SPIDES (SHORT PERIOD INCUBATION DURING EGG STORAGE)

INTRODUCTION

Increasing hatchability of fertile eggs coming into a hatchery is an important goal for utilization and profitability. While there are many reasons hatchability can decline, egg age is one of the common reasons (Figure 1). Research and practical experience over the last 15 years has consistently demonstrated the value of utilizing Short Period Incubation During Egg Storage (SPIDES) to increase hatchability, especially in eggs greater than seven days old. In addition to increasing hatchability, SPIDES may also increase chick quality and narrow the hatch window. Although any incubator can be utilized as a SPIDES cabinet, installing specialized SPIDES incubators in the egg storage room is becoming more popular.

The theory behind SPIDES comes from nature. When a clutch of eggs is laid in the wild, usually one a day, the eggs already in the nest will be warmed up for an hour or two while the bird is in the process of laying the new egg. The eggs will then cool down until the next day's egg is added. When the bird has finished producing the clutch and starts to incubate, all of the eggs are on the same schedule and will hatch on the same day.

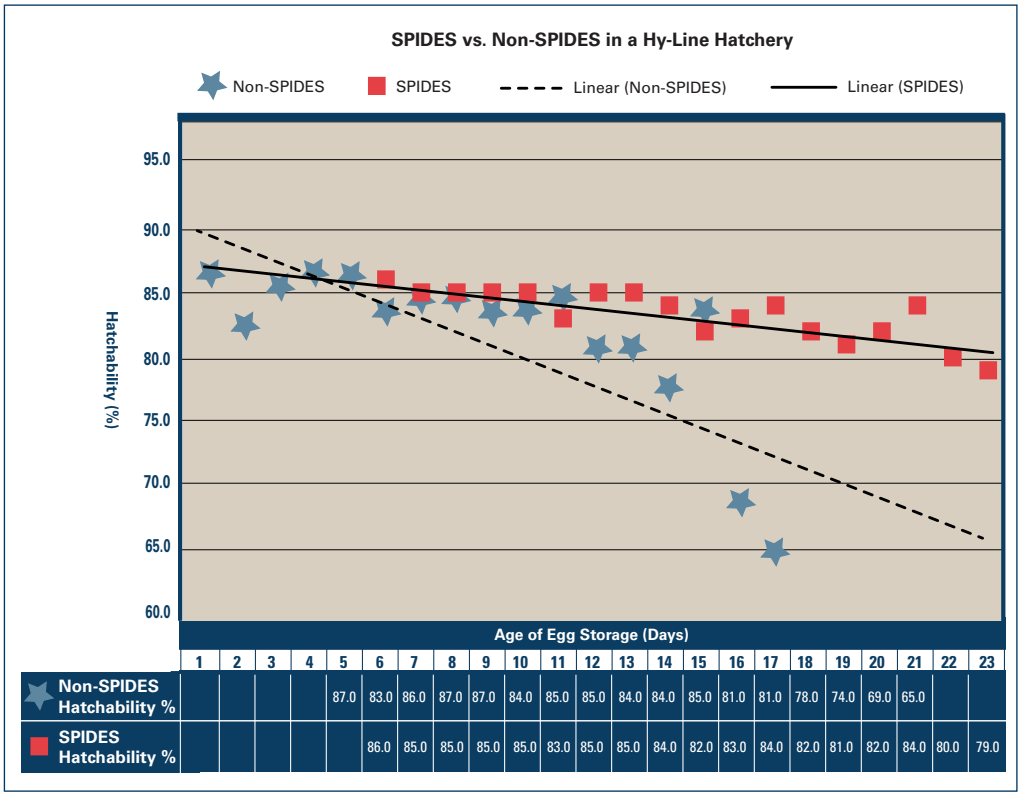
Good quality chicks

The goal of this technical bulletin is to provide the scientific background of SPIDES and to introduce the practical methods for all hatcheries to utilize this excellent management tool for egg-layer strains.

