

THE INFLUENCE OF FLOOR SPACE ON
EGG PRODUCTION AND FERTILITY OF
BELTSVILLE SMALL WHITE AND BROAD
BREASTED BRONZE TURKEY BREEDER HENS

Thesis for the Degree of M. S.
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John Henry Wolford

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by

John Henry Wolford

An Abstract

Submitted to the College of Agriculture, Michigan State University
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ABSTRACT

Housing more turkey breeder hens per given area of floor space is of economic importance to producers of hatching eggs because of high labor and building costs. This study was undertaken to determine the influence of floor space per bird on egg production and fertility of turkey breeder hens. Ninety Beltsville Small White turkey breeder hens were placed in four pens at the rate of 2.36, 2.67, 3.07 and 4.36 square feet of floor space per bird. Eighty Broad Breasted Bronze turkey breeder hens were placed in five pens at the rate of 2.27, 2.88, 5.80, 6.59 and 7.91 square feet per bird. The amount of floor space allowed per bird is less than the usual recommended rate of 12 - 15 square feet per bird, Broad Breasted Bronze turkeys, and 8.5 - 12 square feet per bird, Beltsville Small White turkeys.

Egg production per hen decreased slightly as floor space per bird decreased in both varieties. The Beltsville Small White hens produced 56.9, 50.7, 46.4 and 47.9 eggs per hen respectively when they were housed at 4.36, 3.07, 2.67 and 2.36 square feet of floor space. The number of eggs produced per hen was 42.2, 56.6, 44.9, 48.9 and 50.0 when the Broad Breasted Bronze turkeys were housed at 7.91, 6.59, 5.80, 2.88 and 2.27 square feet of floor space per bird.

Fertility was substantially decreased in both the Beltsville Small White and the Broad Breasted Bronze turkeys as floor space per bird decreased. The percentage of fertile eggs produced by the Beltsville Small White turkeys was 69.6, 82.1, 70.2 and 39.7 percent respectively where the birds were housed at 4.36, 3.07, 2.67 and 2.36

John H. Wolford

square feet of floor space per bird while the Broad Breasted Bronze hens produced 47.2, 58.7, 73.8, 72.5 and 14.2 percent fertile eggs when they were housed at 7.91, 6.59, 5.30, 2.88 and 2.27 square feet of floor space per bird.

Liveability, in this study, did not appear to be influenced by the amount of floor space allowed each bird.

Egg production and fertility may possibly have been affected by factors other than floor space. Feed and water space may have influenced egg production while virility of males, number of females per male and interference during mating of other birds within a pen may have affected fertility.

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INTRODUCTION

Increased building and labor costs during the last few years have resulted in the confinement of more poultry per given area of floor space. Decreasing the amount of floor space per bird is the most obvious way to decrease housing costs per bird but this can lead to hazardous and disastrous troubles. Disease, ventilation and production loss are just a few of the many additional problems with which poultrymen may become plagued.

The main objective of the present study was to determine the influence of floor space on egg production and fertility of turkey breeder hens.

REVIEW OF LITERATURE

There is a decided lack of information on the amount of floor space required per bird for turkey breeder hens. Most of the available information appears to come from opinions of educators, producers and researchers.

According to an outline by Crushman and suggestions by Marsden (Turkey World, 1947 through 1951 and 1953), Broad Breasted Bronze turkey breeder hens require eight square feet of floor space per hen where outside yards are provided; but, if confined, the requirement is twelve and one-half square feet of floor space per hen. The lighter varieties, such as the Beltsville Small White turkeys, require twenty percent less space per bird than is required by the heavy varieties.

Twelve square feet of floor space per hen for the small type turkey and fifteen square feet per hen for the large type turkey was recommended by Marsden and Martin (1949) provided thirty to fifty percent of this area is sun porch.

Wirthmore Feeds (1954) recommends that large type turkey breeder hens be housed at the rate of eight square feet of floor space per bird and the small type hens at six square feet of floor space per bird.

Each breeder hen should be allowed eight to ten square feet of floor space according to Winter and Funk (1956).

Where breeding pens with outside yards are used, eight square feet of floor space for each large type turkey breeder hen should be provided according to suggestions by Marsden (Turkey World, 1956 and 1957). At the same time, fifteen square feet of floor space per bird was recommended where complete confinement is practiced. The recommendations for small type turkey breeders was twenty percent less floor space than that recommended for large type breeders.

Marsden (1952) recommended fifteen square feet of floor space for each large type bird or twelve square feet for each small type bird. He also stated that one-third to one-half of the total floor space should consist of a sun porch.

OBJECTIVES

1. To determine the influence of the amount of floor space per turkey breeder hen on egg production and fertility in both Beltsville Small White and Broad Breasted Bronze turkeys.
2. To ascertain the effect of floor space on viability and livability.
3. To determine some of the economic consequences of decreasing the amount of floor space per breeder hen below that usually recommended (12-15 square feet per hen for Broad Breasted Bronze and 9.5 - 12 square feet per hen for Beltsville Small White).

EXPERIMENTAL PROCEDURE

Selection of Turkeys:

The turkey breeder hens and toms utilized in this study were obtained from the Michigan State University breeding flock. The ninety Beltsville Small White turkey breeder hens used were selected at random and divided into four unequal groups containing 30, 25, 20 and 15 birds, respectively. Each group was then randomly placed in one of four pens. Eighty Broad Breasted Bronze turkey breeder hens used were selected at random and divided into five groups as follows: 9, 9, 15, 20 and 27 birds. Each group was then randomly placed in one of five pens.

Table 1 shows the location of each pen used in this experiment.

Floor Space: (Table 3)

In the pens containing Beltsville Small White turkeys, the amount of floor space allowed per bird after subtracting the space required for feeders, waterers and nests was 2.36 square feet in pen 2 (32 birds), 2.67 square feet in pen 3 (27 birds), 3.07 square feet in pen 4 (22 birds), and 4.36 square feet in pen 5 (17 birds). In the pens containing Broad Breasted Bronze turkeys, each bird was allowed 2.27 square feet in pen 12 (22 birds), 2.88 square feet in pen 11 (17 birds), 5.80 square feet in pen 18 (10 birds), 6.59 square feet in pen 9 (10 birds), and 7.91 square feet in pen 20 (31 birds).

All pens were provided with roosts which were raised approximately two feet above the floor. In pens 2, 3, 4 and 5, the roosts covered approximately 35 percent of the available floor space.

N E
W S

Table 1

Sketch of Michigan State University Breeder Pens

Pen 1 4'10"	15'10"	Pen 2 30 F. 5'11" 2 M. BSW	Pen 3 25 F. 5'4" 2 M. BSW	Pen 4 20 F. 5'1" 2 M. BSW	Pen 5 15 F. 5'1" 2 M. BSW
Aisle					
Pen 19 12'0"	6'0"	Aisle	Pen 6 12'0"	6'3"	
Pen 18 9 F. 1 M. BBB	5'11"		Pen 7	5'8"	
Pen 17	6'1"		Pen 8	6'1"	
Pen 16	6'10"		Pen 9 9 F. 1 M. BBB	6'10"	
Pen 15	5'9"		Pen 10	5'9"	
Pen 14	5'8"		Pen 11 15 F. 2 M. BBB	5'8"	
Pen 13	5'6"		Pen 12 20 F. 2 M. BBB	5'6"	
Pen 20 27 F. 4 M. BBB 19'0"	13'7"		Pen 21 10'6"		

This sketch is not drawn to scale. The sketch shows the number of males and females in each pen. The legend is as follows:

1. BSW = Beltsville Small White turkeys
2. BBB = Broad Breasted Bronze turkeys
3. M = Males
4. F = Females

Approximately 55 percent of the available floor space in pens 11, 12, and 18, 50 percent of the available floor space in pen 9, and 20 percent of the available floor space in pen 20 was covered by roosting area.

Feed and Water:

During the entire experimental period a turkey breeder ration (Table 2) formulated by the Poultry Nutrition Section, Michigan State University, was fed to all pens. Regardless of the number or variety of birds in a pen, the total amount of feed and water space (Table 3) was held constant from pen to pen. Pen 2 with 32 birds had 0.7 inches of water space and 1.5 inches of feeding space per bird; pen 3 with 27 birds had 0.85 inches of water space and 1.8 inches of feeding space per bird; pens 4 and 12 with 22 birds each had 1.05 inches of water space and 2.2 inches of feeding space per bird; pens 5 and 11 with 17 birds each had 1.35 inches of water space and 2.8 inches of feeding space per bird; pens 9 and 18 with 10 birds each had 2.3 inches of water space and 4.8 inches of feeding space per bird; and pen 20 with 31 birds had .74 inches of water space and 1.6 inches of feeding space per bird.

