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Effect of Holding Temperature on Hatchability of Chicken Eggs

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This bulletin reports on Department of Poultry
Husbandry research project 40, Care
of Hatching Eggs

Effect of Holding Temperatures on Hatchability of Chicken Eggs

E. M. FUNK AND JAMES FORWARD

Any condition or factor that affects hatching results is important to the poultry industry. Since environmental conditions where eggs are held before setting can completely destroy hatching results, the most satisfactory temperature for holding eggs is an important condition to determine. Results reported here may not apply to all conditions but they were found for the conditions described for each test.

REVIEW OF PREVIOUS EXPERIMENTS

Moran (1925), in England, reported that the optimum temperature for storing hatching eggs was between 46° F and 50° F.

Olsen and Haynes (1948) of the USDA reported holding purebred White Leghorn and Rhode Island Red hatching eggs at temperatures ranging from 30° F to 70° F. They secured highest hatches from eggs held at 50° F.

Funk, Forward, and Kempster (1950) reported holding hatching eggs at 32° F, 40° F, 45° F, 50° F, 55° F, 60° F, 70° F, 80° F, and 90° F from one to 13 days after laying. Their results showed that eggs produced by New Hampshires and New Hampshires crossed with White Rocks hatched best when held at 50° F but White Rock egg hatched better when held at 60° F than when held at any other temperature.

Some poultry breeders and hatcherymen have reported by personal correspondence that they obtained better hatches with broiler type eggs when they were held at temperatures of 65° F to 70° F.

Some of the advantages of holding hatching eggs at higher temperatures are (1) less refrigeration is required, (2) sweating of eggs when exposed to higher temperatures can be minimized, and (3) when set, the eggs require less time to reach incubation temperature.

EXPERIMENTAL PROCEDURE

In this series of experiments the eggs were obtained from hatching eggs received at a commercial hatchery when one to four days old and then held at temperatures ranging from 50° F to 90° F. All eggs were produced by broiler type New Hampshires, White Rocks, and crosses of Vantress males on New Hampshire females. The eggs of each group were distributed by trays at random throughout the incubators and separate hatching. It should be noted that though temperatures are listed as 50° F etc., there was a fluctuation of 2 or 3 degrees above or below the temperature listed.

The eggs used in these experiments were from four to 10 days old when set.

The cool room (50° F) was 9' x 16' and 9' high. The air movement in the room where the cases were held was 100-150 feet per minute.

The eggs were set at 5:00 p.m. and the chicks removed at 8:00 a.m. 21 days and 15 hours after setting.

RESULTS

New Hampshire (Nichols strain) eggs produced in December, 1953 delivered to the hatchery and held for 7 days at 50° F, 60° F, 70° F, and 80° F had a hatch of all eggs of 71.5, 65.2, 50.0, and 28.9 percent, respectively. (See Table 1.) Eggs in the same test held for 6 days at 50° F and then 1 day at 75° F gave 65.4 percent hatch.

Table 2 shows results with New Hampshire (Christie strain) eggs produced in March, 1954 held 5 days at 50° F, 60° F, 70° F, 80° F, and room temperature (75° F to 80° F), and four days at 50° F plus one day at room temperature (75° F to 80° F). In this test the eggs held for four days at 50° F plus one day at 75° F to 80° F gave best results (81.7% hatch of all eggs). Table 3 shows results when the tests shown in Table 2 were repeated later with eggs laid in April. This test also showed that eggs held at 50° F gave the highest hatch (77.5% hatch of all eggs set). Table 4 shows the results of a third test with eggs produced in May from the same stock (Christie New Hampshires). In this test the eggs held for four days at 50° F and then held for one day at room temperature (75° F to 80° F) gave best results (77.9% hatch of all eggs set).

In none of these three trials did eggs held at 60° F, 70° F, or 80° F hatch as well as eggs held at 50° F.

In another series of experiments from January through June, 1955, eggs were held three days at 50° F, 60° F, 70° F, 80° F and combinations of these temperatures. The results (see Table 5) showed that eggs held at 50° F gave the highest hatch for the season (75.4% hatch of all eggs set).

TABLE 1--EFFECT OF HOLDING TEMPERATURES ON HATCHABILITY OF NICHOLS NEW HAMPSHIRE EGGS. NORMAL HATCHERY RECEIPTS. PRODUCED DURING DECEMBER, 1953, WHEN DAY TEMPERATURES WERE IN THE 40'S AND NIGHT TEMPERATURES IN THE 20'S.