HATCHING EGG CARE

There are two stages of embryonic development in a chicken egg: **Pre-oviposition:** The time from fertilization to oviposition (laying the egg). During this period the egg is exposed to the hen's body temperature of 40–41°C (104–105.8°F). **Post-oviposition:** The time the embryo is incubated in the hatchery at temperatures around 37.5°C (99.5°F) (3,9).

Once the egg is laid, the goal is to drop the temperature of the egg to below physiologic zero as soon as possible. Physiologic zero is the point at which embryonic development stops. Research studies have shown the zone of physiologic zero is from 21–28°C (69.8–82.4°F) (8). In most hatcheries, 25°C (77°F) is used as the point of focus. Hatching egg hatchability is affected by many factors, including breeder flock age, health status of the hen, breeder nutrition, shell quality, breed, environment, and transportation.

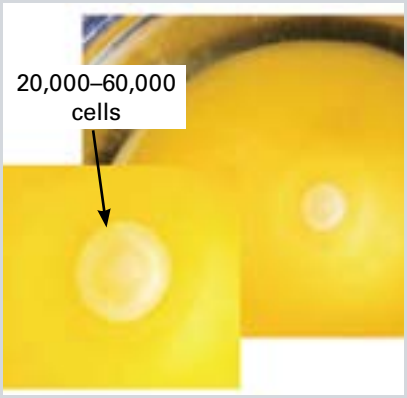


Age of Egg Storage (Days)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Non-SPIDES Hatchability %					87.0	83.0	86.0	87.0	87.0	84.0	85.0	85.0	84.0	84.0	85.0	81.0	81.0	78.0	74.0	69.0	65.0		
SPIDES Hatchability %						86.0	85.0	85.0	85.0	85.0	83.0	85.0	85.0	84.0	82.0	83.0	84.0	82.0	81.0	82.0	84.0	80.0	79.0

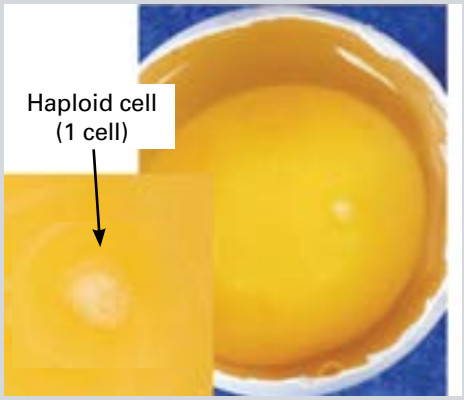
Figure 1. Hatchability percentage, SPIDES vs. non-SPIDES. Data comes from Hy-Line hatcheries using a variety of SPIDES techniques and times. In general, the eggs in this data set were SPIDES treated every seven days and came from eggs taken from breeder flocks 24–75 weeks of age.

The reduction in embryonic viability during egg storage is due to the apoptosis (cell death) in the egg (1). Up until seven days of proper egg storage, the number of embryonic cells remains stable, then after seven days, the number of dead and abnormal cells starts to increase. Maintaining lower temperature and higher humidity during egg storage can dramatically improve cell viability for eggs to be stored long term (4).

FRESH EGG BREAKOUT



Fertile Egg
Blastoderm is always round (doughnut shaped), 4–5 mm



Infertile Egg
Blastodisc is not round with irregular edges, 2–3 mm

HATCHING EGG CARE

- Hy-Line hatching eggs should weigh a minimum of 50 g (40 lb case) from a flock at least 22 weeks of age.
- Smaller eggs from younger flocks may be used, realizing that chick size and early livability will not be optimum.
- Hatch profiles should be optimized based on egg size.
- Hatching eggs should be gathered a minimum of twice daily and more frequently during extremely hot weather.
- Eggs should be in cool storage within 6 hours of laying.
- Eggs should be stored at 15–18°C (59–64°F) with relative humidity of 70–80%.
- When necessary to save eggs longer than 10 days, store at 13°C (55.4°F) with 70–80% humidity or use SPIDES program.
- Best hatches result from eggs 3–7 days of age.
- Store hatching eggs with air cell up (pointed end down). Use only clean eggs laid in nests for hatching.
- Do not use dirty, cracked or malformed eggs for hatching.
- Grade eggs on breeder farm to prevent bringing contaminated eggs to the hatchery.
- Hatching eggs should be sanitized using products specifically developed for this purpose.
- It is extremely important that once eggs are cooled, they are stored at a temperature that does not allow condensation (moisture forming on shell due to exposure to warm humid air).
- The truck taking hatching eggs from farm cooler to hatchery should be capable of keeping eggs cool to avoid condensation.