Electric heating units were placed in the water pans to prevent ice formation and to provide warm water.

Eggs:

Trapnests were used in all pens. The individual nest in each pen measured 26 inches long, 15 inches wide and 24 inches deep. In the

Table 2
Turkey Breeder Ration

Ingredient	Pounds or Grams/Ton
Ground Yellow Corn	999
Ground Heavy Oats	200
Soybean oil meal, solv. 44 percent	200
Wheat Bran	100
Wheat Standard Middlings	100
Alfalfa meal, dehy. 17 percent	100
Fish meal	80
Meat and Bone scraps 50 percent	40
Dried yeast	40
Dried Whey	30
Ground Limestone	60
Dicalcium phosphate	30
Salt, iodized	10
Manganese sulfate 70 percent	0.5
Dry vitamin A 5000/gm.	3
Dry vitamin D ₃ 1500/gm.	3
Cholinechloride	2
Vitamin B ₁₂ Supplement 6 mg./lb.	1.2
N.F. 180	1
Vitamin E supplement 20,000/lb.	0.8
B.H.T. (Butylated hydroxy toluene)	0.25
Niacin	20 grams
Riboflavin	2 grams

pens containing Beltsville Small White turkeys (Table 3), pen 2 had 1 nest per 7.5 breeder hens, pen 3 had 1 nest per 6.3 breeder hens, pen 4 had 1 nest per 5 breeder hens and pen 5 had 1 nest per 3.8 breeder hens. In the pens containing Broad Breasted Bronze turkeys, pens 9 and 18 had 1 nest per 2.3 breeder hens, pen 11 had 1 nest per 3 breeder hens, pen 12 had 1 nest per 4 breeder hens, and pen 20 had 1 nest per 6.8 breeder hens.

Eggs were gathered 5 to 6 times daily. Each egg was marked with hen number, pen number and date. The egg was recorded on a monthly trap nest record sheet located in each pen. Settings were made at two-week intervals with the eggs being kept in the basement of the Michigan State University Poultry Plant egg processing room prior to being placed in the incubator. All poults were pedigree hatched. At the end of 24 days of incubation, all eggs were candled to determine fertility. The infertiles were discarded and the fertile eggs were transferred to a hatcher.

Lighting:

At the time toms were placed in the breeding pens with hens, January 26, 1959, lights were turned on in these pens. Beginning January 2, 1959, toms used in this study were subjected to a 14-hour light day. A 14-hour light day was maintained throughout the experimental period (February 16, 1959, through June 7, 1959). Each pen had one fifty-watt bulb located approximately 6 feet from the floor. Windows located in pens 2, 4, 6, 11, 14, 18 and 20 allowed the birds in these pens some natural light.

Number of Males (Table 3):

Two males per pen were placed in each pen of Beltsville Small White turkeys. In the Broad Breasted Bronze pens, pens 11 and 12 had 2 males each, pens 9 and 18 had 1 male each, and pen 20 had 4 males.

Economics:

Certain information in addition to egg production and fertility data was necessary so that an economic comparison of results from different pens could be made, consequently records were kept of feed consumed in each pen from March 16, 1959, through June 7, 1959. The average cost of the breeder mash was \$93.30 per ton.

A questionnaire forwarded to several hatchery operators located in the State of Michigan gave the following information about the prices they paid for fertile turkey eggs and prices received for turkey poults.

A. Eggs

- | | |
|---------------------------|-----------------------|
| 1. Broad Breasted Bronze | 37.5¢ per fertile egg |
| 2. Beltsville Small White | 27.0¢ per fertile egg |

B. Poults (day-old)

- | | |
|---------------------------|-----------------|
| 1. Broad Breasted Bronze | 74.0¢ per poult |
| 2. Beltsville Small White | 53.0¢ per poult |

Statistical Analysis:

The egg production and fertility data were statistically analyzed using Linear Regression and Analysis of Variance (Dixon and Massey, 1957).

Table 3

Summary of the Number of Birds Per Pen, Square Feet of Floor Space
Per Pen and Per Bird, Amount of Feeding and Watering
Space Per Bird, and Number of Hens Per Nest

Pen	Hens/Toms Housed	Sq.Ft. of Floor Space Per Pen	Sq.Ft. of Floor Space Per Bird	Feeding Space	Water Space	Hens/ Nest.
2	30 / 2	75.4	2.36	1.5	.70	7.5
3	25 / 2	72.2	2.67	1.8	.85	6.3
4	20 / 2	67.5	3.07	2.2	1.05	5.0
5	15 / 2	74.1	4.36	2.8	1.35	3.8
12	20 / 2	49.9	2.27	2.2	1.05	4.0
11	15 / 2	48.9	2.88	2.8	1.35	3.0
18	9 / 1	58.0	5.80	4.8	2.30	2.3
9	9 / 1	65.9	6.59	4.8	2.30	2.3
20	27 / 4	245.1	7.91	1.6	.74	6.8

RESULTS

A. With Beltsville Small White Turkeys

Eggs produced and set (Table 4)

As the total amount of floor space in each pen was approximately the same, the total number of eggs set from each pen increased as the number of hens per pen was increased, thus resulting in more eggs per square foot of floor space. The 15 hens in pen 5 laid 853 eggs; the 20 hens in pen 4 laid 1,013 eggs; the 25 hens in pen 3 laid 1,161 eggs; and the 30 hens in pen 2 laid 1,436 eggs. Thus this is 56.9 eggs set per hen at the highest amount of floor space per bird (4.36 sq. ft.) and 47.9 eggs set per hen at the lowest amount of floor space per bird (2.36 sq. ft.). The 2 intermediate groups were 50.7 and 46.4 eggs respectively for pen 4 (3.07 sq. ft. of floor space per bird) and pen 3 (2.67 sq. ft. of floor space per bird). Therefore, the general tendency was for the number of eggs per hen to decrease as floor space per hen decreased; however, as the number of square feet per hen decreased the number of eggs set per pen increased. This increase was from 11.5 eggs per square foot in pen 5 (4.36 sq. ft. of floor space per bird), to 15.0 eggs per square foot in pen 4 (3.07 square feet of floor space per bird), to 16.1 eggs per square foot in pen 3 (2.67 sq. ft. of floor space per bird), to 19.0 eggs per square foot in pen 2 (2.36 sq. ft. of floor space per bird). Based on total hens housed, percent production showed a general improvement as floor space per hen increased. The hens in pen 5, housed at 4.36 square feet of floor

Table 4

Influence of Floor Space Per Bird on Percent Production
And on Number Eggs Set Per Pen, Hen and Square Foot
(Beltsville Small White Turkeys)

Pen	Hens/Toms Housed	Sq. Ft. per Bird	Eggs Set			Percent* Production
			Total	Per Hen	Per Sq.Ft.	
2	30 / 2	2.36	1436	47.9	19.0	42.7
3	25 / 2	2.67	1161	46.4	16.1	41.5
4	20 / 2	3.07	1013	50.7	15.0	45.2
5	15 / 2	4.36	853	56.9	11.5	50.8

*Based on number of hens housed

space per hen, produced at the rate of 50.8 percent. This was 5.6 percent higher than the production in pen 4 where birds were housed at 3.07 square feet of floor space per hen; 9.3 percent higher than the production in pen 3 where birds were housed at 2.67 square feet of floor space per hen; and 8.1 percent higher than the production in pen 2 where the birds were housed at 2.36 square feet of floor space per hen.