Holding Conditions	No. Eggs	Infer- tile %	Dead 1-18 Days %	Dead in shell %	Hatch all Eggs %	Hatch Fertile Eggs %
7 Days at 50°F.	263	3.0	9.9	15.6	71.5	73.7
7 Days at 60°F.	264	2.6	10.6	21.6	65.1	66.9
7 Days at 70°F.	264	3.4	18.6	28.0	50.0	51.8
7 Days at 80°F.	264	2.6	34.1	34.5	28.8	29.6
6 Days at 50°F., one day at room temp. (75°F.-80°F.)	263	1.9	12.9	19.8	65.4	66.7

TABLE 2--EFFECT OF HOLDING TEMPERATURES ON HATCHABILITY OF CHRISTIE NEW HAMPSHIRE EGGS. NORMAL HATCHERY RECEIPTS. PRODUCED DURING MARCH, 1954, WHEN DAY TEMPERATURES WERE IN THE 60'S AND NIGHT TEMPERATURES IN 30'S AND 40'S.

Holding Conditions	No. Eggs	Infer- tile %	Dead 1-18 Days %	Dead in Shell %	Hatch all Eggs %	Hatch Fertile Eggs %
5 Days at 50°F.	285	2.8	9.8	8.8	78.6	80.9
5 Days at 60°F.	285	2.8	8.8	13.0	75.4	77.6
5 Days at 70°F.	285	2.8	11.6	10.9	74.7	76.9
5 Days at 80°F.	285	2.8	10.5	12.3	74.4	76.5
5 Days at room tempe- rature (75°F.-80°F.)	285	2.5	8.4	8.4	80.7	82.7
4 Days at 50°F., one day at room temp. (75°F.-80°F.)	284	2.8	6.3	9.1	81.7	84.1

TABLE 3--EFFECT OF HOLDING TEMPERATURES ON HATCHABILITY OF CHRISTIE NEW HAMPSHIRE EGGS. NORMAL HATCHERY RECEIPTS. PRODUCED DURING APRIL, 1954, WHEN DAY TEMPERATURES WERE IN THE 70'S AND NIGHT TEMPERATURES IN THE 50'S.

Holding Conditions	No. Eggs	Infer- tile %	Dead 1-18 Days %	Dead in Shell %	Hatch all Eggs %	Hatch Fertile Eggs %
5 Days at 50°F.	285	3.2	6.0	13.3	77.5	80.1
5 Days at 60°F.	285	2.8	9.8	15.1	72.3	74.4
5 Days at 70°F.	285	3.2	14.0	18.6	64.2	66.3
5 Days at 80°F.	283	3.5	21.5	17.7	57.2	59.3
5 Days at room temp., (75°F.-80°F.)	284	3.5	12.3	16.2	68.0	70.4
4 Days at 50°F., one day at room temp. (75°F.-80°F.)	284	3.2	8.8	13.0	75.3	77.8

TABLE 4--EFFECT OF HOLDING TEMPERATURES ON HATCHABILITY OF CHRISTIE NEW HAMPSHIRE EGGS. NORMAL HATCHERY RECEIPTS, PRODUCED DURING MAY, 1954, WHEN DAY TEMPERATURES WERE IN THE 80'S AND NIGHT TEMPERATURES IN THE 60'S.

Holding Conditions	No. Eggs	Infer- tile %	Dead	Dead	Hatch	Hatch
			1-18 Days %	in Shell %	all Eggs %	Fertile Eggs %
5 Days at 50°F.	352	1.4	7.1	15.9	75.6	76.7
5 Days at 60°F.	351	2.0	7.7	15.9	74.4	75.8
5 Days at 70°F.	354	2.5	10.7	16.9	69.8	72.0
5 Days at 80°F.	354	1.7	15.5	30.5	52.3	53.2
5 Days at room temp., (75°F.-80°F.)	352	2.6	9.4	19.3	68.7	70.5
4 Days at 50°F., one day at room temp., (75°F.-80°F.)	353	2.5	8.5	11.0	77.9	79.9