Figure 2. Eggs in a hatchery cooler.

Figure 3. Eggs on setter trays and racks.

USING SPIDES

Preincubation of eggs enhances the viability of the embryo after long egg storage (greater than 7 days). Studies and practical experience have shown that SPIDES can increase hatchability up to 25%, depending on the breed and the breeder flock age. SPIDES has the greatest effect on eggs from breeder flocks younger than 45 weeks (2,6,7,8) compared to untreated eggs with the same egg age.

Figure 4. Hy-Line Brown eggs from young (left) and older (right) breeder flocks.

CHART ANALYSIS

0–10 days egg storage

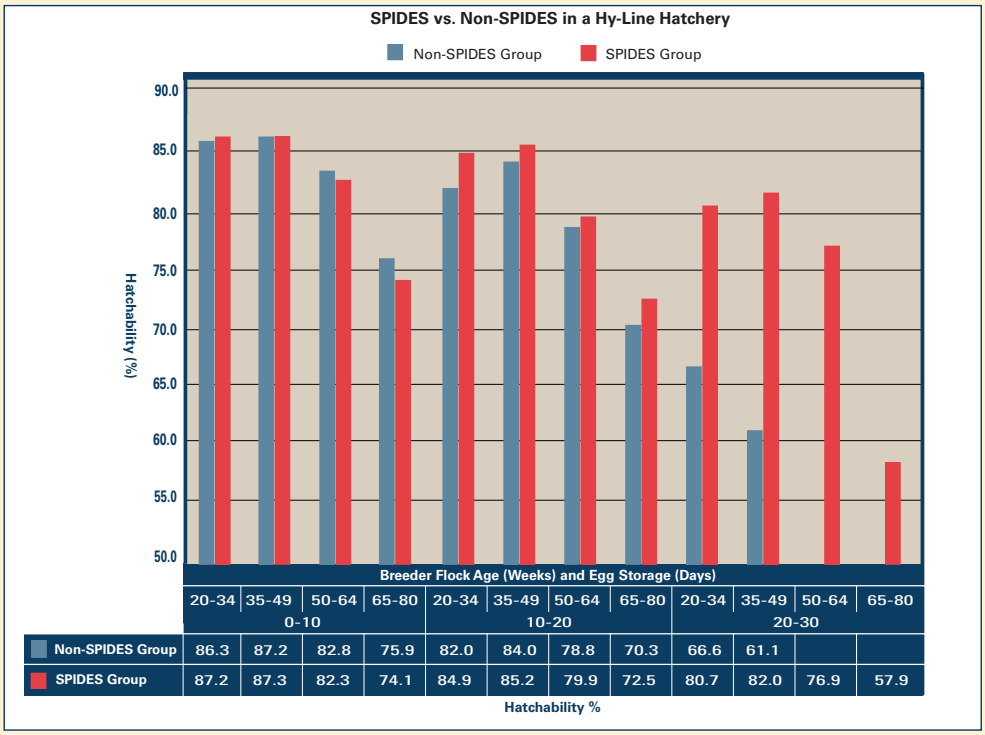
- SPIDES provides little to no increase in hatchability of eggs from younger breeder flocks.

10–20 days egg storage

- Younger breeder flocks show the biggest improvement from SPIDES, but all age groups increase in hatchability from 1–3%.

20–30 days egg storage

- Eggs from older breeder flocks are typically not stored this long without SPIDES. The comparison for the younger breeder flocks show that there is greater than a 10% increase in hatchability.