Fertile eggs (Table 5)

Number of fertile eggs produced per pen was not consistent. Of the eggs produced in pen 4, 832 out of 1,013 eggs (82.1 percent) were fertile. Fertility was lowest in the eggs from pen 2. Five hundred seventy (570) of the 1,436 eggs (39.7 percent) from this pen were fertile. Figures for pen 3 were 815 fertile eggs out of a total of 1,161 eggs (70.2 percent). There were 594 fertile eggs out of 853 eggs (69.6 percent) produced by the hens in pen 5. In general, the number of fertile eggs per hen increased as the number of square feet per bird

Table 5

Influence of Floor Space Per Bird on Fertility and Number
of Fertile Eggs Produced Per Pen, Hen and Square Foot
(Beltsville Small White Turkeys)

Pen	Hens/Toms Housed	Sq. Ft. Per Bird	Fertile Eggs			Percent Fertile Eggs
			Total	Per Hen	Per Sq. Ft.	
2	30 / 2	2.36	570	19.0	8.1	39.7
3	25 / 2	2.67	815	32.6	26.3	70.2
4	20 / 2	3.07	832	41.6	26.8	82.1
5	15 / 2	4.36	594	39.6	9.1	69.6

increased. The number of fertile eggs per hen was 19 for pen 2 where the birds were housed at 2.36 square feet of floor space per bird; 32.6 for pen 3 where the birds were housed at 2.67 square feet of floor space per bird; 41.6 for pen 4 where the birds were housed at 3.07 square feet of floor space per bird; and 39.6 for pen 5 where the birds were housed at 4.36 square feet of floor space per bird. The two pens in which the greatest number of fertile eggs were produced per square foot of floor space were pens 4 (3.07 square feet of floor space per bird) and 3 (2.67 square feet of floor space per bird) with 26.8 and 26.3 fertile eggs per square foot of floor space. The two pens which produced the lowest number of fertile eggs per square foot of floor space were pens 5 (4.36 square feet of floor space per bird) and 2 (2.36 square feet of floor space per bird) with 9.1 and 8.1 fertile eggs per square foot of floor space.

Poults (Table 6):

The total number of poults produced per pen was highest in pen 4 (628 poults) and lowest in pen 2 (406 poults). Pens 3 and 5 were intermediate with 586 and 490 poults. In general, more poults were produced per hen as floor space per bird was increased. Where birds were allowed 2.36 square feet of floor space, 13.5 poults per hen were produced; where birds were allowed 2.67 square feet of floor space, 23.4 poults per hen were produced; where birds were allowed 3.07 square feet of floor space, 31.4 poults per hen were produced; and where birds were allowed 4.36 square feet of floor space, 32.7 poults per hen were produced. However, poults produced per square foot of floor space did not follow this same order. Pen 4 was high with 9.3 poults per square foot being produced and pen 2 was low with 5.4 poults per square foot being produced. From pens 3 and 5, 8.1 and 6.6 poults were produced respectively per square foot of floor space.

Table 6

Influence of Floor Space Per Bird on Percent Hatch of
Total Eggs Produced and On The Number of Poults
Produced Per Pen, Hen and Square Foot
(Beltsville Small White Turkeys)

Pen	Hens/Toms Housed	Sq. Ft. Per Bird	Poults			Percent Hatch of Total Eggs
			Total	Per Hen	Per Sq.Ft.	
2	30 / 2	2.36	406	13.5	5.4	28.3
3	25 / 2	2.67	586	23.4	8.1	50.5
4	20 / 2	3.07	628	31.4	9.3	62.0
5	15 / 2	4.36	490	32.7	6.6	57.4

Mortality (Table 7):

The over-all mortality of the Beltsville Small White turkey breeders in this study was low. Actual mortality was only three hens; however, four hens were removed because of a Four plus reaction to the Salmonella Pullorum Tube Test and were considered as having died. Additional laboratory tests proved these reactor birds to be free from pullorum disease. Two birds were removed from pen 2; one bird was removed from pen 3; and one bird was removed from pen 5 because of the positive reaction 10 days after the experiment began. The mortality loss was 6.7 percent in pen 2 (2.36 square feet of floor space per bird); 8.0 percent in pen 3 (2.67 square feet of floor space per bird), 10 percent in pen 4 (3.07 square feet of floor space per bird) and 6.7 percent in pen 5 (4.36 square feet of floor space per bird).

Table 7
Mortality (Beltsville Small White Turkeys)

Pen	Hens/Toms Housed	Sq. Ft. Per Bird	Total Hens Lost	Percent Mortality	Average Hens
2	30 / 2	2.36	2	6.7	28.2*
3	25 / 2	2.67	2	8.0	23.2
4	20 / 2	3.07	2	10.0	18.8
5	15 / 2	4.36	1	6.7	14.1

*Based on number of hen days

Feed (Table 8):

Regardless of the number of birds in each pen, the feeding space per pen was held constant (48 inches in each pen). Feed consumed per bird was 25.0 pounds in pen 2 where birds were housed at 2.36 square feet of floor space per hen (47.6 percent production), 25.6 pounds in pen 5 where birds were housed at 4.36 square feet of floor space per hen (53.6 percent production), 25.8 pounds in pen 3 where birds were housed at 2.67 square feet of floor space per hen (47.6 percent production) and 26.2 pounds in pen 4 where birds were housed at 3.07 square feet of floor space per hen (47.9 percent production). The feed required to produce a dozen eggs was 7.8 pounds for pen 5, 8.0 pounds for pen 2, 8.4 pounds for pen 3 and 8.6 pounds for pen 4.

Table 8

Influence of Floor Space Per Bird on the Amount of Feed
Required Per Bird and Per Dozen Eggs
(Beltsville Small White Turkeys)¹

Pen	Hens/Toms Housed	Sq. Ft. Per Bird	Feed (lbs.)		Percent Production ³	Average No. Hens ⁴ in Pens	Dozen Eggs
			Per Bird ²	Per Dozen Eggs			
2	30 / 2	2.36	25.0	8.0	47.6	28	94.2
3	25 / 2	2.67	25.8	8.4	47.6	23	76.7
4	20 / 2	3.07	26.2	8.6	47.9	19.6	65.8
5	15 / 2	4.36	25.6	7.8	53.6	14	52.5

¹The feed records were kept only for the last 84 days of the 112-day experiment.

²Feed per bird based on average number of hens and toms in each pen.

³Based on number of hen days.

⁴Average number of hens based on hen days.

Graphic (Table 9):

A graphic view of the results with Beltsville Small White turkeys is presented in Table 9 to give an over-all picture.

Table 9

Comparative Results of Number of Eggs Set Per Hen and Per Square Foot, Number of Fertile Eggs Per Hen and Per Square Foot, Number Poults Per Hen and Square Foot, Percent Production, Percent Fertile Eggs, Percent Hatch of Total Eggs and Percent Mortality as Influenced by the Amount of Floor Space Per Bird
(Beltsville Small White Turkeys)