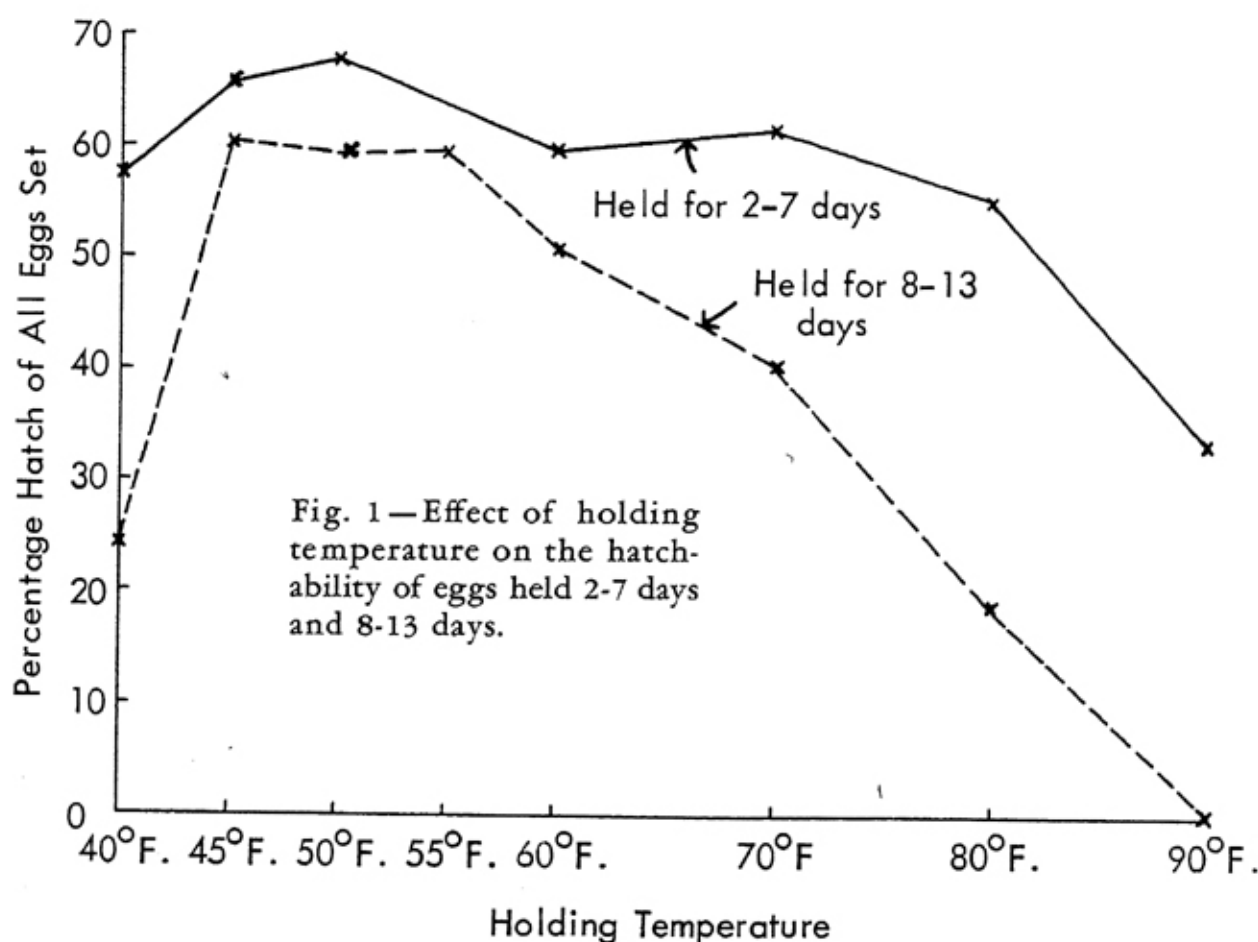
TABLE 5--THE EFFECT OF HOLDING NORMAL HATCHERY RECEIPT EGGS AT WARMER TEMPERATURES AFTER THEY HAVE BEEN COOLED. NEW HAMPSHIRE EGGS USED IN JANUARY AND FEBRUARY AND WHITE ROCK EGGS, MARCH-JUNE, 1955.