	Breeder Flock Age (Weeks) and Egg Storage (Days)											
	20-34	35-49	50-64	65-80	20-34	35-49	50-64	65-80	20-34	35-49	50-64	65-80
	0-10				10-20				20-30			
Non-SPIDES Group	86.3	87.2	82.8	75.9	82.0	84.0	78.8	70.3	66.6	61.1		
SPIDES Group	87.2	87.3	82.3	74.1	84.9	85.2	79.9	72.5	80.7	82.0	76.9	57.9

Hatchability %

Figure 5. Breeder flock age and egg storage, SPIDES vs. non-SPIDES. The data set is one year of Hy-Line hatches with both SPIDES and non-SPIDES, with different varieties included.

What:

- Short Period Incubation During Egg Storage (SPIDES)
- Using SPIDES increases the viability of the blastoderm by allowing the embryo to grow through several stages of development (stage 9–stage 11). This development counteracts the loss of embryonic cells during egg storage (5).
- Enables longer egg storage
- Allows setting older eggs with fresher eggs
- Narrows the hatch window
- Reduces the incubation period
- Improves chick quality and hatchability in all age eggs
- The increase in hatchability is greater in younger flocks than older flocks

Where:

- In a custom cabinet in the egg storage room:
  - o If a custom cabinet is added to an existing egg room, it is recommended that the air intake for heating come from outside or the attic.
- In a single or multi-stage setter near the egg storage room:
  - o Take into account the impact on other eggs if using a multi-stage machine
  - o The increase in hatchability from using SPIDES will reduce the number of eggs required to be set. This creates extra space in the hatchery to set more eggs or use a setter for the purpose of SPIDES.

Figure 6. SPIDES cabinet located in an egg cooler.

When:

- Eggs to be set with less than 10 days egg age rarely need SPIDES.
  - o Flocks less than 45 weeks can see a 1–2% increase in hatchability.
- The standard SPIDES timeline is for treatment after 7 days of egg storage, and again every 7 days until the eggs are utilized.
- Several program options exist for SPIDES treatment:
  - o When the eggs arrive directly to the hatchery, usually 0–3 days post lay, then no other treatments
  - o 2–4 days post lay, then no other treatments
  - o 5–6 days post lay, then every 5–6 days
  - o 7–10 days post lay, then every 7–10 days after
- SPIDES can be repeated up to 3 times for a group of eggs.
- Plan for a 24-hour process from start of pre-warming to completion of cooling.

How:

- Many different methods have been tried for SPIDES. Many slight variations to this program can be effective and may be adjusted depending on egg flow and incubator space.
- Use setter trays. Do not use paper flats.
- The main goal is control:
  - o Control the increase in temperature.
    - – Achieve an egg shell temperature between 32°C (90.0°F) and 37.8°C (100.0°F) within 2 to 8 hours from a cool room temperature of 17°C (62.6°F).
    - – Ideally, the higher temperature of 37.8°C (100.0°F) can be achieved in as little as 6 hours.
  - o Control the stable temperature.
    - – Monitor egg shell temperature or use temperature data loggers to maintain the egg shell temperature between 32°C (90.0°F) and 37.8°C (100.0°F) for 1 hour.
    - – Other programs also work with holding the constant temperature between 3–5 hours.
    - – Provide proper airflow by running:
      - – 100% fans during cooling/heating phases
      - – 25% fans during the stable cool phase
      - – 50% fans during the stable hot phase

