Lecture 5

INTRODUCTION TO FERTILITY AND HATCHABILITY

The words "fertility" and "hatchability" are often used incorrectly by small producers. These terms are important and have very important meaning.

Percent Fertility is the percentage of fertile eggs of all eggs produced.

$$\% \text{ fertility} = \frac{\text{\# of fertile eggs}}{\text{\# of total eggs produced or set}}$$

Percent Hatchability is the percentage of fertile eggs which actually hatch out as live young.

$$\% \text{ hatchability} = \frac{\text{\# of eggs which hatch out}}{\text{\# of fertile eggs}}$$

Care of Hatching Eggs

Before setting eggs in an incubator, you must obtain or produce quality fertile eggs from a well managed, healthy flock which are fed properly balanced diets.

1. Keep the nest full of clean, dry litter. Collect the eggs early in the morning and frequently during the day to prevent excessive chilling or heating of the eggs.
2. DO NOT wash eggs unless necessary. If it is necessary to wash eggs always use a damp cloth with water warmer than the egg. This causes the egg to sweat the dirt out of the pores. Never use water cooler than the egg. Also, do not soak the eggs in water. If the egg is allowed to soak in water for a period of time, the temperature difference can equalize and bacteria have a greater chance of entering through the pores. Be sure eggs are dry before storing. Never place damp or wet eggs in a styrofoam carton for storage.
3. Store the clean fertile eggs in an area which is kept at 55°- 60°F and 70-75% humidity. Never store eggs at temperatures about 75°F and at humidity lower than 40%. These conditions can decrease hatchability dramatically in a very short period of time. Slant or turn the fertile eggs daily while they are being stored. Store the eggs small end down and slanted at 30-45 degrees. Putting a piece of 2" x 4" under one end of the carton or storage container and changing it to the other end daily works well. Do not store eggs for more than 10-14 days. After 14 days of storage, hatchability begins to decline significantly.
4. Just before setting the eggs, allow them to warm to room temperature (70-80°F) and remove any cracked eggs.

Incubation

Four factors are of major importance in incubating eggs artificially: temperature, humidity, ventilation and turning. Of these factors, temperature is the most critical. However, humidity tends to be overlooked and causes many hatching problems. Extensive research has shown that the optimum incubator temperature is 100°F (37.8^0C) when relative humidity is 60 percent. Concentrations of oxygen should be above 20 percent, CO_2 should be below 0.5 percent, and air movement past the egg should be 12 cubic feet per minute. There are two types of incubators commonly used:

1. Forced-air incubators which have a built in fan to circulate the air.
2. Still-air incubators which have no fans, so the air is allowed to stratify.

The forced-air incubator should be set at 99-99.5°F and 60-65% relative humidity (83-88°F wet bulb). The advantage of the forced-air incubator is that it is easier to maintain humidity at a constant level because of air circulation.

Still air incubators are smaller and air flow is harder to manage. Set still-air incubators at 100 to 101°F at egg height. This is important since the air stratifies in these incubators. There can be as much as a 5° difference in temperature from the top to the bottom of some of the still-air incubators. Humidity should be 60-65% (80-90° wet bulb) during incubation and 70-75% (92-97° wet bulb) at hatching time. It is very easy to overheat the eggs in still-air incubators and difficult to maintain proper humidity. It should be noted that the various incubators (dependent on size and source of power) that exist could either be still-air or forced air incubator.

Temperature

During the warm-up period, the temperature should be adjusted to hold a constant 101°F for still air, 99°- 100°F for forced air. To obtain reliable readings, the bulb of the thermometer should be at the same height as the tops of the eggs and away from the source of heat. Using two thermometers is a good idea to ensure you are getting an accurate reading. Incubator temperature should be maintained between 99° and 100°F. The acceptable range is 97° to 102°F. Mortality is seen if the temperature drops below 96°F or rises above 103°F for a number of hours. If the temperature stays at either extreme for several days, the eggs may not hatch. Overheating is more critical than under-heating. Running the

incubator at 105°F for 15 minutes will seriously affect the embryos, while running it at 95° for 3 or 4 hours will only slow the chick's metabolic rate.

An incubator should be operated in a location free from drafts and direct sunlight. An incubator should also be operated for several hours with water placed in a pan to stabilize its internal atmosphere before fertile eggs are set. Do not adjust the heat upward during the first 48 hours after eggs are set. This practice cooks many eggs. The eggs will take time to warm to incubator temperature and many times in small incubators the incubator temperature will drop below 98°F for the first 6-8 hours or until the egg warms to 99°-100°F.

In Case of Power Outage

If you experience a power failure, do not scrap the hatch. Most of the time, the hatch can be saved. The key is to keep the eggs as warm as possible until the power returns.

This can be done by placing a large cardboard box or blankets over the top of small incubators for additional insulation. To warm the eggs, place candles in jars, light them and place the jars under the box that covers the incubator. Be careful not to put any flammable material closer than a foot from the top of the candles. The heat from the candles can easily keep the eggs above 90°F until the power returns.

Embryos have survived at temperatures below 90°F for up to 18 hours. You should continue to incubate the eggs after the outage; then candle them 4 to 6 days later to check for further development or signs of life. If, after 6 days, you do not see life or development in any of the eggs, then terminate incubation. Most of the time, a power outage will delay hatching by a few days and decrease the hatchability to 40-50 percent.

