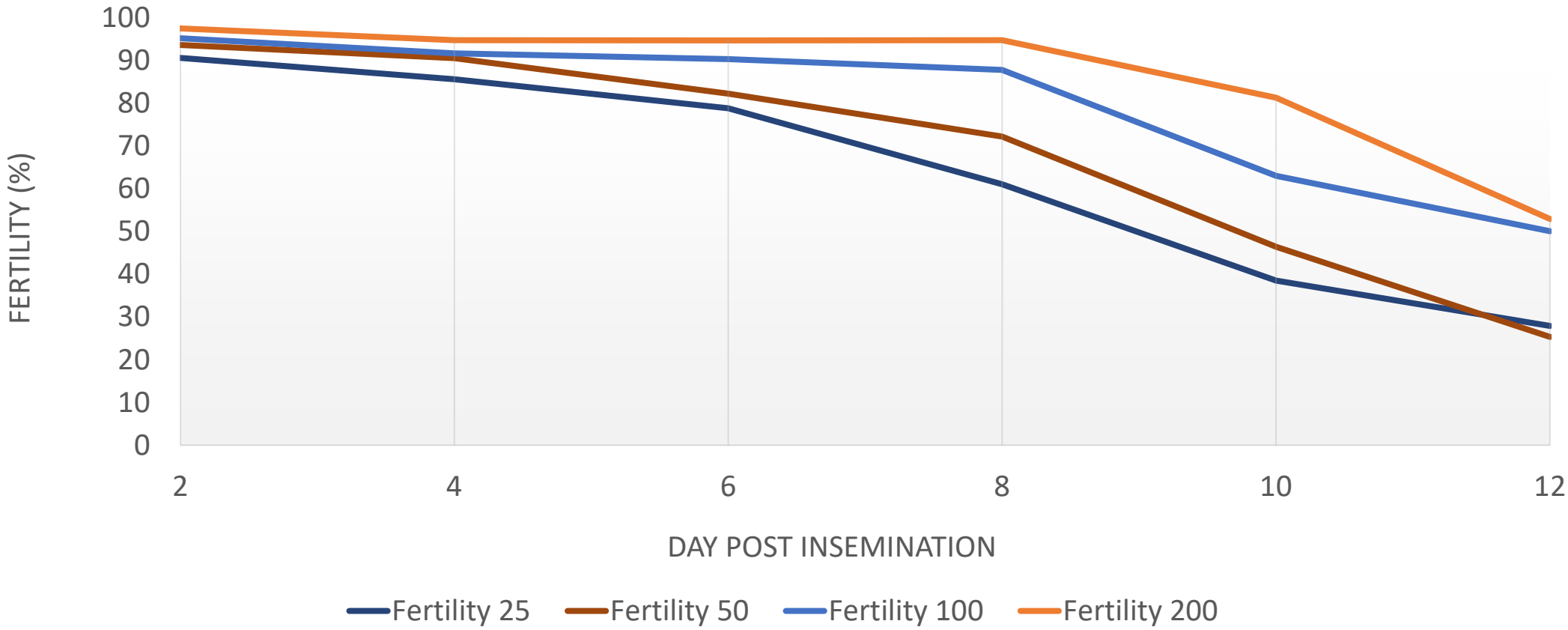




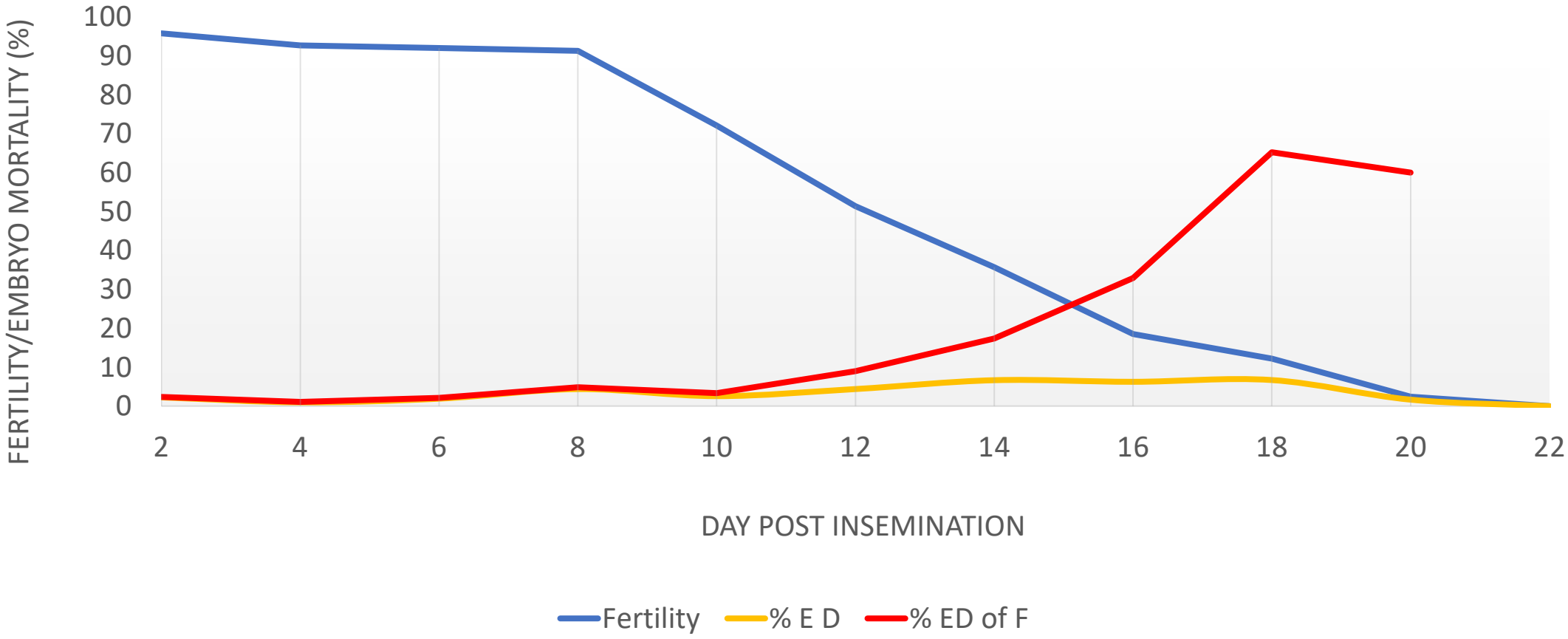
Daily Sperm Penetration Following Insemination

Dose (mil)	2	4	6	8	10	12	14	16
200	69.2	50.6	18.9	14.1	10.5	8.7	7.0	3.6
100	35.9	20.4	10.5	8.8	7.3	4.8	3.7	2.5
50	24.6	14.1	7.8	6.2	5.0	3.6	2.0	0.7

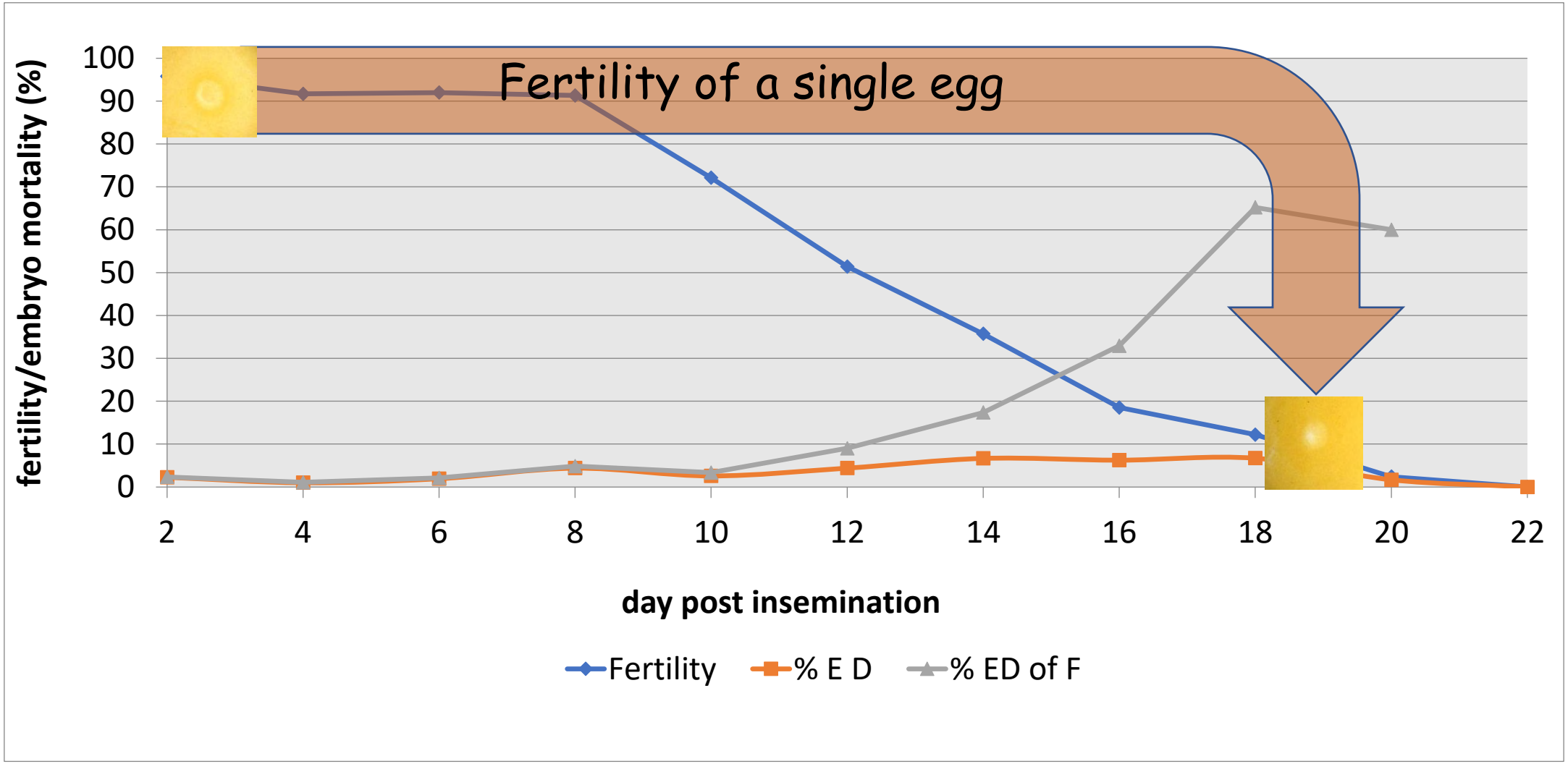
Fertility & Embryonic Mortality



Fertility & Embryonic Mortality



Good Fertile or “Sort of Fertile”