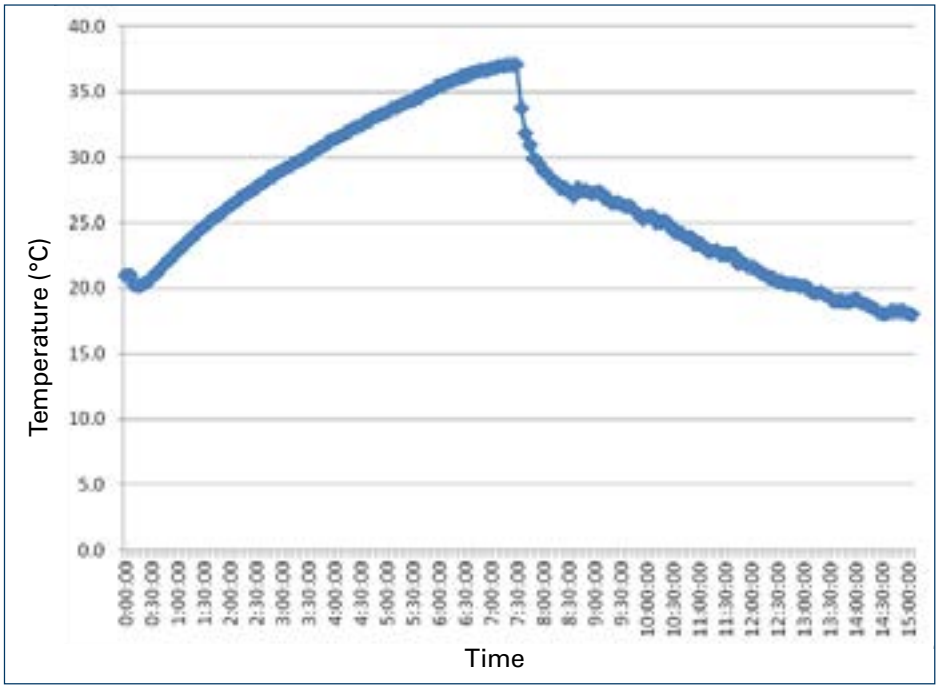


Figure 7. Air temperature during SPIDES.

  - o Control the cooling temperature.
    - – Cool the eggs to 25°C (77°F) as soon as possible, then bring the eggs to storage temperatures soon after that.
    - – The eggs should reach 18–25°C (64.4–77°F) (below physiological zero) in 8–10 hours to stop the development of the embryo.
    - – The eggs should be water cooled in the SPIDES cabinet or setter or moved into the egg storage room.
    - – If the eggs are to be fully cooled in the egg storage room, ensure there is sufficient ventilation and cooling power to keep the temperature of the storage room stable.
    - – Avoid egg sweating.

CONCLUSION

Utilizing SPIDES in your hatchery can greatly improve the hatchability of eggs that have greater than 7–10 days of storage. While it is ideal to have specialized SPIDES cabinets to heat and cool the eggs efficiently, any incubator with room can be used for this procedure. Hy-Line International recommends SPIDES for all hatcheries to increase hatchability and improve chick quality. **Hatchery managers should experiment with several SPIDES treatment programs to find one that works well.**

REFERENCES

1. Bakst M. R. Welch, G. R. Fetterer, R. and Miska, K. 2016. Impact of broiler egg storage on the relative expression of selected blastoderm genes associated with apoptosis, oxidative stress, and fatty acid metabolism. Poultry Science, 95:1411–1417.
2. Dymond, J., Vinyard, B., Nicholson, A. D., French, N. A., & Bakst, M. R. (2013). Short periods of incubation during egg storage increase hatchability and chick quality in long-stored broiler eggs. Poultry science, 92(11), 2977-2987.
3. Eyal-Giladi, H., and Kochav, S. 1976. From cleavage to primitive streak formation: A complementary normal table and a new look at first stages of development of chick. I. General morphology. Dev. lol. 49:321-337.
4. Fasenko, G. M. (2007). Egg storage and the embryo. Poultry science, 86(5), 1020-1024.
5. Hamburger V. Hamilton H. L. (1951). A series of normal stages in the development of the chick embryo. J. Morphol. 217 4992.
6. Jaimes, Pablo. "SPIDES Field Experiences." 2015. Presentation.
7. Nicholson, D., French, N., Tullett, S., van Lierde, E., & Jun, G. (2013). Short periods of incubation during egg storage–SPIDES. Lohmann Information, 48(2), 51-61.
8. Rocha, J. S. R., Baiao, N. C., Barbosa, V. M., Pompeu, M. A., Fernandes, M. N. S., Lara, L. J. C., ... & Batista, J. V. M. S. P. (2013). Negative effects of fertile egg storage on the egg and the embryo and suggested hatchery management to minimise such problems. World's Poultry Science Journal, 69(01), 35-44.
9. Tazawa, Hiroshi. "Incubation Physiology." Sturkie's Avian Physiology. By G. Causey Whittow. San Diego: Academic, 2000. Print.