Month Set	Eggs per Lot	Percent Hatch of All Eggs										
		3 Days		1 Day	2 Days	3 Days			1 Day	2 Days	1 Day	2 Days
		50°F.	60°F.	50°F.	50°F.	70°F.	70°F.	70°F.	70°F.	80°F.	80°F.	80°F.
Jan.	260	82.0	80.3	83.8	84.6	79.3	83.8	82.4	74.6	84.9	87.0	
Feb.	257	82.8	75.2	79.4	79.1	81.3	76.3	80.5	82.1	78.1	81.8	
Mar.	252	69.8	73.8	67.5	63.7	67.3	70.2	72.2	71.4	76.6	69.7	
Apr.	188	72.0	66.5	75.1	73.9	73.0	71.4	72.9	75.5	69.8	73.0	
May	250	76.7	67.9	70.3	68.7	62.3	66.3	69.4	68.7	68.3	63.9	
June	125	60.3	67.5	61.7	62.7	61.9	65.9	62.7	55.6	55.6	73.8	
	1332	75.4	72.6	74.1	73.0	71.7	73.0	74.5	72.7	74.0	75.2	

In another series of trials (see Table 6 and Figure 1) New Hampshire eggs were held for different periods of time (2 to 13 days) at 40° F, 45° F, 55° F, 60° F, 70° F, 80° F, and 90° F. Eggs held at 50° F gave the best results.

TABLE 6--EFFECT OF HOLDING TEMPERATURE ON THE PERCENTAGE HATCH OF ALL EGGS SET. DELAWARE x NEW HAMPSHIRE EGGS. APPROXIMATELY 300 EGGS IN EACH LOT. JANUARY-JULY, 1955.

Age of Eggs	40° F.	45° F.	50° F.	55° F.	60° F.	70° F.	80° F.	90° F.
2-4 days	66.9	69.3	68.7	66.1	60.4	62.8	61.5	53.9
5-7 days	47.6	61.1	67.1	60.0	58.8	60.1	48.5	13.8
2-7 days	57.2	65.2	67.9	63.0	59.6	61.4	55.0	33.8
8-10 days	33.5	64.5	59.7	60.2	55.3	44.7	29.9	0.0
11-13 days	15.5	56.6	59.1	59.6	46.2	35.9	6.9	0.0
8-13 days	24.5	60.5	59.4	59.9	50.7	40.3	18.9	0.0
2-13 days	40.9	62.9	63.8	61.5	55.2	50.9	38.7	14.4



Broiler type hatching eggs (Vantress males x Nichols New Hampshire females) were held for three days at 50° F, 60° F, 70° F, 80° F and various combinations thereof (see Table 7). The eggs held at 50° F hatched best. However, eggs held at 50° F which were warmed one day at 80° F before setting gave equally good hatches.

TABLE 7--EFFECT OF HOLDING TEMPERATURE ON HATCHABILITY OF EGGS PRODUCED BY VANTRESS MALES x NEW HAMPSHIRE FEMALES. 1955.

	No. Eggs	Percentage Hatch of all Eggs
Held 3 days at 50° F.	1300	75.4
Held 3 days at 60° F.	1300	72.6
Held 3 days at 70° F.	1300	71.7
Held 3 days at 80° F.	1300	72.7
Held 1 day at 50° F. and then 2 days at 60° F.	1300	74.1
Held 2 days at 50° F. and then 1 day at 60° F.	1300	73.1
Held 1 day at 50° F. and then 2 days at 70° F.	1300	73.1
Held 2 days at 50° F. and then 1 day at 70° F.	1300	74.5
Held 1 day at 50° F. and then 2 days at 70° F.	1300	74.0
Held 2 days at 50° F. and then 1 day at 80° F.	1300	75.2

Table 8 and Fig. 2 show the results of holding eggs at combinations of temperatures from 50° F to 90° F. Best hatchability was obtained from eggs held at 50° F.