In Vivo Sperm Storage (in the hen)

Dose (mil)	2	4	6	8	10	12	14	16
200	69.2	50.6	18.9	14.1	10.5	8.7	7.0	3.6
100	35.9	20.4	10.5	8.8	7.3	4.8	3.7	2.5
50	24.6	14.1	7.8	6.2	5.0	3.6	2.0	0.7

Table 1: Hatchability after in vivo Sperm Storage Length

	% Hatch	% Hatch of Fertile
0-5 days	66.21^{A}	78.93
6-10 days	49.83^{AB}	74.66
11-15 days	24.64^{B}	67.03

[1]Numbers with different superscript are significantly different P<0.05

In Vivo Sperm Storage (in the hen)

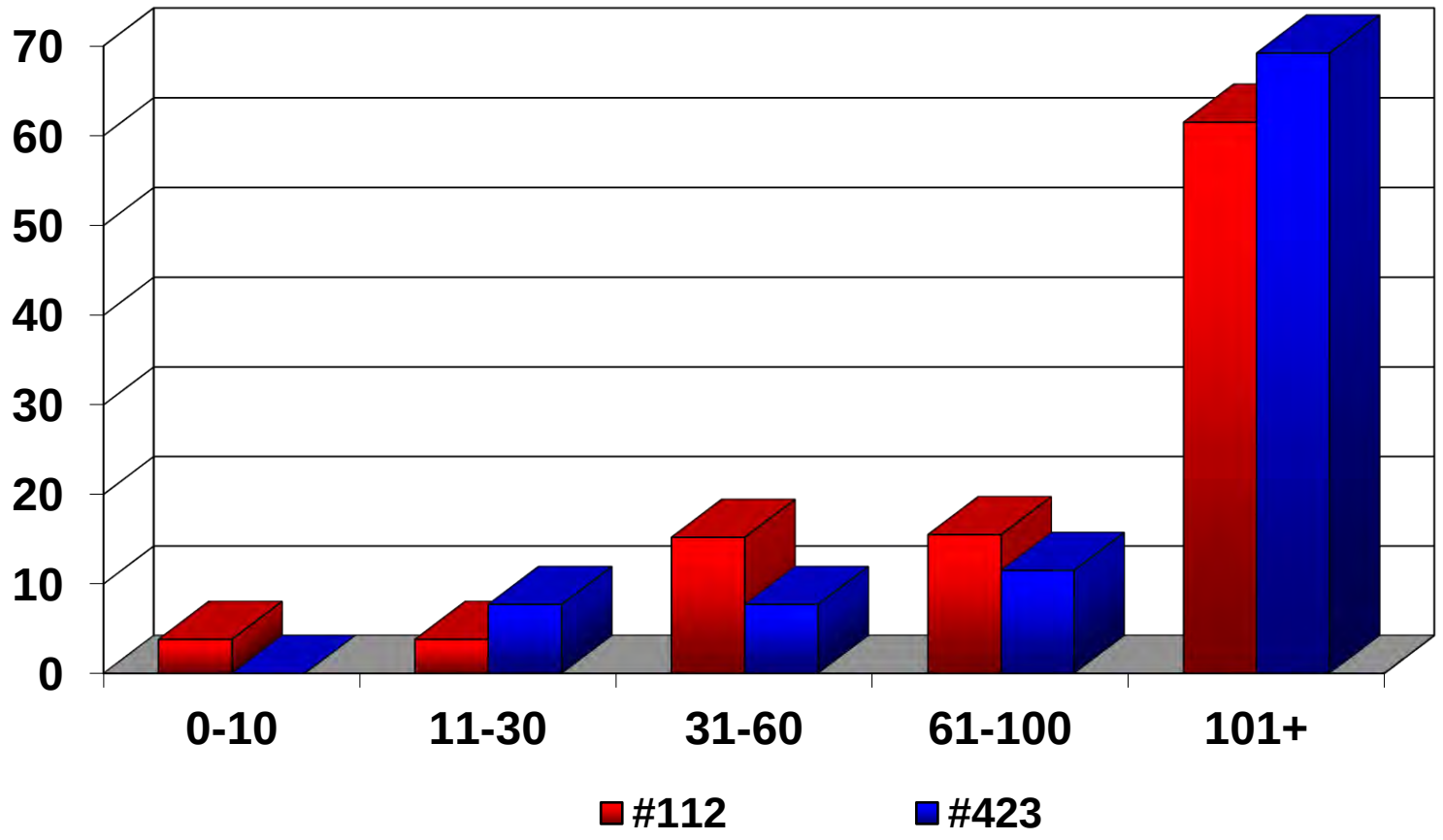
Dose (mil)	2	4	6	8	10	12	14	16
200	69.2	50.6	18.9	14.1	10.5	8.7	7.0	3.6
100	35.9	20.4	10.5	8.8	7.3	4.8	3.7	2.5
50	24.6	14.1	7.8	6.2	5.0	3.6	2.0	0.7

Table 2: Growth Rate and Livability after in vivo Sperm Storage

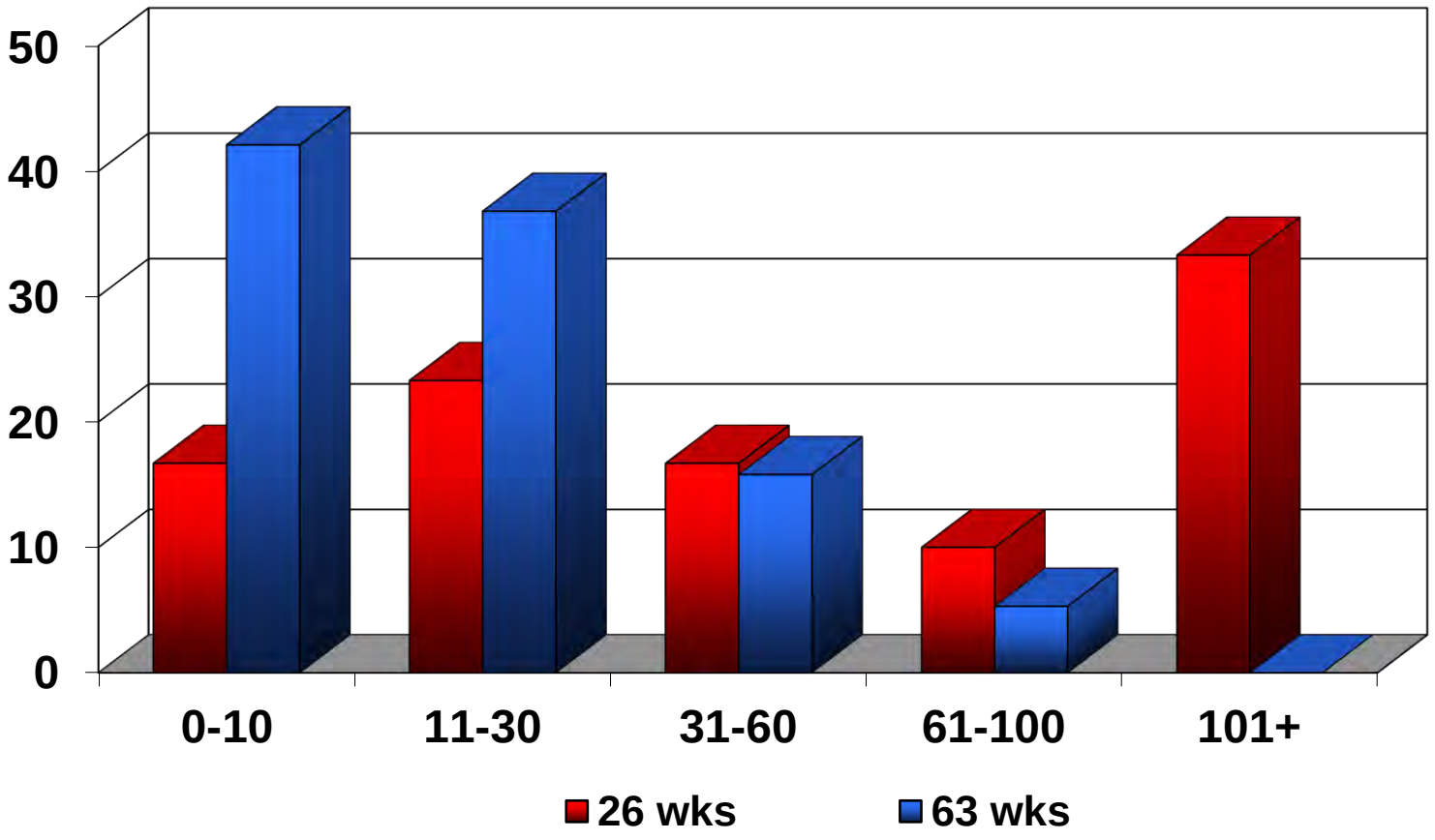
	0 day	7 day	14 day	% dead
0-5 days	54	155	399	1.1%
6-10 days	52	149	395	1.2%
11-15 days	48	145	388	9.7%