Humidity

The relative humidity of the air within an incubator should be about 60 percent. During the last 3 days (the hatching period) the relative humidity should be nearer 65-70 percent. (Too much moisture in the incubator prevents normal evaporation and results in decreased hatch, but excessive moisture is seldom a problem in small incubators.) Too little moisture results in excessive evaporation, causing chicks to stick to the shell, remain in the piped shells, and sometimes hatch crippled.

The relative humidity in the incubator can also be varied by changing the size of the water pan or by putting a sponge in the pan to increase the evaporative surface. The pan should be checked regularly while the incubator is in use to be sure that there is always an adequate amount of water. Adding additional water pans to small still-air incubators is also helpful to increase humidity.

During the hatching period, the humidity in the incubator may be increased by using an atomizer to spray a small amount of water into the ventilating holes. (This is especially helpful when duck or goose eggs are hatching). Whenever you add water to an incubator, it should be about the same temperature as the incubator so you do not stress the eggs or the incubator. A good test is to add water just warm to the touch.

Using a wet-bulb thermometer is also a good way for determining relative humidity. The wet-bulb thermometer measures the evaporative cooling effect. If the wet and dry bulb read the same temperature, you would have 100 percent humidity. The greater the evaporation taking place, the lower the temperature reading on the wet-bulb thermometer and the larger the spread will be between the wet- and dry-bulb readings. To make a wet-bulb thermometer, just add a cotton wick to the end of a thermometer. Then place the tail of the wick in water. The cotton then absorbs the water.

As the water evaporates from the cotton it causes a cooling effect on the thermometer. The table below (Relative Humidity) will enable you to calculate relative humidity using readings from a wet- bulb thermometer and the incubator thermometer.

Table 2: Incubation temperature and humidity

Incubator Temperature	Wet Bulb Readings					
100°F 101°F 102°F	81.3 82.2 83.0	83.3 84.2 85.0	85.3 86.2 87.0	87.3 88.2 89.0	89.0 90.0 91.0	90.7 91.7 92.7
Percent Relative Humidity	45%	50%	55%	60%	65%	70%

(From Egg to Chick, Northeast State Cooperative Extension Service)

Ventilation

The best hatching results are obtained with normal atmospheric air, which usually contains 20-21 percent oxygen. It is difficult to provide too much oxygen, but a deficiency is possible. Make sure that the ventilation holes are adjusted to allow a normal exchange of air. This is critical on home-made incubators. It is possible to suffocate the eggs and chicks in an air-tight container. However, excessive ventilation removes humidity and makes it difficult to heat incubators properly.

Turning

Eggs set on their sides must be rotated 1/2 turn at least 3 times daily (Mostly at odd number of times). Eggs set with the air cell end up should be tilted in the opposite direction 3 times daily. This keeps the embryo centred in the egg and prevents it from sticking to the shell membrane. When using hand turning, to insure proper turning, mark each side of the egg with a pencil. Put an "x" on one side and an "o" on the opposite side. Stop turning the eggs for the last three (3) days of the incubation cycle (at 18 days for chickens, 25 days for waterfowl, etc.) and do not open the incubator until the hatch is completed to insure that a desirable hatching humidity is maintained. Note that the relevance of egg turning to the developing embryo cannot be over emphasized: It is aimed at ensuring even distribution of nutrients for the growing embryo and also to prevent the embryo from sticking to one side of the egg shell.

Hatch Time

Do not help the chicks from the shell at hatching time. If it doesn't hatch, there is usually a good reason. Also, prematurely helping the chick hatch could cripple or infect the chick. Humidity is critical at hatching time. Don't allow your curiosity to damage your hatch.

As soon as the chicks are dry and fluffy or 6 to 12 hours after hatching, remove the chicks from the incubator. It is good practice to remove all the chicks at once and destroy any late hatching eggs. Hatching time can be hereditary and you can control the uniformity of hatching by culling late hatchers. If you keep every chick which hatches late, in a few years each hatch could last 4 days or longer.

Sanitation of Incubator and Equipment

No matter what type of incubation you use, it is important that you thoroughly clean and disinfect the incubator before and after you use it. It is just as important that the incubation room and egg storage area are kept equally clean. The lack of sanitation will decrease hatchability. Immediately after each hatch, thoroughly clean and disinfect all hatching trays, water pans and the floor of the hatcher. Scrape off all egg shells and adhering dirt. Wipe clean surfaces thoroughly with a cloth dampened in quaternary ammonium, chlorox or other disinfectant solution.

Incubation *Periods of Other Species

One of the miracles of nature is the transformation of the egg into the chick. In a brief three weeks of incubation, a fully developed chick grows from a single cell and emerges from a seemingly lifeless egg.

Incubation Periods (species and days required to hatch)

Bobwhite Quail	(23-24)	Guinea	(27-28)
Chicken	(21)	Muscovy Duck	(35)
Chukar Partridge	(23-24)	Pheasants	(24-26)
Coturnix Quail	(16-18)	Ostrich	(42)
Ducks	(28)	Swan	(35)
Geese	(28-33)	Turkey	(28)

*The values so stated are averages of what holds in reality due to some inherent genetic factors affetcting fertility and hatchability.