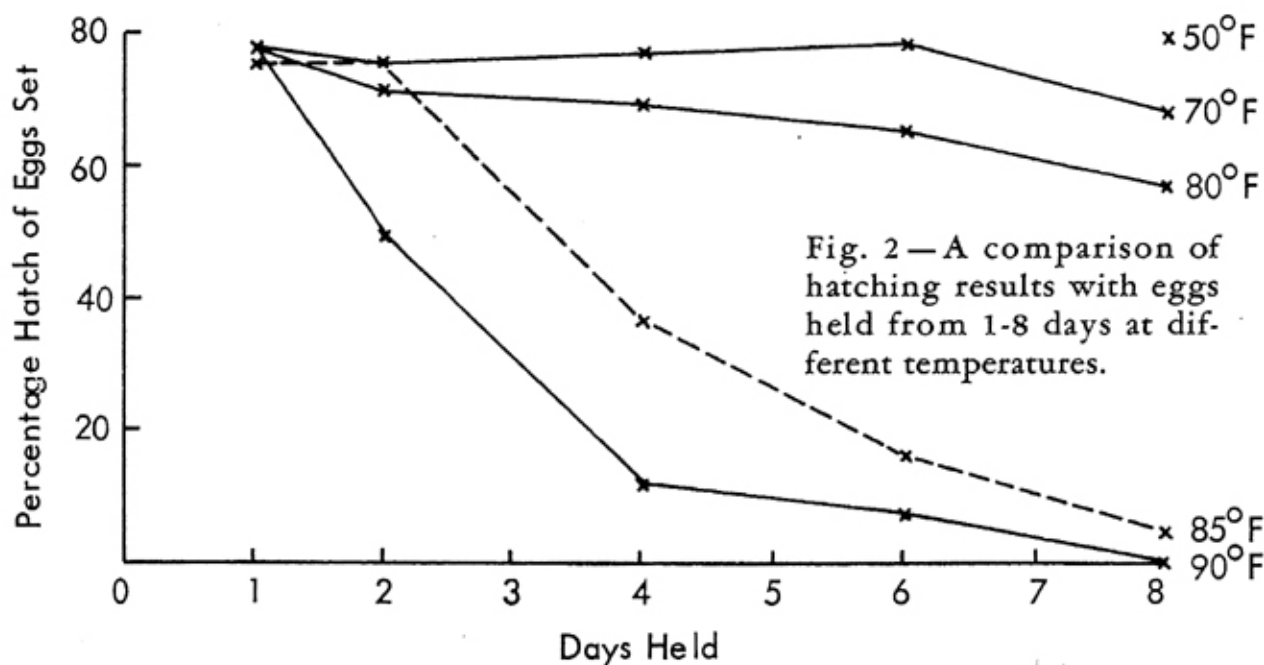


TABLE 8--EFFECT OF HOLDING CONDITIONS ON HATCHABILITY OF CHICKEN EGGS (NICHOLS NEW HAMPSHIRE) NOVEMBER, 1953. EGGS WERE ONE AND TWO DAYS OLD WHEN RECEIVED. ONE HUNDRED FIFTY EGGS PER LOT.

Temperature and Time	No. Days Subsequently Held at 50°F.	Percentage Hatch	
		All Eggs	Fertile Eggs
70°F. for 0 days	8	79.3	82.1
" for 8 "	0	68.0	71.3
" for 1 "	7	78.0	80.7
" for 2 "	6	76.0	79.2
" for 4 "	4	76.7	78.7
" for 6 "	2	78.7	80.8
80°F. for 0 days	8	78.7	82.5
" for 8 "	0	57.3	58.9
" for 1 "	7	78.0	80.1
" for 2 "	6	72.0	74.0
" for 4 "	4	70.0	73.4
" for 6 "	2	66.0	69.7
85°F. for 0 days	8	76.0	79.7
" for 8 "	0	5.3	5.6
" for 1 "	7	76.0	78.1
" for 2 "	6	76.0	79.2
" for 4 "	4	37.3	38.6
" for 6 "	2	17.3	17.8
90°F. for 0 days	8	75.3	79.0
" for 8 "	0	0.0	0.0
" for 1 "	7	78.7	81.4
" for 2 "	6	50.0	52.1
" for 4 "	4	12.7	13.0
" for 6 "	2	8.0	8.3

Table 9 indicates some improvement in hatching results when eggs are held for one day at 90° F and one or two days at 85° F before they are held at 50° F.

TABLE 9--EFFECT OF HOLDING TEMPERATURE ON HATCHABILITY OF NICHOLS NEW HAMPSHIRE PULLET (MAY HATCHED) HATCHING EGGS RECEIVED AT A HATCHERY FROM DECEMBER 30, 1953, TO MARCH 31, 1954. ONE HUNDRED AND FORTY EGGS PER LOT.