***Weights in g**

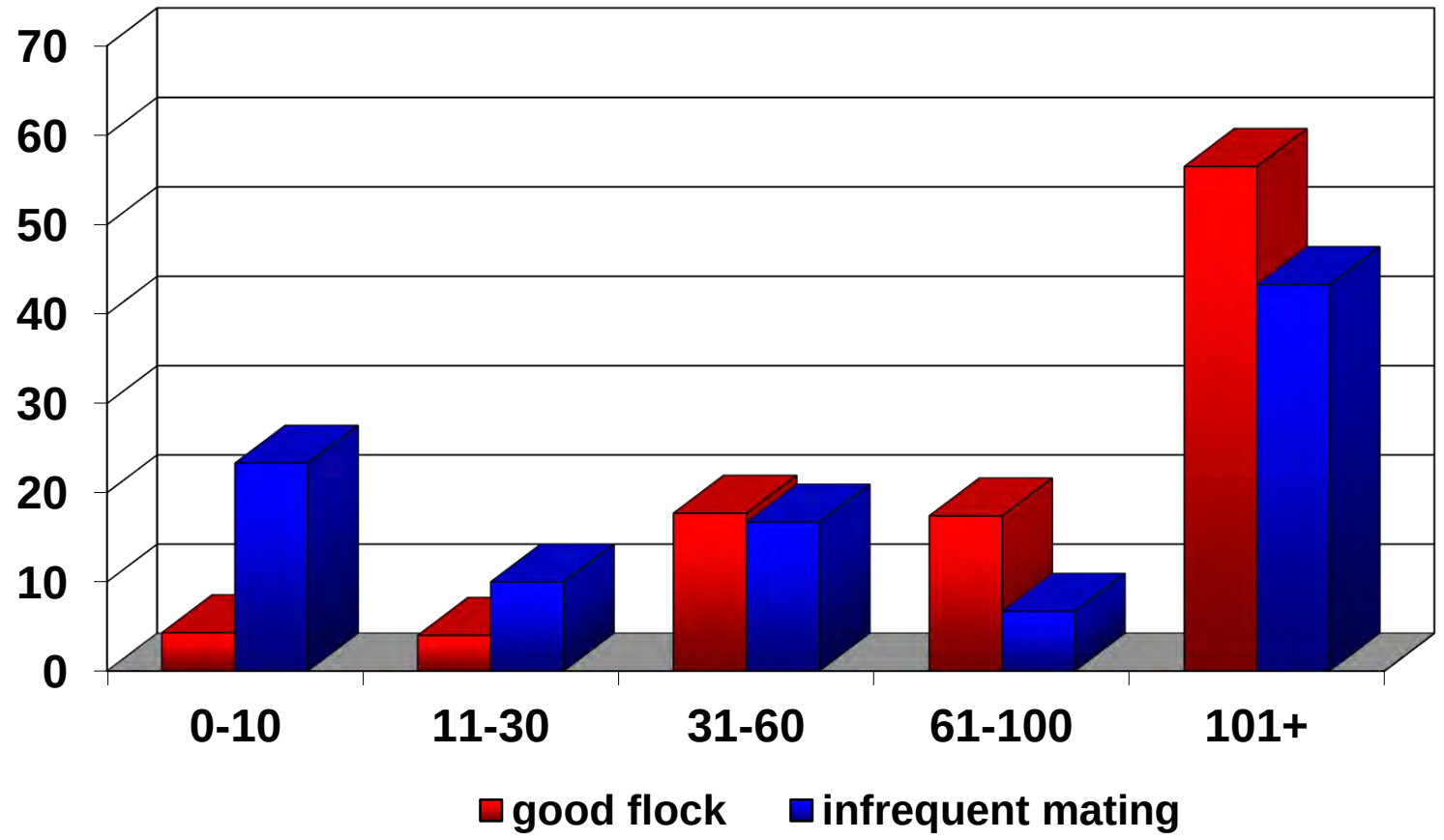
Frequency Distribution of Sperm Penetration (good flocks, peak production)



Frequency Distribution of Sperm Penetration (old vs. young flocks)



Frequency Distribution of Sperm Penetration (average flock vs. infrequent mating activity)



Fertility - Egg Handling

We have to have excellent fertility to have excellent hatch results.

Needs more attention and has a huge impact on hatch of fertile.

Egg handling starts at the farm and continues until the eggs are set in the incubator.

Purpose of Storing Hatching Eggs

- “Arrest” embryo development of embryo, preserve integrity of egg contents (yolk, albumen, etc)
- “Physiological Zero” - The temperature at which embryonic development stops, or is appreciably decreased
- For embryonic development to be virtually stopped, we need to get below ‘physiological zero’. ~ 75 F (23 C)

Embryo Development (Germinal Disc Size in mm)

Storage time	75 °F	80 °F	85 °F	90 °F	100 °F
24 hr	4.96	5.44	6.01	7.41	12.29
48 hr	4.78	6.08	10.19	15.48	-
72 hr	4.87	6.54	16.68	28.23	-
96 hr	4.86	9.13	22.62	38.96	-

1 mm

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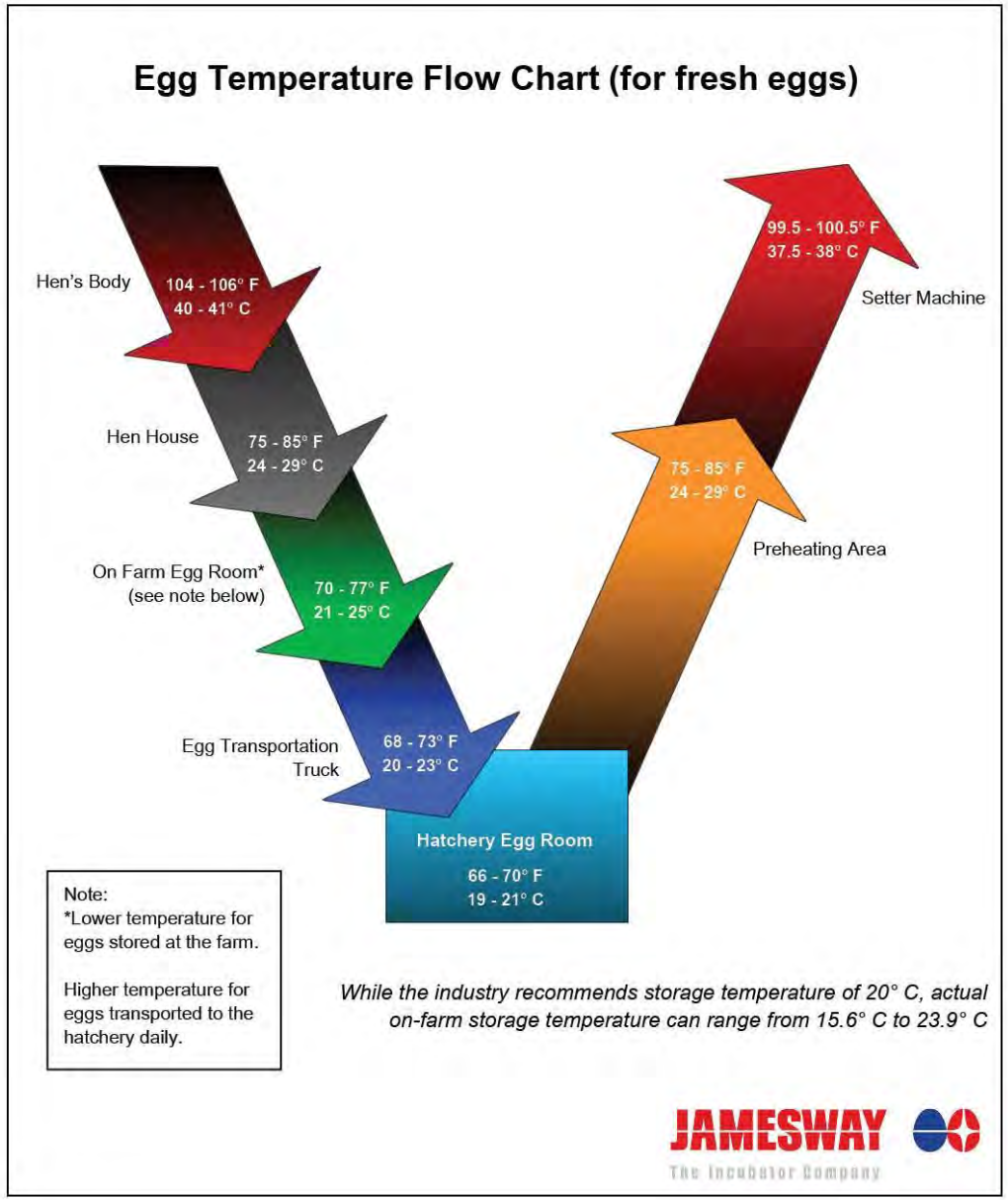
- Ideal hatching egg temperatures from the farm to the incubator.
- <u>Two</u> temperature changes, cooling from the farm until the hatchery egg room, then warming until they go in the setter.