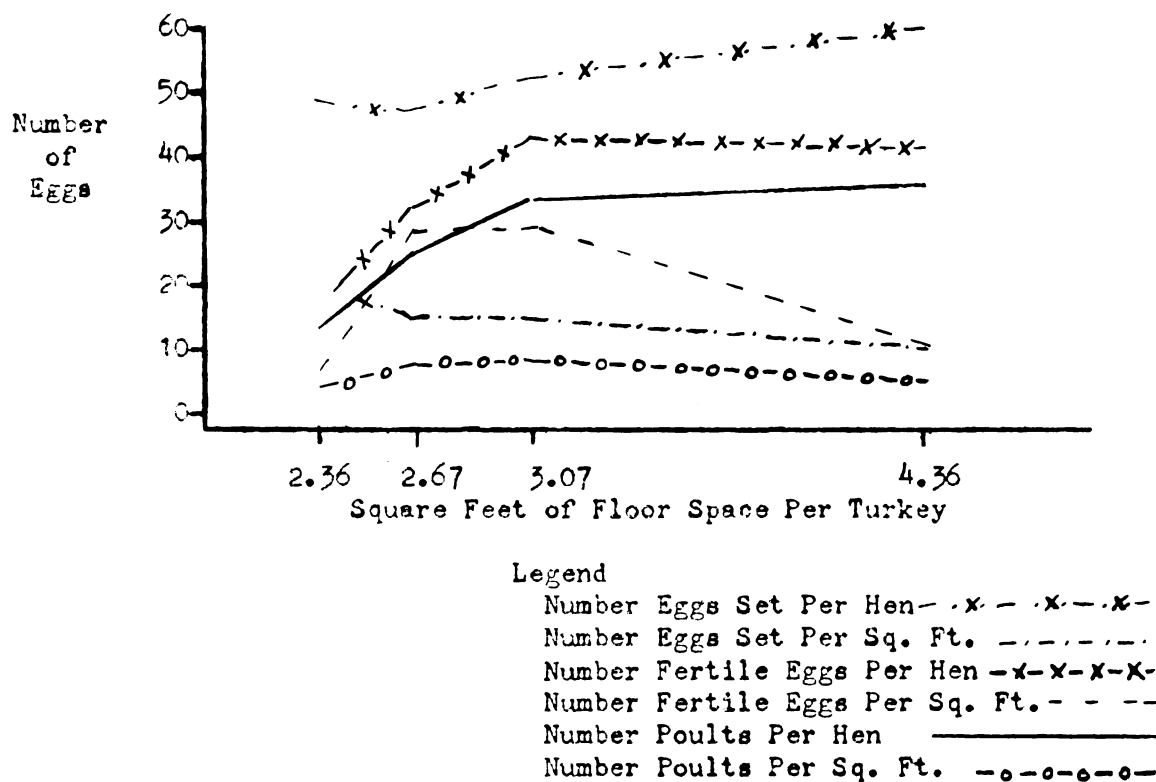
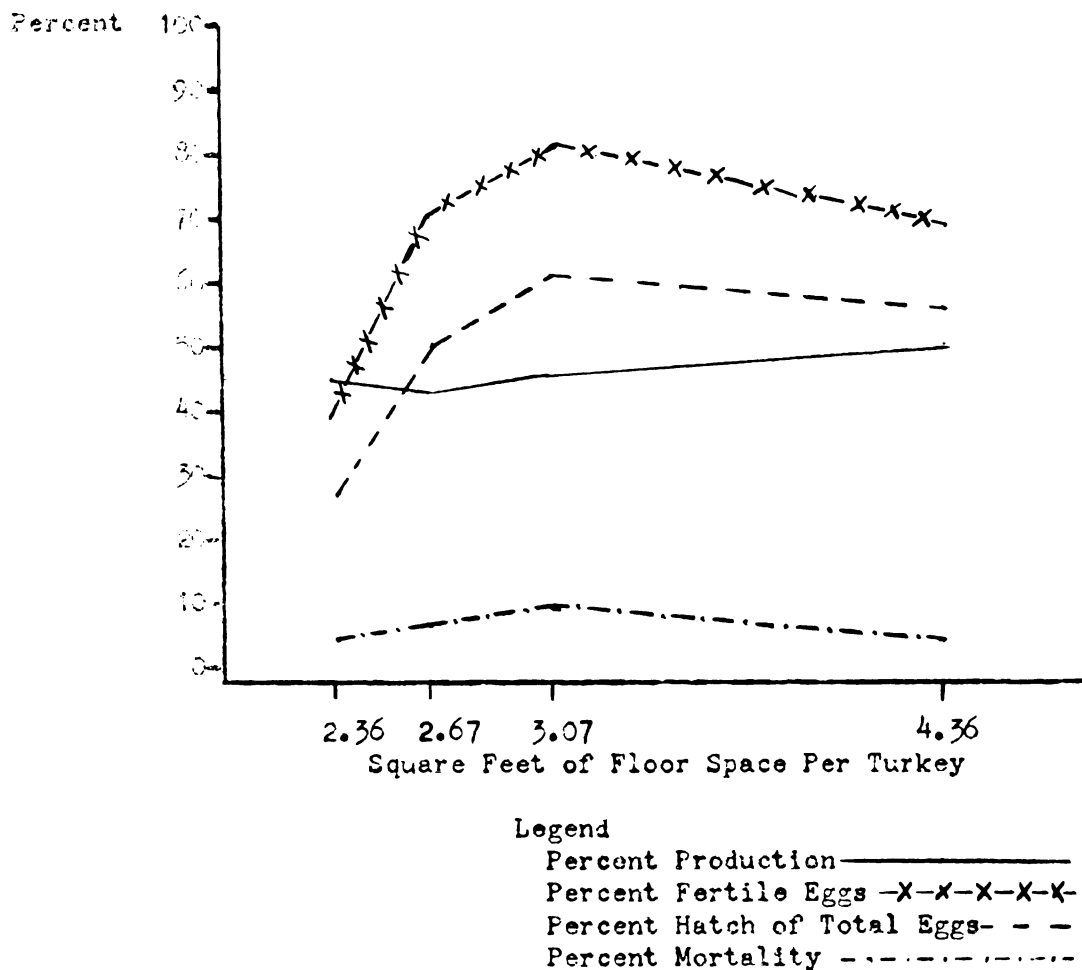


Table 9 - Continued



B. With Broad Breasted Bronze Turkeys

Eggs produced and set (Table 10):

The total number of eggs set per given area of floor space increased as the number of hens housed in this area increased. The twenty hens in pen 12 (2.27 square feet of floor space per bird) produced 999 eggs; the fifteen hens in pen 11 (2.88 square feet of floor space per bird) produced 734 eggs; the nine hens in pen 9 (6.59 square feet of floor space per bird) produced 509 eggs; the nine hens in pen 18 (5.80

square feet of floor space per bird) produced 404 eggs; and the 27 hens in pen 20 (7.91 square feet of floor space per bird) produced 1,138 eggs. Thus this is 56.6 eggs set per hen (50.5 percent production) in pen 9, 50.0 eggs set per hen (44.6 percent production) in pen 12, 48.9 eggs set per hen (43.7 percent production) in pen 11, 44.9 eggs set per hen (40.1 percent production) in pen 18 and 42.2 eggs set per hen (37.6 percent production) in pen 20. The number of eggs set per square foot increased as the square feet of floor space per bird decreased. This increase was from 4.6 eggs (pen 20) to 7.0 eggs (pen 18); to 8.6 eggs (pen 9) to 15.0 eggs (pen 11), to 20.0 eggs (pen 12).

Table 10

Influence of Floor Space Per Bird on Percent Production
And on Number Eggs Set Per Pen, Hen and Square Foot
(Broad Breasted Bronze Turkeys)

Pen	Hens/Toms Housed	Sq. Ft. Per Bird	Eggs Set			Percent* Production
			Total	Per Hen	Per Sq.Ft.	
12	20 / 2	2.27	999	50.0	20.0	44.6
11	15 / 2	2.88	734	48.9	15.0	43.7
18	9 / 1	5.80	404	44.9	7.0	40.1
9	9 / 1	6.59	509	56.6	8.6	50.5
20	27 / 4	7.91	1138	42.2	4.6	37.6

*Based on number of hens housed

Fertile eggs (Table 11):

The total number of fertile eggs produced per pen was not consistent. Of the eggs produced in pen 18, 298 out of 404 eggs (73.8

Table 11

Influence of Floor Space Per Bird on Fertility and Number
of Fertile Eggs Produced Per Pen, Hen and Square Foot
(Broad Breasted Bronze Turkeys)

Pen	Hens/Toms Housed	Sq. Ft. Per Bird	Fertile Eggs			Percent
			Total	Per Hen	Per Sq.Ft.	
12	20 / 2	2.27	142	7.1	3.1	14.2
11	15 / 2	2.88	532	35.5	12.3	72.5
18	9 / 1	5.80	298	33.1	5.7	73.8
9	9 / 1	6.59	299	33.2	4.5	58.7
20	27 / 4	7.91	537	19.9	2.5	47.2

percent) were fertile. Fertility was lowest in the eggs from pen 12. Only 142 of the 999 eggs (7.1 percent) from this pen were fertile. Figures from pen 11 were 532 fertile eggs out of a total of 734 eggs (72.5 percent). The hens in pens 9 and 20 were intermediate in that those in pen 9 produced 299 fertile eggs out of a total of 509 eggs (58.7 percent) while those in pen 20 produced 537 fertile eggs out of a total of 1,138 eggs (47.2 percent). The hens in pens 11, 9 and 18 produced 35.5, 33.2 and 33.1 fertile eggs per hen, respectively, while those in pens 20 and 12 were much lower with 19.9 and 7.1 fertile eggs per hen. The two pens having the least number of fertile eggs produced per square foot were pens 20 (7.91 square feet of floor space per bird) and pen 12 (2.27 square feet of floor space per bird) with 2.5 and 3.1 fertile eggs per square foot. Pen 11 (2.88 square feet of floor space per bird) was high with 12.3 fertile eggs per square foot. Pens 9 (6.59 square feet of floor space per bird) and 18 (5.80 square feet of

floor space per bird) were intermediate with 4.5 and 5.7 fertile eggs per square foot.

Poults (Table 12):

The total number of poults produced per pen was highest in pen 11 (406 poults) and lowest in pen 12 (72 poults). Pens 20, 9 and 18 were in between with 308, 181 and 180 poults. Where birds were housed at 2.88 square feet of floor space, 27.1 poults per hen were produced; where birds were housed at 6.59 square feet of floor space, 20.1 poults per hen were produced; where birds were housed at 5.80 square feet of floor space, 20.0 poults per hen were produced; where birds were housed at 7.91 square feet of floor space, 11.4 poults per hen were produced; and where birds were housed at 2.27 square feet of floor space, 3.6 poults per hen were produced. The number of poults produced per square foot was highest in pen 11 (8.3 poults) while pens 12 (1.4 poults) and 20 (1.3 poults) were lowest. Pens 9 (2.7 poults) and 18 (3.1) were intermediate.