Temperature and Time	No. Days Subsequently Held at 50° F.	Percentage Hatch	
		All Eggs	Fertile Eggs
70° F. for 0 days	8	67.9	68.8
" for 8 "	0	70.0	71.0
" for 1 "	7	57.1	57.6
" for 2 "	6	68.6	71.1
" for 4 "	4	71.4	73.5
" for 6 "	2	66.4	67.9
80° F. for 8 days	0	65.0	65.9
" for 1 "	7	52.9	54.0
" for 2 "	6	75.0	77.2
" for 4 "	4	74.3	77.0
" for 6 "	2	65.7	68.2
85° F. for 1 days	7	80.7	83.7
" for 2 "	6	80.7	81.3
90° F. for 1 days	7	78.6	80.9
" for 2 "	6	70.7	72.8

Table 10 shows the effect of holding temperature on the hatchability of large eggs laid by New Hampshires. Eggs held at 85° F for one or two days before cooling to 50° F gave best hatchability.

Table 11 shows that eggs held at 50° F and combinations of 50° F, 60° F, 70° F and 80° F hatched best and better than eggs held continuously at 60° F, 70° F, and 80° F.

TABLE 10--EFFECT OF HOLDING TEMPERATURE ON HATCHABILITY OF EGGS LAID BY NICHOLS NEW HAMPSHIRE AFTER 5-6 MONTHS PRODUCTION. DECEMBER 16 AND DECEMBER 23, 1953. ONE HUNDRED SEVENTY EGGS PER LOT.

Temperature and Time	No. Days Subsequently Held at 50°F.	Percentage Hatch	
		All Eggs	Fertile Eggs
70°F. for 0 days	8	75.3	75.7
" for 8 "	0	61.8	63.3
" for 1 "	7	75.3	76.7
" for 2 "	6	70.6	73.2
" for 4 "	4	67.1	67.5
" for 6 "	2	64.1	65.7
80°F. for 8 days	0	58.8	60.6
" for 1 "	7	77.1	78.9
" for 2 "	6	78.2	79.6
" for 4 "	4	57.1	59.2
" for 6 "	2	64.1	64.9
85°F. for 1 days	7	74.7	75.6
" for 2 "	6	72.4	74.7
90°F. for 1 days	7	70.6	71.9
" for 2 "	6	68.2	69.9

TABLE 11--EFFECT OF HOLDING TEMPERATURES ON THE HATCHABILITY OF DELAWARE x NEW HAMPSHIRE EGGS. EIGHT HATCHES SET FROM JANUARY 9, 1955, TO FEBRUARY 27, 1955.

Holding Conditions	No. Eggs	Percentage Hatch of All Eggs	No. Cull Chicks (Rough Navels, etc.)
3 days at 50°F.	517	82.4	8
3 days at 60°F.	517	77.8	14
1 day at 50°F., 2 days at 60°F.	516	81.6	20
2 days at 50°F., 1 day at 60°F.	518	81.8	16
3 days at 70°F.	518	80.3	18
1 day at 50°F., 2 days at 70°F.	517	80.1	15
2 days at 50°F., 1 day at 70°F.	518	81.5	12
3 days at 80°F.	517	78.3	14
1 day at 50°F., 2 days at 80°F.	515	81.5	24
2 days at 50°F., 1 day at 80°F.	519	84.4	11

DISCUSSION

The results of this series of experiments indicate that 50° F is possibly the best temperature for storing hatching eggs if one uniform temperature is to be selected. Holding eggs at 60° F, 70° F, or 80° F certainly did not improve hatching results with eggs produced by meat-type birds. However, it appears that one uniform temperature may not give the best hatching results. These trials suggest that warming the eggs at room temperature (75° F to 80° F) 80° F, 85° F, or 90° F for 24 hours before setting may improve hatching results.

Hatchability is not a simple phenomenon and as with all biological data there is considerable variation and conclusions that cannot be made with certainty. We would suggest that those who can should compare hatchability of eggs held under different conditions on their own premises.

On the basis of our observations and experiments we would recommend that hatching eggs be held between 50° F and 60° F. These appear to be practical limits unless observations on the premises indicate otherwise. If the thermostat on the cooler is set to give a temperature of 55° F normally the temperature will be within the limits of 50° F to 60° F. We know that excellent hatches can be secured from eggs held within this range of temperature.

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