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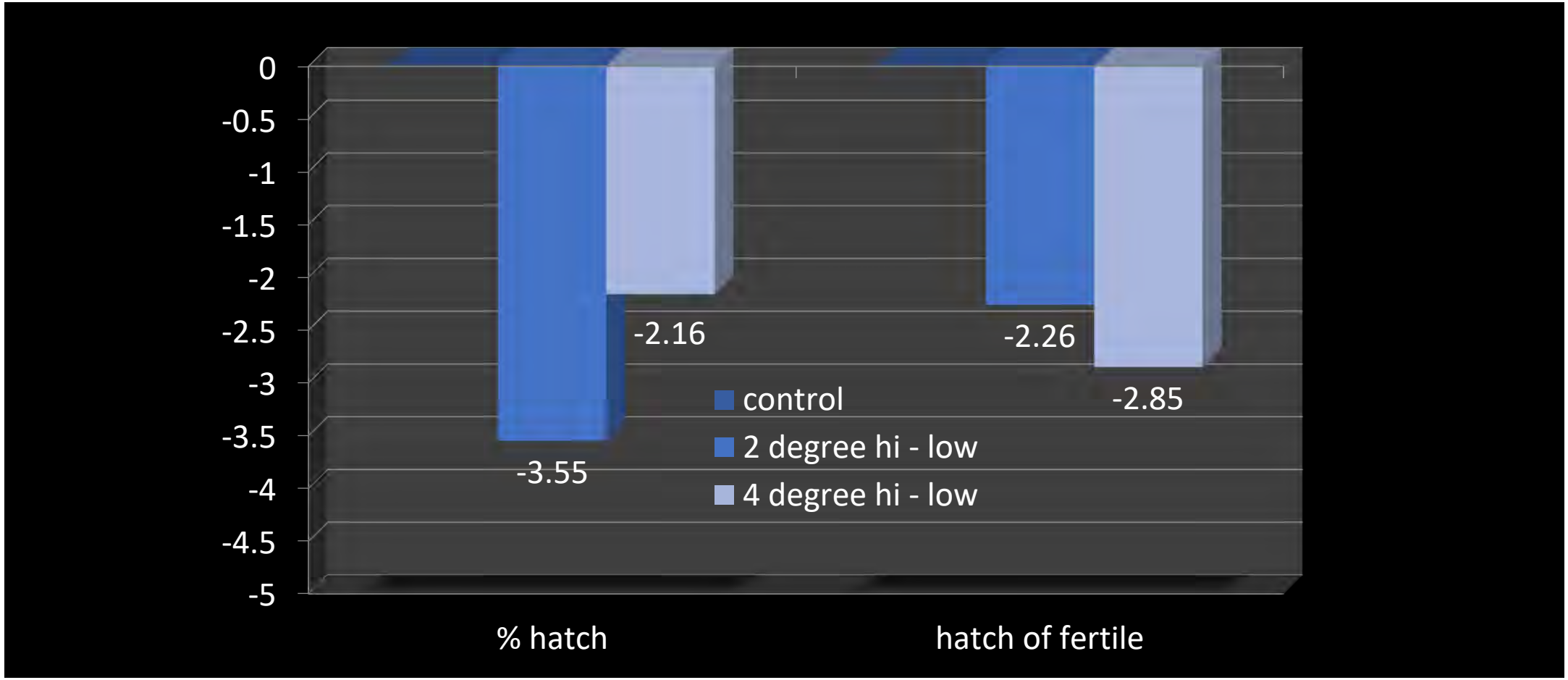
Hatch Loss Caused by Storage Temperature



Types of cull eggs:

- Broken/cracked
- Cull/shell quality
- Dirty
  - Sanded
  - Wiped
- Upside Down
- Egg weight
- Egg shape
- Egg color

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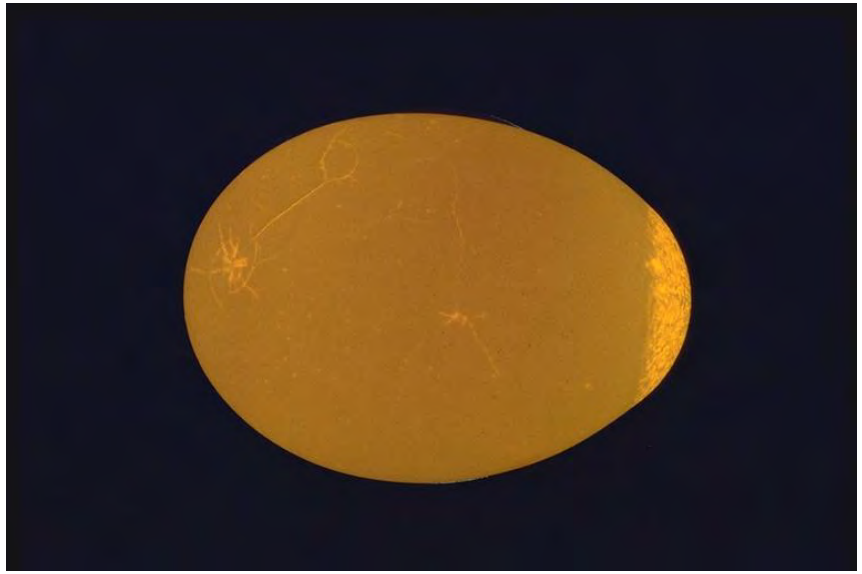
Broken Eggs

- Some are obviously broken
- Some small fractures are not noticeable
- Important to handle eggs with care



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Cull Eggs

- Slab sided
- Long narrow
- Wrinkled
- Extra calcium deposits
- Misshaped
- Too small

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Dirty Eggs

- Fecal material
- Broken eggs
- Litter material
- Nesting material
- Blood

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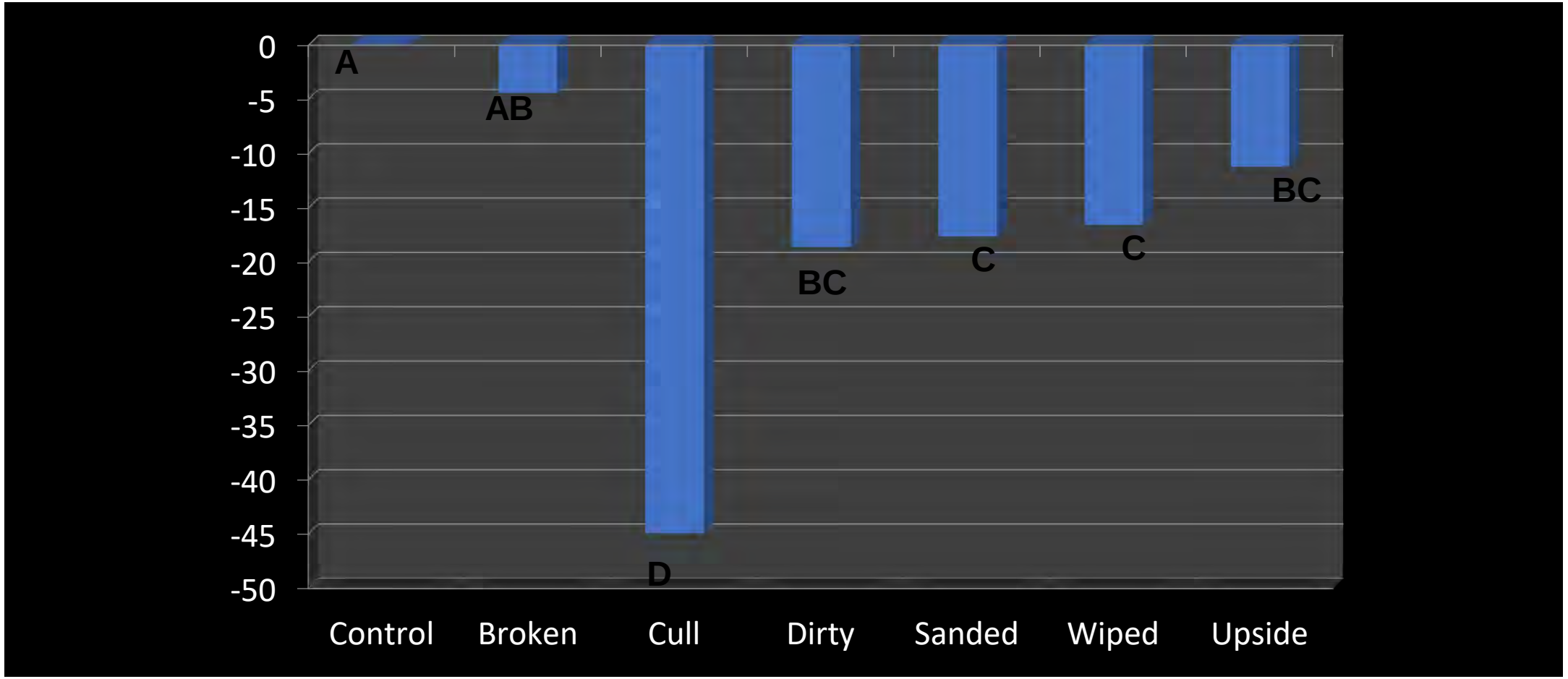
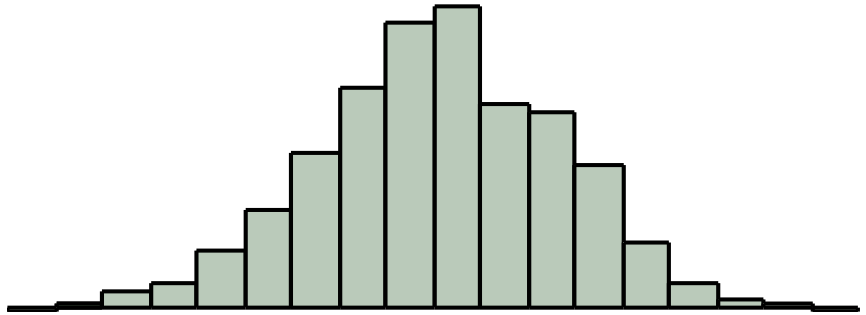
% Hatch Loss

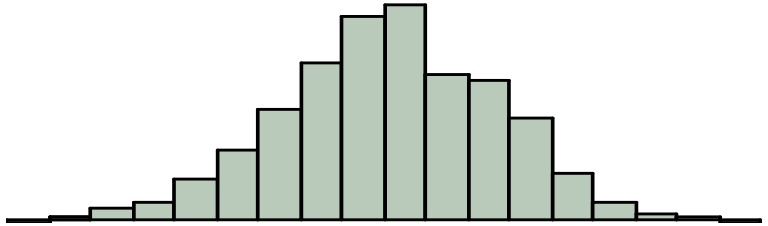

0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
A
AB
D
BC
C
C
BC
Control
Broken
Cull
Dirty
Sanded
Wiped
Upside