Table 12

Influence of Floor Space Per Bird on Percent Hatch of
Total Eggs Produced and on the Number of Poults
Produced Per Pen, Hen and Square Foot
(Broad Breasted Bronze Turkeys)

Pen	Hens/Toms Housed	Sq. Ft. Per Bird	Poults			Percent Hatch of Total Eggs
			Total	Per Hen	Per Sq.Ft.	
12	20 / 2	2.27	72	3.6	1.4	7.2
11	15 / 2	2.88	406	27.1	8.3	55.3
18	9 / 1	5.80	180	20.0	3.1	44.6
9	9 / 1	6.59	181	20.1	2.7	35.6
20	27 / 4	7.91	308	11.4	1.3	27.1

Mortality (Table 13):

Mortality in the Broad Breasted Bronze turkey pens was exceptionally low. Only 2 hens were lost during the experimental period. This loss (7.4 percent) occurred in pen 20 which had the greatest amount of floor space (7.91 square feet) per bird.

Table 13
Mortality
(Broad Breasted Bronze turkeys)

Pen	Hens/Toms Housed	Sq. Ft. Per Bird	Total Hens Lost	Percent Mortality	Average Hens*
12	20 / 2	2.77	0	0	20
11	15 / 2	2.88	0	0	15
18	9 / 1	5.80	0	0	9
9	9 / 1	6.59	0	0	9
20	27 / 4	7.91	2	7.4	25.5

*Based on number of hen days.

Feed (Table 14):

Regardless of the number of birds in each pen, feeding space per pen was held constant (48 inches per pen). Feed consumed per bird was 41.4 pounds for those housed at 2.27 square feet of floor space (47.3 percent production), 41.6 pounds for those housed at 5.8 square feet of floor space (42.9 percent production), 41.6 pounds for those housed at 7.91 square feet of floor space (45.6 percent production), 47.1 pounds for those housed at 2.88 square feet of floor space (47.3 percent

production) and 54.3 pounds for those housed at 6.59 square feet of floor space (58.1 percent production).

Table 14

Influence of Floor Space Per Bird on the Amount of Feed
Required Per Bird and Per Dozen Eggs
(Broad Breasted Bronze Turkeys)¹

Pen	Hens/Toms Housed	Sq. Ft. Per Bird	Feed (lbs.)		Percent ³ Production	Average ⁴ No. Hens In Pen	Dozen Eggs
			Per Bird ²	Per Doz. Eggs			
12	20 / 2	2.27	41.4	13.8	47.3	20	66.2
11	15 / 2	2.88	47.1	16.9	47.3	15	47.4
18	9 / 1	5.80	41.6	15.4	42.9	9	27.1
9	9 / 1	6.59	54.3	14.8	58.1	9	36.6
20	27 / 4	7.91	41.6	15.1	45.6	25.5	81.3

¹The feed records were kept only for the last 84 days of the 112 day experiment.

²Feed per bird is based on average number of hens and toms in each pen.

³Based on number of hen days.

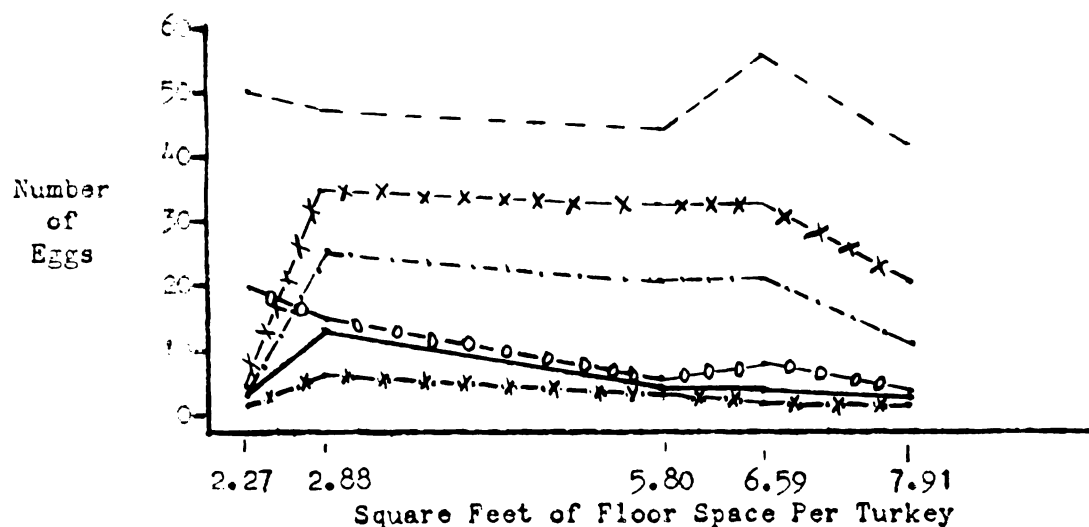
⁴Average number of hens based on hen days.

Graphic (Table 15):

A graphic view of the results with Broad Breasted Bronze turkeys is presented in Table 15.

Table 15

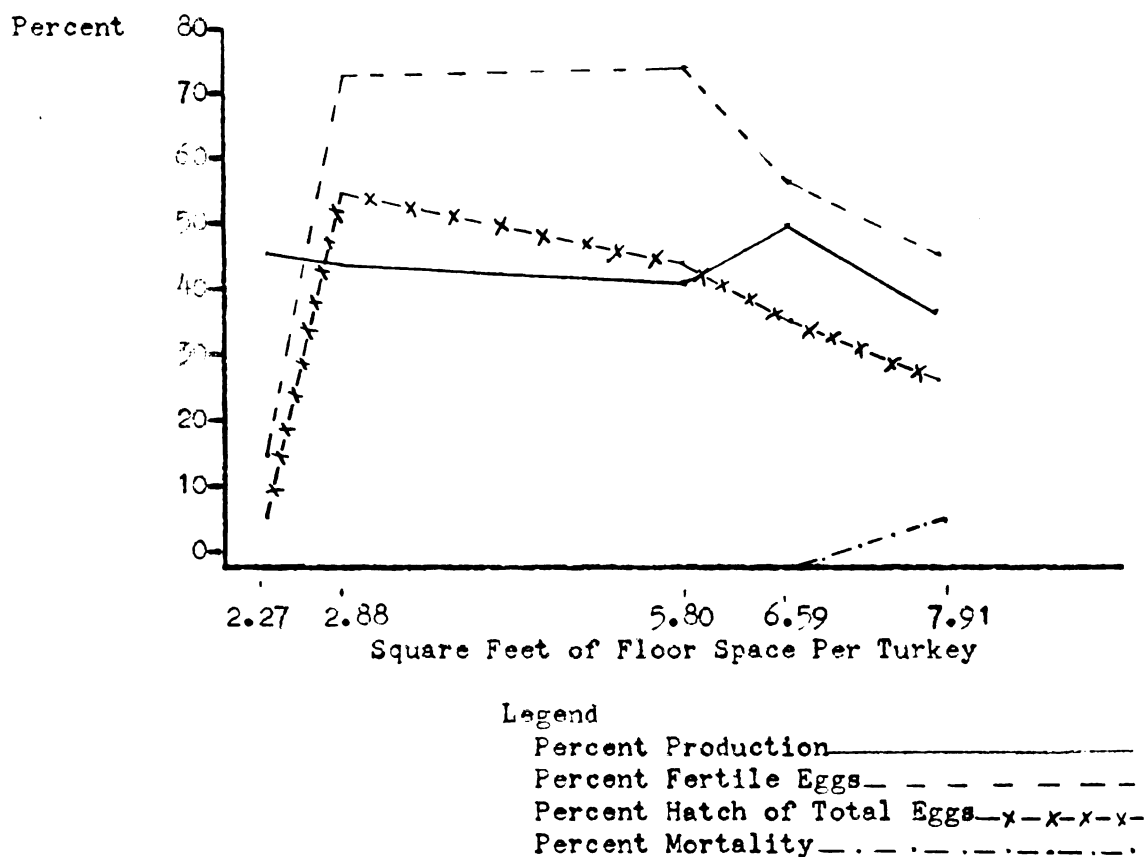
Comparative Results of Number of Eggs Set Per Hen and Per Square Foot, Number of Fertile Eggs Per Hen and Per Square Foot, Number Poults Per Hen and Square Foot, Percent Production, Percent Fertile Eggs, Percent Hatch of Total Eggs and Percent Mortality as Influenced by the Amount of Floor Space Per Bird
(Broad Breasted Bronze Turkeys)