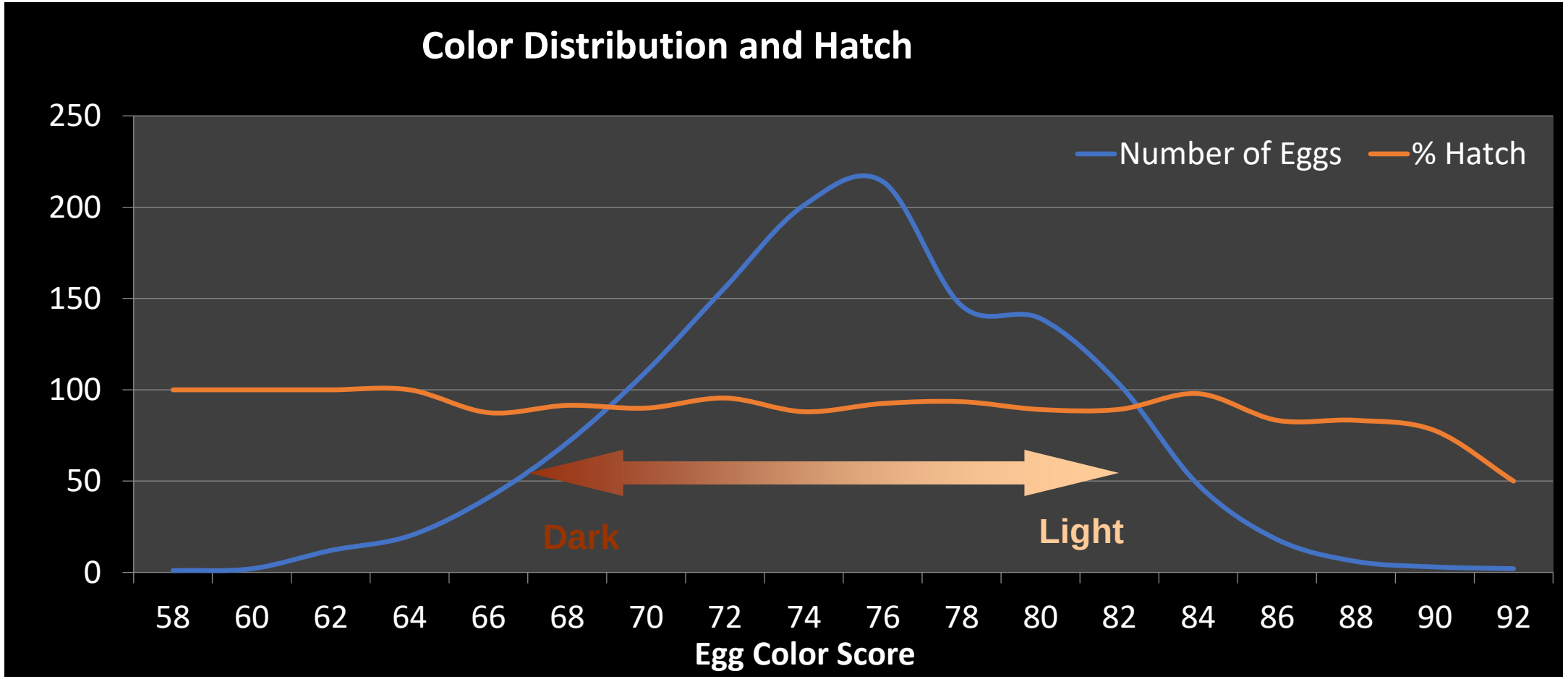
Variation of Color in Eggs



Mean = 76.22

Median = 76.27

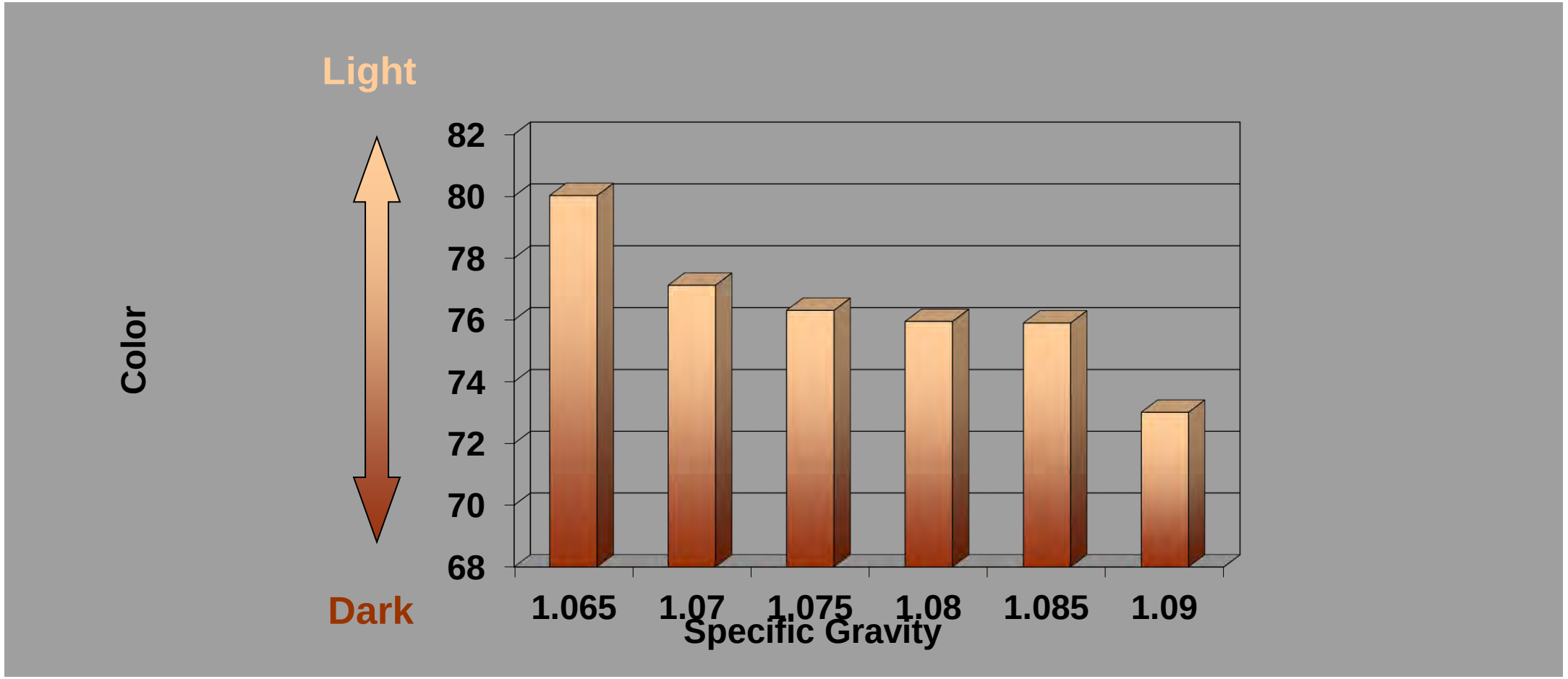



Color Distribution and Hatch
250
200
150
100
50
0
Number of Eggs
% Hatch
Dark
Light
58
60
62
64
66
68
70
72
74
76
78
80
82
84
86
88
90
92
Egg Color Score

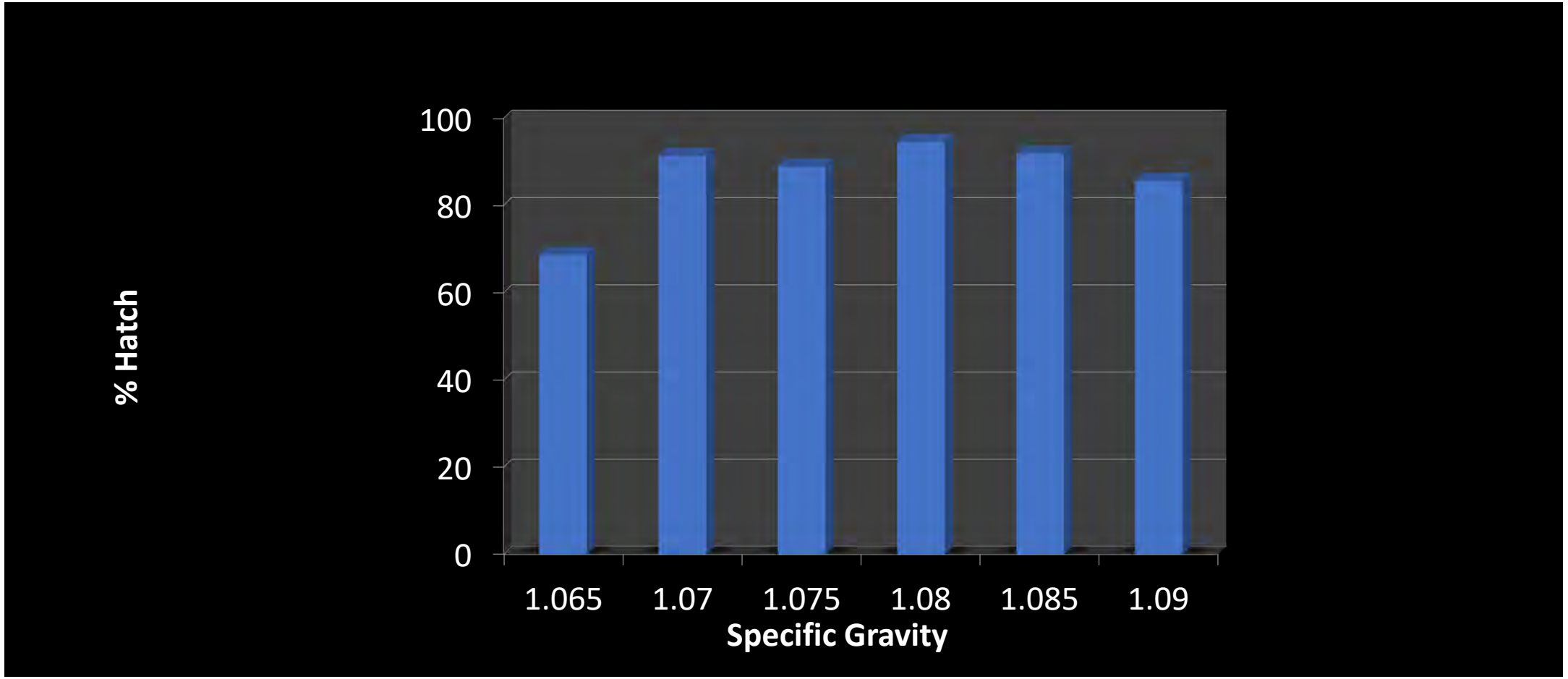
Specific Gravity: What Does it Mean?