Legend

Number Eggs Set Per Hen— — — — —
 Number Eggs Set Per Square Foot—o—o—o—o—
 Number Fertile Eggs Per Hen—x—x—x—x—x—
 Number Fertile Eggs Per Sq. Ft. —————
 Number Poults Per Hen—
 Number Poults Per Square Foot—x—x—x—x—

Table 15 - Continued



C. Economics

Beltville Small White Turkeys (Table 16):

Average prices figured from the questionnaire sent to four Michigan hatcherymen (see Experimental Procedure) were used as a basis in computing gross income from fertile eggs in each pen. Gross income was highest (\$130.95) from pen 4 where birds were housed at 3.07 square feet of floor space per bird. From pen 5, where birds were housed at 4.36 square feet of floor space per bird, gross income was lowest (\$70.45). Comparable figures for pen 3, where birds were housed at 2.67 square feet of floor space per bird, and for pen 2, where birds

Table 16

Gross Income and Income Per Pen, Hen and Square Foot Over Feed Cost as Influenced
By the Amount of Floor Space Per Bird (Beltsville Small White Turkeys)

Pen	Average ¹ Hens/Toms	Sq. Ft. per hen Initially	Feed Pounds	Feed Cost ²		Fertile Eggs		Gross ⁴ Income		Income over feed cost	
				Per Pen	Per Hen ³	Number	Percent	Per Pen	Per Hen	Per Pen	Per Hen
2	28 / 2	2.36	750	\$34.88	\$1.25	308	37.0	\$83.16	\$48.28	\$1.72	\$0.64
3	23 / 2	2.67	645	29.99	1.30	432	63.3	116.64	86.65	3.77	1.20
4	19.6 / 2	3.07	565	26.27	1.34	485	76.5	130.95	104.68	5.34	1.55
5	14 / 2	4.36	410	19.07	1.36	298	60.8	76.45	41.39	2.96	0.56

¹These figures are based on the average number of hens in each pen for the period March 16, 1959, through June 7, 1959.

²Based on a feed cost of \$93.30 per ton.

³Includes the feed eaten by the toms.

⁴Gross income based on 27¢ per fertile egg.

were housed at 2.36 square feet of floor space per bird, were \$116.64 and \$83.16.

In order to figure income over feed cost, an average of \$93.30 per ton was charged for the feed consumed (see Experimental Procedure). On this basis, feed cost amounted to \$26.27 for pen 4, \$19.07 for pen 5, \$29.99 for pen 3, and \$34.83 for pen 2 leaving an income over feed cost of \$104.68 for pen 4, \$41.39 for pen 5, \$86.65 for pen 3, and \$48.28 for pen 2. Income per hen over feed cost was \$5.34 in pen 4 (3.07 square feet of floor space per bird), \$3.77 in pen 3 (2.67 square feet of floor space per bird), \$2.95 in pen 5 (4.36 square feet of floor space per bird) and \$1.75 in pen 2 (2.36 square feet of floor space per bird).

When income was computed on the basis of income over feed cost per square foot of floor space, the two lowest pens were pen 5 (\$0.56 per square foot) and pen 2 (\$0.64 per square foot). Income per square foot was highest from pen 4 (\$1.55 per square foot) while pen 3 had an income of \$1.20 per square foot of floor space.

Broad Breasted Bronze turkeys (Table 17):

The average prices used in computing gross income from fertile eggs were obtained from the questionnaire (see Experimental Procedure) sent to four Michigan hatcherymen. Gross income was highest (\$113.25) from pen 20 where birds were allowed 7.91 square feet of floor space per bird. From pen 12, where birds were allowed 2.27 square feet of floor space per bird, gross income was lowest (\$26.25). Comparable figures for pen 11, where birds were allowed 2.88 square feet of floor space per bird, for pen 18, where birds were allowed 5.80 square feet

Table 17

Gross Income and Income Per Pen. Hen and Square Foot Over Feed Cost as Influenced
By the Amount of Floor Space per Bird (Broad Breasted Bronze)

Average ¹ Pen Hens/Tons		Sq. Ft. Per Hen	Feed Initially Found	Feed Cost ²		Fertile Eggs		Gross ⁴		Income Over Feed Cost	
				Per Pen	Per Hen ³	Number	Percent	Income	Per Pen	Per Hen	Per Sq. Ft.
12	20 / 2	2.27	910	\$42.32	\$2.12	70	11.3	\$26.25	\$16.07 ⁵	\$0.80	\$0.35
11	15 / 2	2.88	800	37.20	2.48	279	63.9	104.33	67.13	4.48	1.41
18	9 / 1	5.80	416	19.41	2.16	178	73.0	66.75	47.34	5.26	0.82
9	9 / 1	6.59	543	25.32	2.81	145	46.6	54.38	29.06	3.23	0.44
20	25.5 / 4	7.91	1228	57.29	2.25	302	39.8	113.25	55.96	2.19	0.23

¹These figures are based on the average number of hens in each pen for the period March 16, 1959 through June 7, 1959.

²Based on a feed cost of \$93.30 per ton.

³Includes the feed eaten by the toms.

⁴Gross income based on 37.5¢ per fertile egg.

⁵Encircled figures indicate negative figures.

of floor space per bird and for pen 9, where birds were allowed 6.59 square feet of floor space per bird, were \$104.33, \$66.75 and \$54.38 respectively.

A base figure of \$93.30 per ton (see Experimental Procedure) was used to compute feed cost. This cost amounted to \$37.20 for pen 11, \$57.29 for pen 20, \$19.41 for pen 18, \$25.32 for pen 9, and \$42.32 for pen 12, leaving an income over feed cost of \$67.13 for pen 11, \$55.96 for pen 20, \$47.34 for pen 18, \$29.06 for pen 9, and a loss of \$16.07 for pen 12. Income per hen over feed cost was \$5.26 in pen 18 (5.80 square feet of floor space per bird), \$4.48 in pen 11 (2.88 square feet of floor space per bird), \$3.23 in pen 9 (6.59 square feet of floor space per bird), \$2.19 in pen 20 (7.91 square feet of floor space per bird) and a loss of \$0.80 per hen in pen 12 (2.27 square feet of floor space per bird).

The lowest pen, when income was computed on the basis of income over feed cost per square foot of floor space, was pen 12 (loss of \$0.32 per square foot). Income per square foot was highest from pen 11 (\$1.41 per square foot) while pens 18, 9 and 20 had an income of \$0.82, \$0.44, and \$0.23 respectively per square foot of floor space.

D. Statistical Analysis

The number of floor eggs laid by the hens in each pen made the use of a statistical analysis somewhat difficult. The Beltsville Small White hens laid 22.4 percent floor eggs in pen 2 (2.36 square feet of floor space per bird), 20.1 percent floor eggs in pen 3 (2.67 square feet of floor space per bird), 18.1 percent floor eggs in pen 5 (4.36

square feet of floor space per bird), and 15.4 percent floor eggs in pen 4 (3.07 square feet of floor space per bird). The Broad Breasted Bronze turkeys produced a higher percentage of floor eggs than did the Beltsville Small White turkeys. The hens in pen 20 (7.91 square feet of floor space per bird) laid 91.4 percent floor eggs; the hens in pen 9 (6.59 square feet of floor space per bird) laid 60.9 percent floor eggs; the hens in pen 18 (5.80 square feet of floor space per bird) laid 51.2 percent floor eggs; the hens in pen 12 (2.27 square feet of floor space per bird) laid 37.5 percent floor eggs; and the hens in pen 11 (2.88 square feet of floor space per bird) laid 35.1 percent floor eggs.

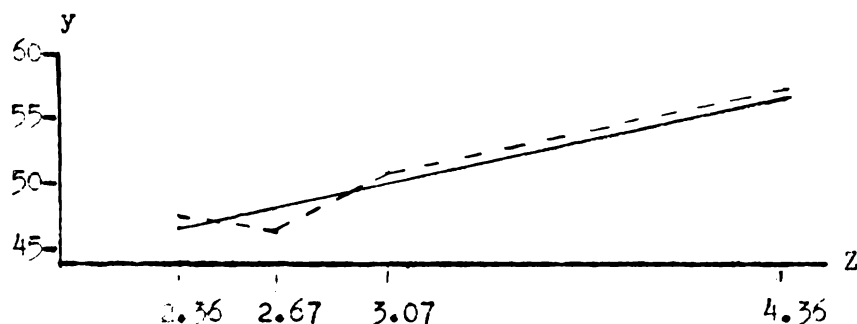
A statistical analysis, using Linear Regression, was made of the number of eggs set per hen and fertile eggs produced per hen. This analysis was made under the assumption that when a line is fitted to the mean of the number of eggs set per hen and fertile eggs produced per hen, there is linear regression. The hypothesis, floor space influence is equal to zero, was tested. The hypothesis tested, therefore, was whether the number of eggs laid and set per hen and fertile eggs produced per hen depended on the amount of floor space per bird under the assumption that either there was no dependence or that, if there was dependence, the dependence was linear.

The analysis, Beltsville Small White turkeys, shown in Tables 18 and 19, clearly indicate that "a" influence of floor space is not equal to zero when the number of eggs set per hen or the fertile eggs produced per bird was analyzed but it should be remembered that this analysis assumes a linear dependence between floor space and number of

Table 18

Statistical analysis of the number of eggs set per
hen for Beltsville Small White Turkey Breeder
Hens (Linear Regression)

- A. The estimates, $a = 4.98$ and $b = 34.97$, were obtained for the equation, $y = aZ + b$ where y equal number of eggs set per hen and Z equal the amount of floor space per bird. The following graph shows the estimated mean of eggs set per hen and the actual number obtained in the experiment.



Legend

1. Broken Line Equal Actual Mean
2. Solid Line Equal Estimated Mean

- B. The F-test for $a = 0$ is:

<u>Source of Variance</u>	<u>Sum of Squares</u>	<u>D.F.</u>	<u>Mean Square</u>	<u>F Value</u>
Total	1315.04	89		
Regression	209.26	88	2.38	
Error	1105.78	1	1105.78	464.61 ¹

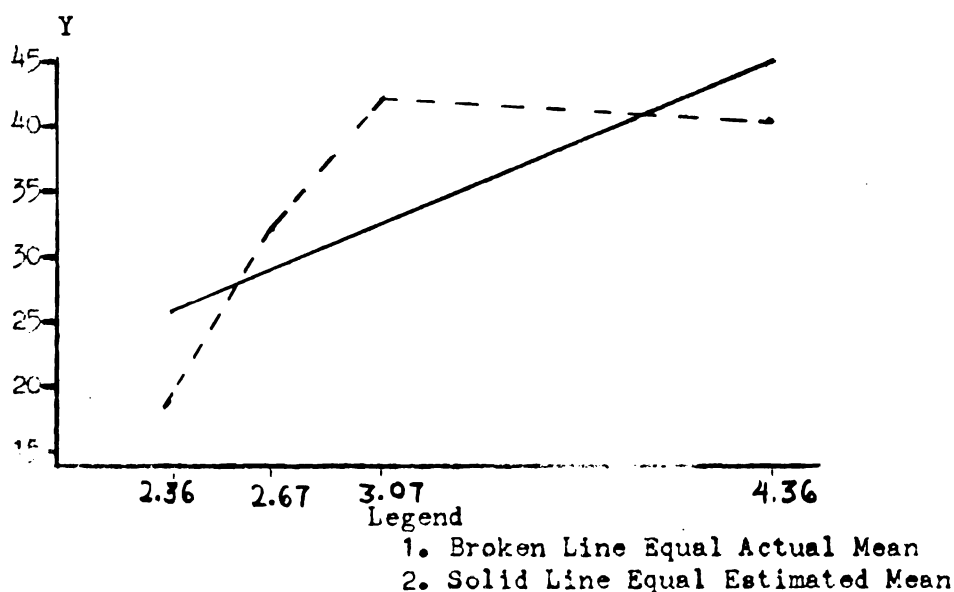
¹Significant at $P < 0.01$

eggs per hen and between floor space and fertile eggs produced per hen. Further, the largest estimate for "a" was an additional 4.98 eggs set per hen and 9.52 fertile eggs produced per hen for an increase of one square foot of floor space per hen for a 112 day experimental period.

Table 19

Statistical analysis of the fertile eggs
produced per hen for Beltsville
Small White Turkey Breeder Hens
(Linear Regression)

- A. The estimates, $a = 9.52$ and $b = 3.28$, were obtained for the equation, $y = aZ + b$ where y equal number of fertile eggs produced per hen and Z equal the amount of floor space per bird. The following graph shows the estimated mean of fertile eggs produced per hen and the actual number obtained in the experiment.



- E. The F-test for $a = 0$ is:

<u>Source of Variance</u>	<u>Sum of Squares</u>	<u>D.F.</u>	<u>Mean Square</u>	<u>F Value</u>
Total	7745.70	89		
Regression	3824.58	88	43.36	
Error	3921.12	1	3921.12	90.22 ¹

¹ Significant at $P < 0.01$

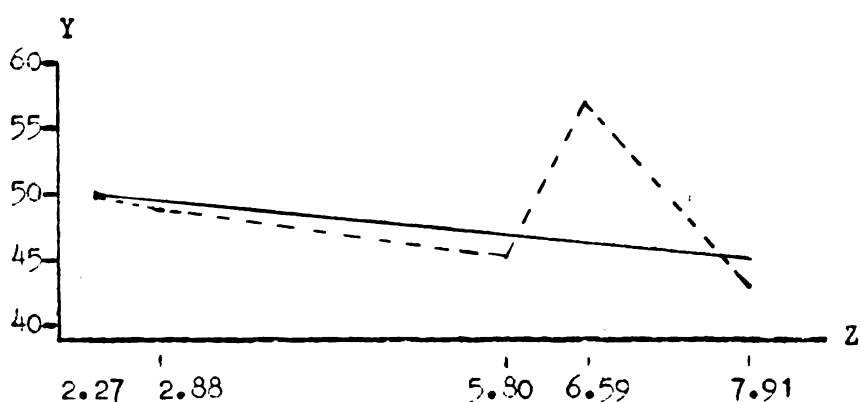
An analysis (Tables 20 and 21) of the number of eggs set per hen from the Broad Breasted Bronze turkeys also indicates that "a" influence of floor space was not equal to zero. The estimates for "a" was an additional 0.97 fertile eggs produced per hen and a negative 1.03 eggs set per hen for an increase of one square foot of floor space per hen for a 112 day experimental period.

In the preceding analysis, the total number of eggs laid and set for each bird was not available because of the large number of floor eggs. An estimate of the variability between hens was made of the number of eggs set per hen and fertile eggs produced per hen by the Beltsville Small White turkeys without assuming linearity. This analysis was made disregarding the number of floor eggs laid in each pen; therefore, a measure of variability between hens was possible although in a limited way. Since the number of eggs set per hen varied from zero to 83 for the 112 day experimental period, the value of 4.98 eggs increase per unit of floor space is small by comparison. This indicates that individual hens and possibly other management practices determine production per bird much more than does floor space. However, this type of analysis confirmed the results obtained in the preceding analysis of fertile eggs produced per hen and maybe indicates the need for fewer hens per male. The analysis in Table 22 shows the test of variability between hens in pens and bears out the statements made about the number of eggs set per hen and fertile eggs produced per hen in the Beltsville Small White turkey pens.

Table 20

Statistical analysis of the number of eggs set per
hen for Broad Breasted Bronze Turkey Breeder
Hens (Linear Regression)

- A. The estimates, $a = -1.03$ and $b = 52.65$, were obtained for the equation, $y = aZ + b$ where y equal number of eggs set per hen and Z equal the amount of floor space per bird. The following graph shows the estimated mean of eggs set per hen and the actual number obtained in the experiment.