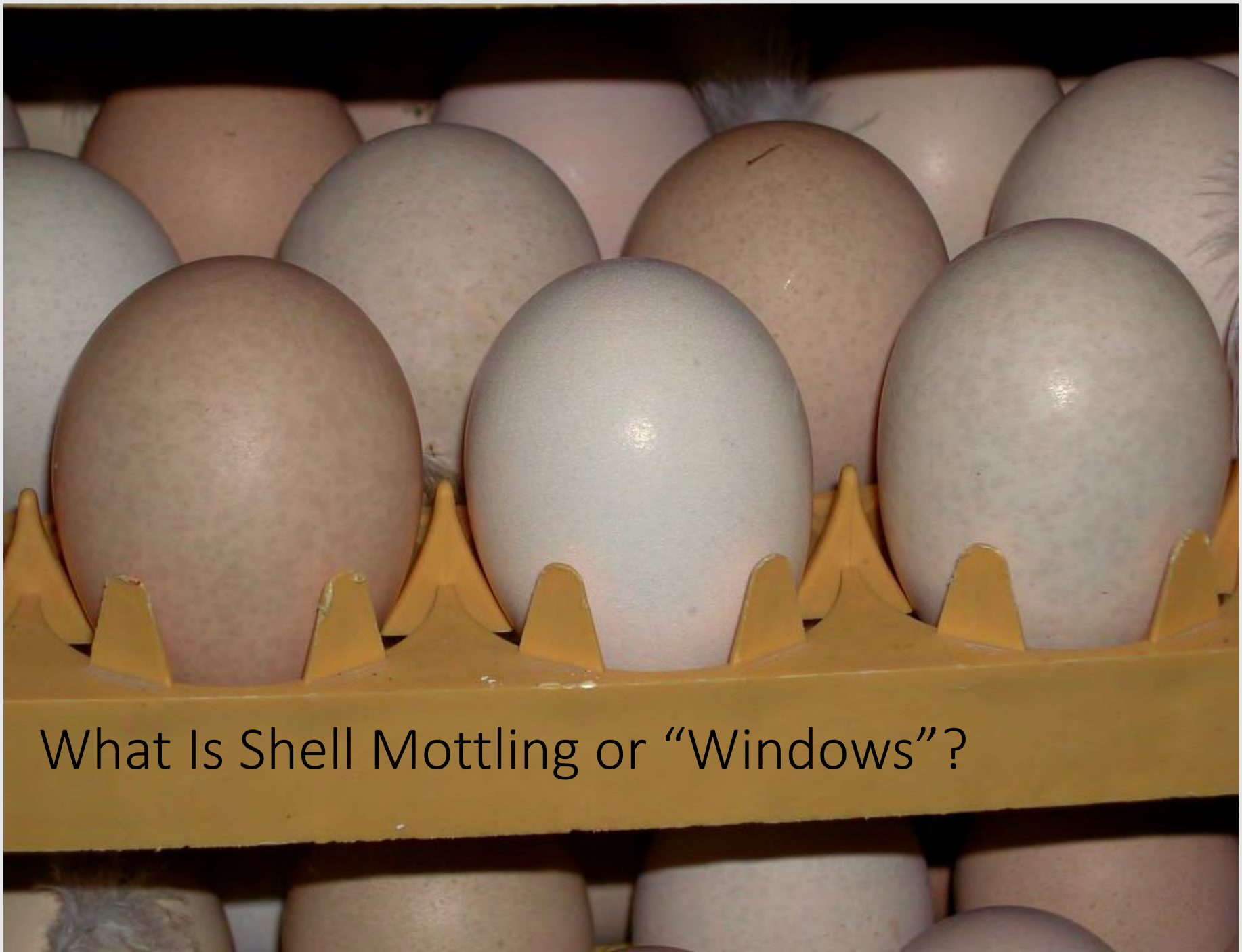
- Measures egg shell strength
- Solutions range from 1.06 to 1.095 in increments of 0.005
- Usually 1.085 and above are considered ideal
- Eggs at 1.080 and below are considered to have weaker shells and may be more susceptible to breakage, moisture loss, etc.

Color and Specific Gravity



% Hatch and Specific Gravity




What Is Shell Mottling or “Windows”?

Variations in Eggs

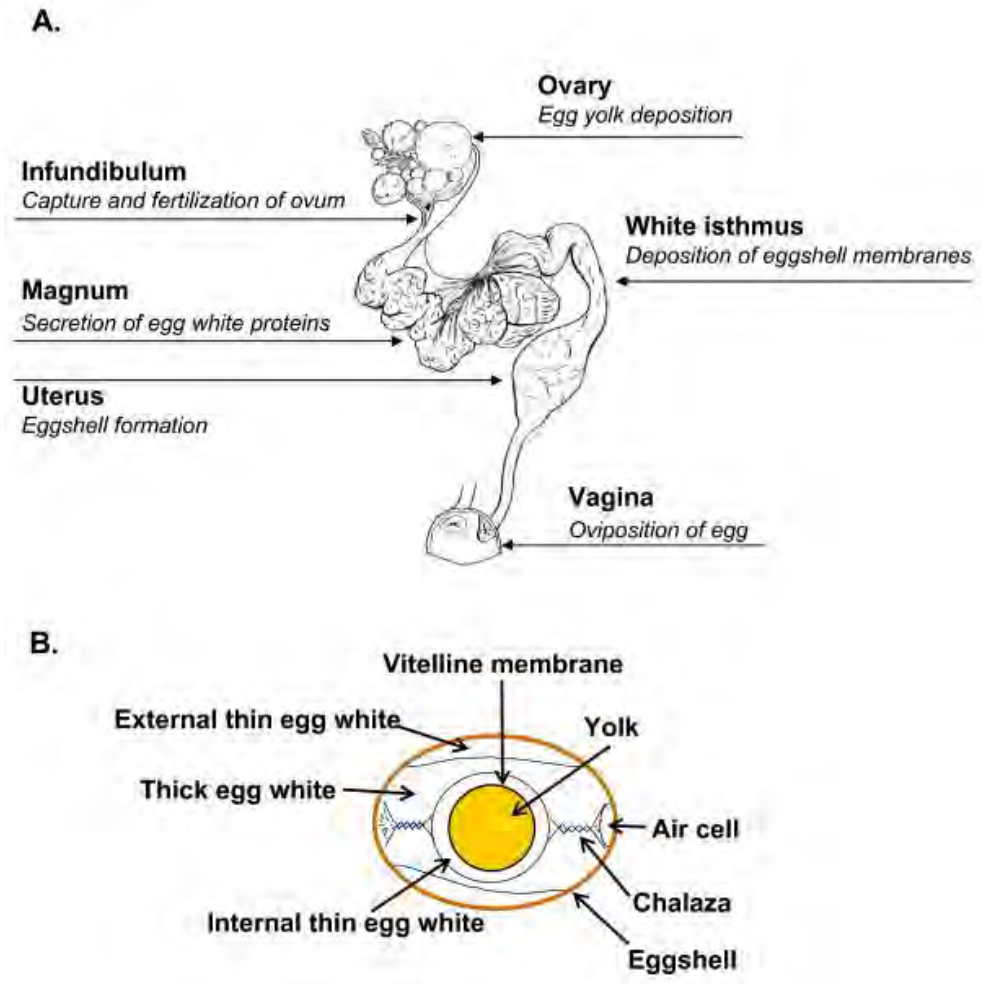
- 1) Size
- 2) Shape
- 3) Shell

Variations in Egg Size (weight)

- Greater variation in egg weight than length or width of the egg
- Small hens tend to lay smaller eggs and visa versa (1920's), this relationship continues as the hens age
  - Small eggs early = small eggs for life of flock
- More prolific layers tend to lay smaller eggs
  - Hens with shorter clutch lengths (egg sequences) tend to lay larger eggs
- As hens age egg size tends to increase
- Eggs laid in the early morning are typically larger

Variations in Egg Shape

- Egg shape is determined by:
  - 1) amount of albumen secreted in the albumen-secreting region
  - 2) the size of the lumen at that part of the isthmus
  - 3) muscular activity of the walls in this region
  - 4) some possible alteration in the uterus