Legend

1. Broken Line Equal Actual Mean
2. Solid Line Equal Estimated Mean

- B. The F-test for $a = 0$ is:

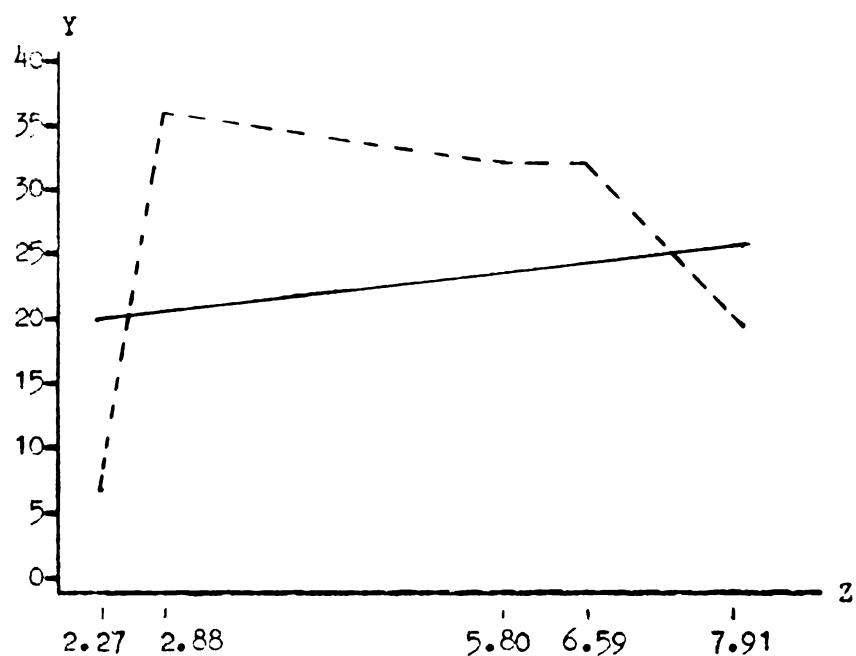
<u>Source of Variance</u>	<u>Sum of Squares</u>	<u>D.F.</u>	<u>Mean Square</u>	<u>F Value</u>
Total	1716.5	79		
Regression	1118.48	78	14.33	
Error	597.67	1	597.67	41.71 ¹

¹Significant at $P < 0.01$

Table 21

Statistical analysis of the fertile eggs
produced per hen for Broad Breasted
Bronze Turkey Breeder Hens
(Linear Regression)

- A. The estimates, $a = 0.97$ and $b = 17.60$, were obtained for the equation, $y = aZ + b$ where y equal number of fertile eggs produced per hen and Z equal the amount of floor space per bird. The following graph shows the estimated mean of fertile eggs produced per hen and the actual number obtained in the experiment.



Legend

1. Broken Line Equal Actual Mean
2. Solid Line Equal Estimated Mean

- B. The F-test for $a = 0$ is:

<u>Source of Variance</u>	<u>Sum of Square</u>	<u>D.F.</u>	<u>Mean Square</u>	<u>F Value</u>
Total	9524.07	79		
Regression	9084.67	78	116.47	
Error	439.40	1	439.40	3.77 ¹

¹Not significant at $P < 0.05$

Table 22

Statistical analysis of the total eggs set per hen and fertile eggs produced per hen by the Analysis of Variance method (Beltsville Small White Turkeys)

A. Total eggs set per hen

<u>Source of Variance</u>	<u>Sum of Squares</u>	<u>D.F.</u>	<u>Mean Square</u>	<u>F Value</u>
Total	57,310.0	89		
Between	1,300.9	3	433.63	.667 ¹
Error	55,909.1	86	650.10	

B. Fertile eggs produced per hen

<u>Source of Variance</u>	<u>Sum of Squares</u>	<u>D.F.</u>	<u>Mean Square</u>	<u>F Value</u>
Total	37,422.82	89		
Between	6,338.52	3	2112.84	5.845 ²
Error	31,084.30	86	361.44	

¹Not significant at $P < 0.05$

²Significant at $P < 0.01$

In summary, if the number of eggs set per hen does depend on the amount of floor space per bird, linearly, the dependence is only slight as indicated by the estimates; and as shown, where a per bird measurement could be made, there was no indication that the number of eggs set per hen did depend on the amount of floor space given each bird. At any rate, the differences due to floor space, even if real, are much smaller than the differences due to hens.

E. General Discussion

In this study, the amount of floor space allowed per bird was probably not the only factor effecting egg production and fertility. Some other possible explanations of the adverse results obtained are the amount of feeding and watering space allowed, amount of feed consumed, weather conditions during the study, virility of males, interference by other males and females during mating, number of females per male and the genetic background of the hens involved.

Litter condition also proved to be another limitation in decreasing floor space per bird because the problem of damp litter was prevalent in some pens even during good drying weather. Clean, dry litter had to be added more often to pens where less floor space was allowed per bird; therefore resulting in increased litter and labor costs.

Amount of water space per bird may be a possible explanation of the lowered egg production per hen as the amount of floor space per bird was decreased because the amount of water space per pen was held constant (23 inches per pen) regardless of the number of birds in each pen. Although each pen had watering space equal to or greater than the 0.7 inches per hen recommended by Schaible (1957), the watering space per bird in several of the pens was somewhat less than the 1.2 inches per hen recommended by Heuser, Hall and Bruchner (1952). At any rate, the amount of water space per bird would reach a critical stage more quickly in pens where birds were allowed less floor space. This was especially true during extremely cold weather because the water partially froze even though small electric water heaters were used in the water pans. Freezing becomes even more important when watering space is already

possibly at a minimum in pens where less floor space per bird was allowed. Egg production in pen 20 may have been affected more by freezing water than in the other pens because the water in this pen froze solid several nights during the experiment, and, as a result, the birds in this pen did not have any water from the time the water froze until the caretaker arrived. The affect of water space per bird on egg production becomes even more important when one considers that a turkey egg weighs approximately 60 to 85 grams depending on variety and that approximately 70 per cent of each egg is water; therefore, ample water space per bird becomes a necessity if maximum egg production is to be obtained.

Virility of males, number of females per male, and interference by other males and females during mating in the pens where birds were allowed less floor space, may partially explain the lowered fertility in pens with less floor space per bird and the variation in percent fertility between pens. Decreasing the number of females per male and/or increasing the total area of the pen, but not the number of square feet per bird, might have resulted in increased fertility because of the possibility of less interference from other birds. The poor fertility in pen 20 may possibly be explained by the fact that the males used in this pen were those left after the best males were selected by external features for the other pens; and there is also a possibility that there was more competition between males in this pen since it had the lowest ratio of females to males of any pen in the experiment. The use of artificial insemination could possibly have offset the problem of lower fertility which occurred in pens where birds were allowed only

a small amount of floor space per bird, since McCartney (1951) reported that fertility was improved by artificial insemination either alone or in combination with natural mating and Stotts and Darrow (1955) reported that under commercial conditions artificial insemination, when used as a supplement to natural mating, improved fertility in healthy flocks having a natural fertility of 85 per cent or less.

Feeding space may have affected egg production in this study, because, regardless of the amount of floor space allowed per bird, feeding space per pen was held constant (48 inches per pen). Five of the 9 pens were far below the recommended level of 2.88 to 3.6 inches (Schaible, 1957) of feeder space per bird while 2 other pens were very close to the minimum amount with 2.8 inches of feeder space per bird. Therefore, egg production may have suffered as feeding space per bird decreased because the hens might not have gotten enough feed for maximum egg production. This may also be a partial explanation of the low egg production from the hens in pen 20. Although this pen had the greatest amount of floor space per bird of any of the Broad Breasted Bronze pens in this experiment, it also contained the greatest number of birds, hence resulting in the least amount of feeding space per bird. The fact that feed consumed per bird generally decreased as feeder space per bird decreased tends to support the statement that the hens could not get enough feed for maximum egg production. However, since more total heat was produced in the pens where birds were allowed less floor space, the temperature would be higher; therefore, feed consumption per bird may have been less because less feed would be required to maintain body temperature. Thus, the feed consumption per bird in

pens where less floor space was allowed may have been less because the temperature in these pens did not get as low as the temperature in pens where birds were allowed more floor space.

Summary

In this study, the number of eggs produced per hen tended to decrease in both the Beltsville Small White and Broad Breasted Bronze turkey breeder hens as the amount of floor space allowed per bird decreased; however, a comparison of average egg production figures will show that this effect was only slight. Other factors, such as, available feeding and watering space may have been partially responsible for the lower egg production experienced as floor space per bird decreased.

Fertility, under the conditions of this study, tended to decrease as the amount of floor space allowed per bird decreased in both varieties of turkey breeder hens. However, the number of females per male, virility of the males and interference during mating of other birds in the pen may also have lowered fertility.

Conclusions

Where turkey breeder hens are kept under environmental conditions similar to the conditions of the study, decreasing the amount of floor space below that usually recommended would be impractical. However, if several of these conditions were changed, decreasing floor space per bird may become practical. The changes which may possibly increase fertility and production of turkey breeder hens are as follows:

1. The lower fertility encountered in this study would probably be offset by rotating males from pen to pen, decreasing the number of females per male and/or using artificial insemination.
2. Increasing pen size but not the number of square feet of floor space per bird may also result in higher fertility by allowing more breeding room without interference of equipment and allowing each bird more freedom to move, therefore possibly lessening interference during mating of other birds in the pen.
3. Floor eggs may possibly be decreased by placing nests in the pens with the hens several days before the first egg is laid, decreasing the number of hens per nest and placing hens which are about to lay on the floor in nests to break this habit.
4. Holding feed and water space constant per bird rather than per pen may possibly elevate the lowered egg production experienced in the pens where less floor space was allowed per bird.

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