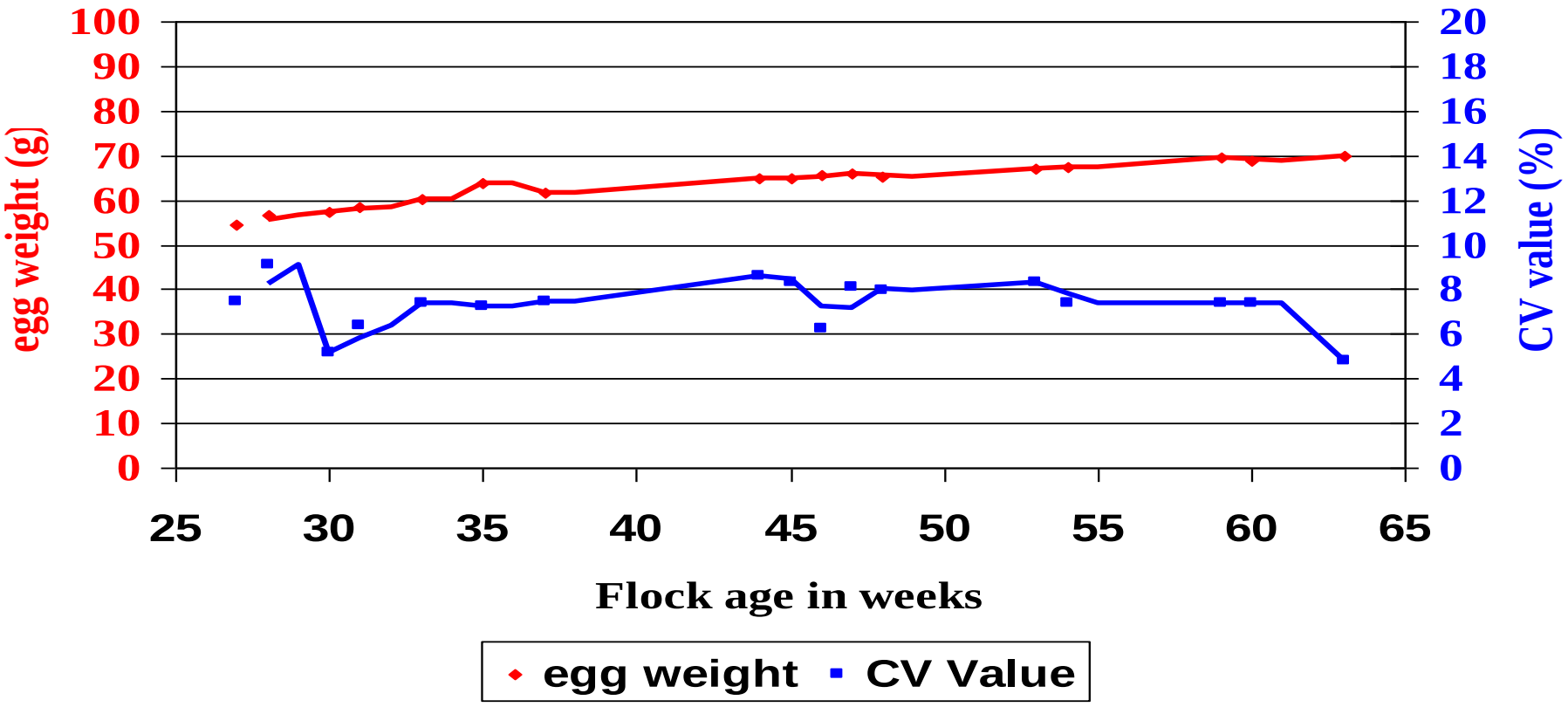
Variations in Egg Shape

- Shape is more variable than length or width but not weight
- No seasonal changes in shape
- First egg of a cycle is typically more oblong
- Strong genetic influence, but individual variation exists

Is Variable Egg Size Really a Problem?

- Industry suggested a problem in all flocks
  - Does it reduce hatch?
- Believed to be getting worse over time
- Most based upon visual observations
- How much does it affect performance?

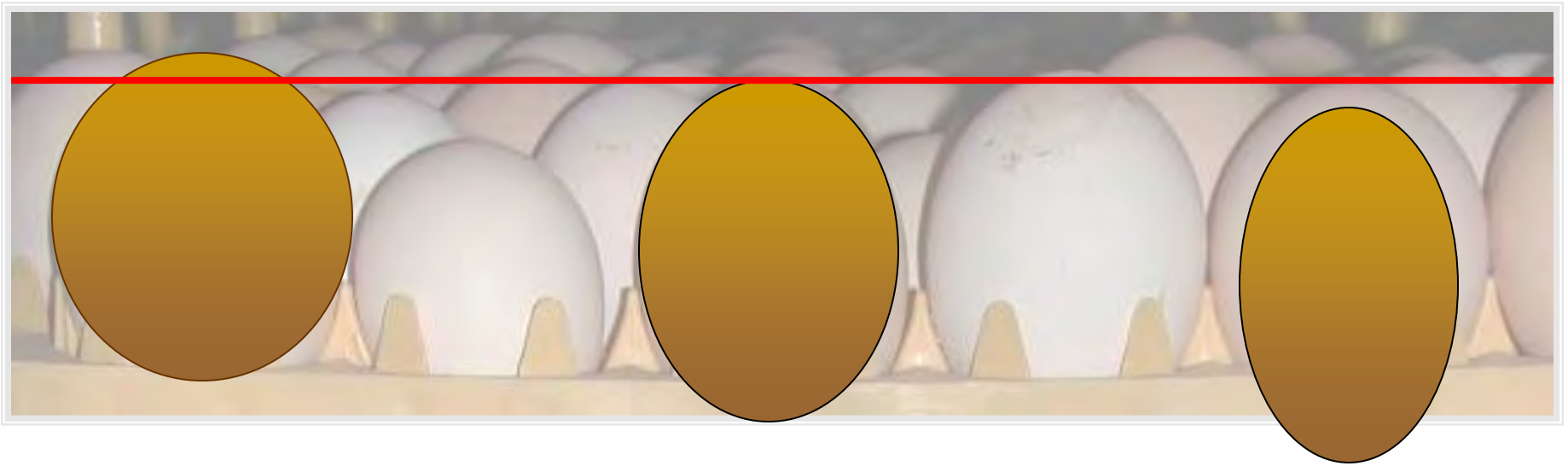
Egg Weight and CV Values



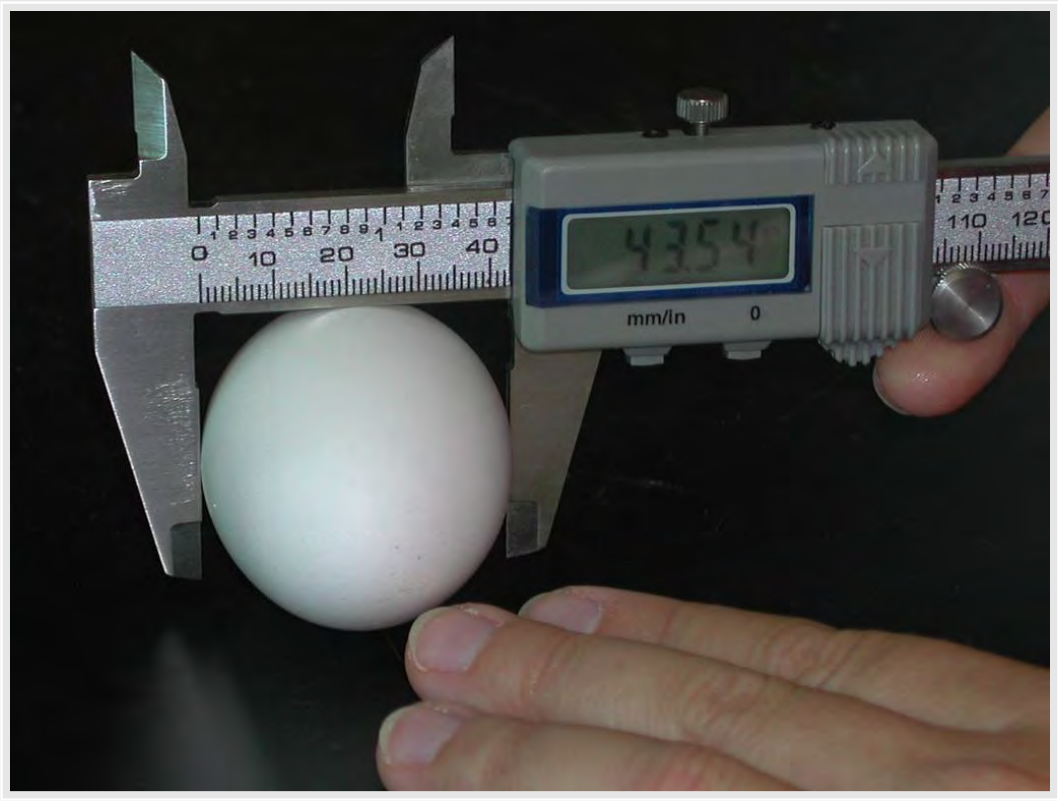
Egg Weight vs Hatchability

	Heavy	Medium	Light	Total
% Hatch	89.45	91.38	89.94	89.27
Range	85.8 - 95.5	85.2 – 96.2	84.6 – 93.9	84.6 – 96.2

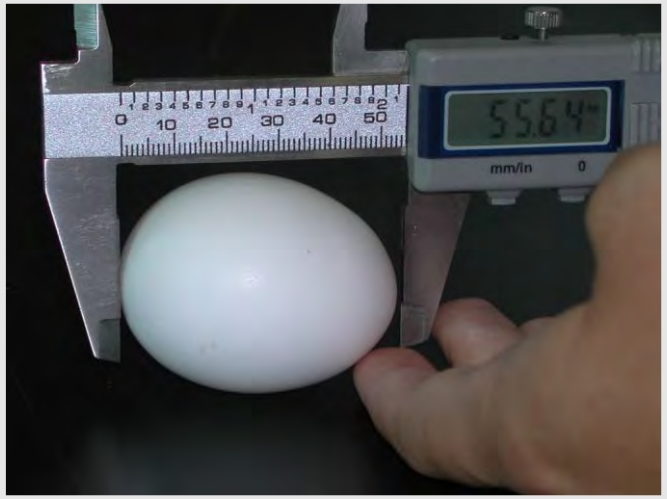
Egg Size (weight) vs. Egg Shape



- Egg size is usually measured by weighing eggs

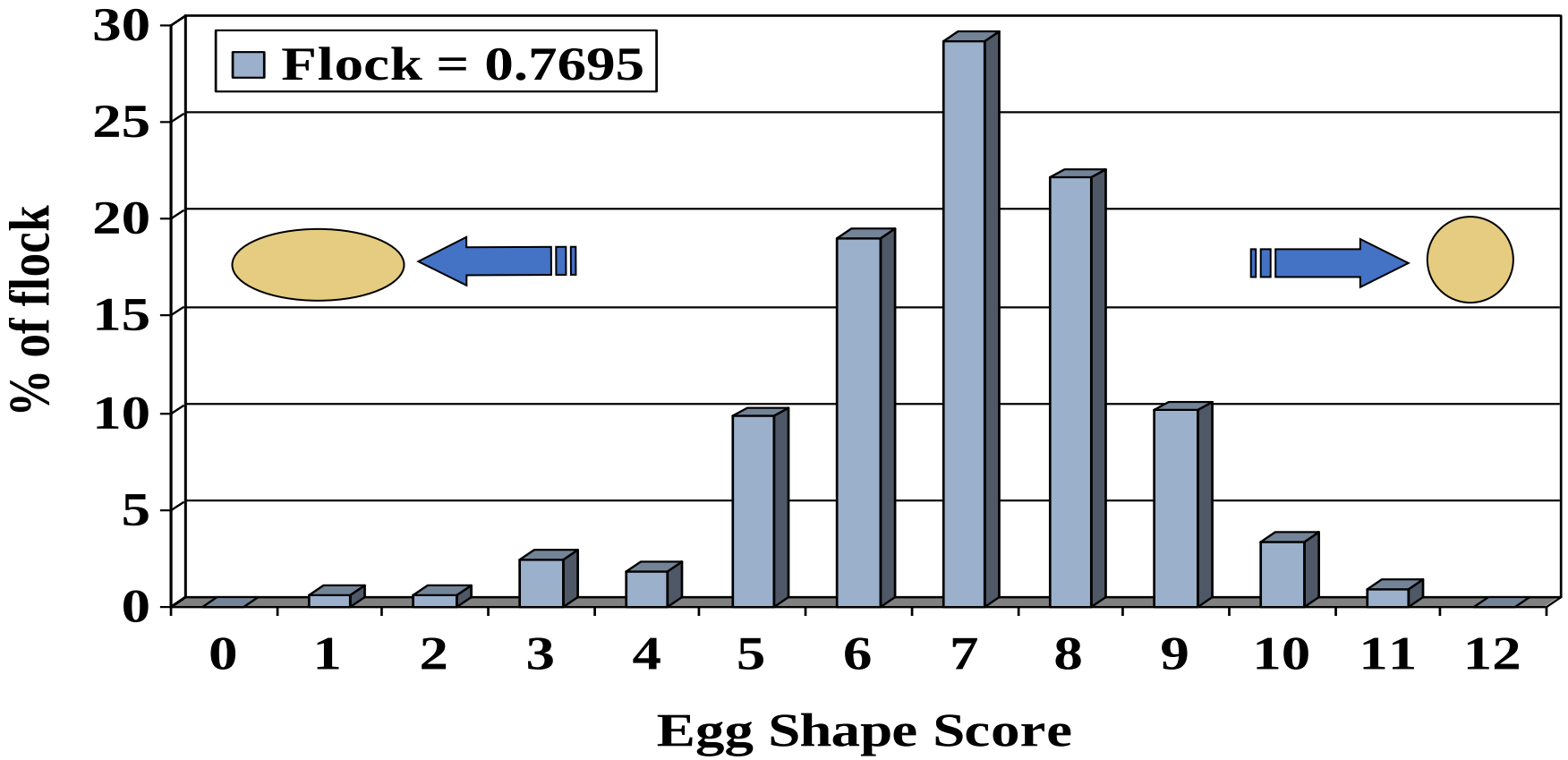


Egg Shape Index

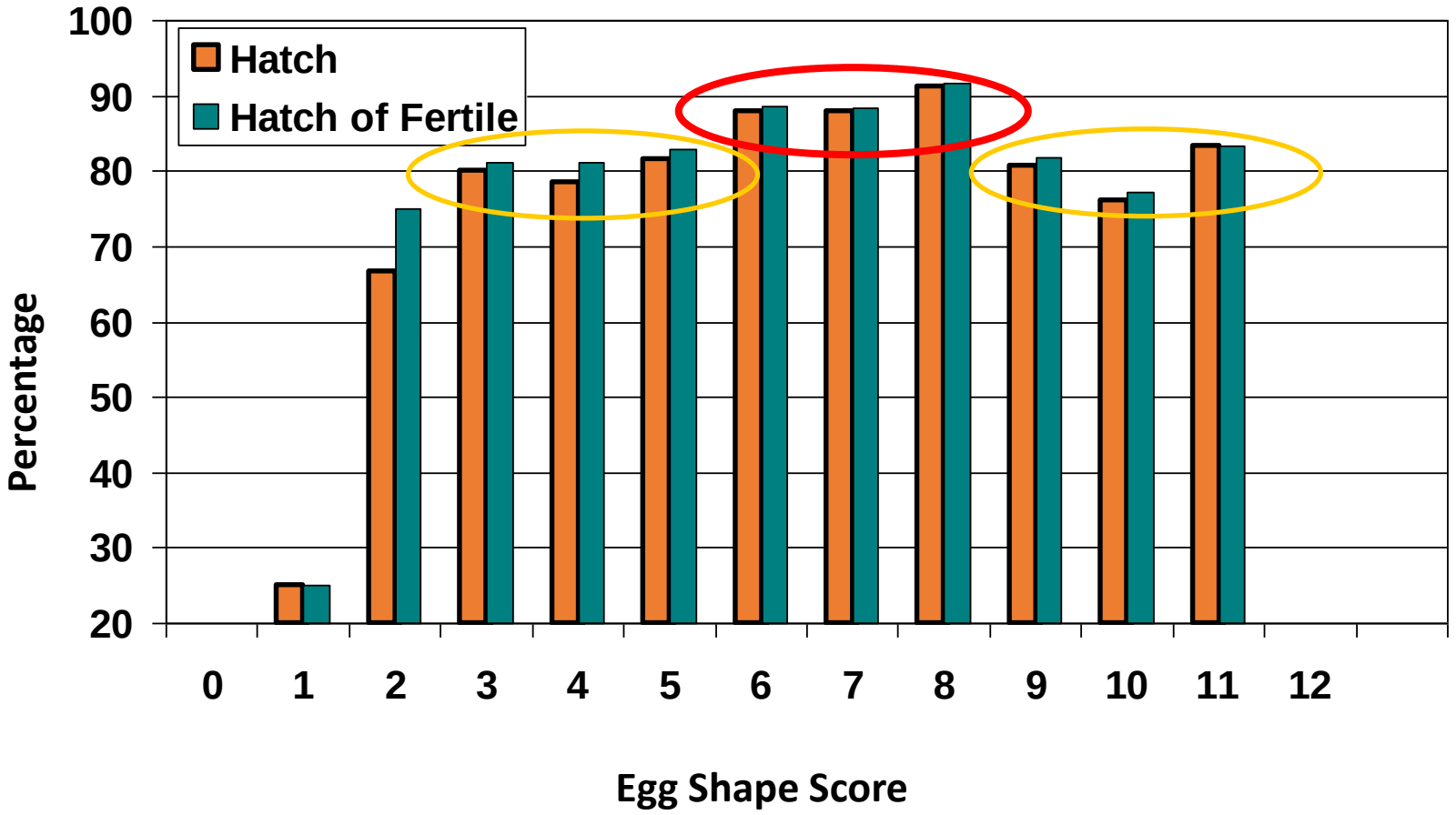


$$\frac{\text{width}}{\text{length}} = \frac{43.54}{55.64} = 0.78$$

Commercial Broiler Breeder Flock



Commercial Egg Shape Score vs Hatch and Hatch of Fertile



Summary

- Most hatchability problems are a result of poor fertility
- However, when egg production is attained, and the flock maintains high levels of fertility, how we care for hatching eggs can have a tremendous effect on the overall hatchability

Take Home Message

- 1) Evaluate your on farm egg handling practices
  - How often are hatching eggs collected?
  - Are eggs moved into the egg room to stay?
    - Where are they positioned?
  - Are cull or ‘bad eggs’ removed?

Lets Get Back To The Basics

- Egg gathering should be done at least 4X/day and 6X/day during peak production.
  - Why?
- Handle eggs carefully to avoid breakage.

Take Home Message

- 2) Evaluate your egg storage facilities
  - Can they maintain temperature settings?
    - Do the doors seal properly?
    - Do they need insulation?
    - Does the heating/cooling equipment operate correctly?
  - Are there ‘hot and cool spots’?
    - Egg rack/buggy positioning
  - Are there air leaks?

Lets Get Back To The Basics

- Do not remove the farm racks from the cooler unless it is going to the egg truck.
- Keep cooler doors closed.
- Do not place farm racks with eggs in front of the cooler in the egg room.
- Avoid any hot or cold spots in cooler, either in general or by egg buggy placement.

Take Home Message

- 3) Egg pack quality
  - Care in handling eggs
  - ‘Cleaning’ eggs has marginal benefits
  - Egg specific gravity, shell color, egg shape – only the extremes will significantly reduce hatch
    - Don’t waste time blaming these variables

Lets Get Back To The Basics

- Dirty eggs sent as hatching eggs need to be placed on bottom of farm racks.
- ‘Moderately’ clean hatching eggs.
  - Sand blocks – OK in moderation
  - Spray bottles, wash rags – generally a “no”

Remember ……

You can have a great breeder program and a bad hatchery, but…

You CAN NOT have a bad breeder program and a great hatchery!

We must set quality hatching eggs in our incubators <u>before</u> we can expect the best results!!!

Questions?

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-or-

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