COMPARISONS BETWEEN CONFINEMENT AND RANGE REARING OF PULLETS

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COMPARISONS BETWEEN CONFINEMENT AND RANGE REARING OF PULLETS

By

Hugh Swaney Johnson

AN ABSTRACT

Submitted to the College of Agriculture
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There are many poultrymen who believe they can reduce their feed costs, lessen the mortality in the laying house and increase egg production by rearing their pullets on range instead of in confinement. Many commercial poultrymen, however, are changing to confinement rearing as they are brooding out of season, using their land for purposes other than grazing, and reducing their labor requirements by mechanization. Therefore, to help producers further evaluate their situation, it seemed advisable to undertake a study of this nature.

At eight weeks of age 756 White Leghorn pullets were divided into two groups. One group, containing 374 birds, was moved to range and the other group of 382 remained in confinement. Both lots were fed an unrestricted all mash ration. Growing mash was fed from eight to sixteen weeks and after that laying mash was fed.

When the pullets were 20 weeks old, 240 from each group were randomly selected and placed in the laying house. One hundred sixty from each group were housed in adjacent pens, and the other 80 from each group were housed in an intermingled pen. The laying house performance was recorded for 26 weeks.

The results indicated there was a highly significant difference in body weight at 20 weeks of age. This difference favored the confinement reared pullets. Mash

consumption was also less per bird for the confinement reared pullets. On a hen day basis, from eight to twenty weeks, the range reared pullets consumed 14.82 pounds as compared with 13.98 pounds for the confined group. Mortality during the growth period was practically the same for both groups.

The date of sexual maturity was five days earlier for the range reared group. They matured in 172.1 days as compared to 177.4 days for the confined pullets. During the laying period, on a hen day basis, the rate of lay was 50.2 percent for the range reared birds and 44.6 percent for the confinement reared birds. This difference was not statistically significant. The average egg size was 51.99 and 51.92 grams, respectively, for range and confinement reared pullets. Laying house mortality varied from 14.38 percent in the range group to 16.88 percent in the confined group. Although there was a significant difference in body weight at 20 weeks, this difference was not found at 46 weeks.

It would appear from this study that no feed savings is realized by range reared pullets when they are on an unrestricted ration. Even though egg production is slightly higher for range reared pullets, the difference is not enough to be statistically significant. The laying house mortality of confinement reared pullets was somewhat higher than range reared birds, but again, the difference was not significant.

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INTRODUCTION

Many practical poultrymen still prefer to grow pullets on range. They believe that laying house mortality will be less and a better developed pullet will result when the birds have been provided with range.

There are many poultrymen, however, who are changing to confinement rearing. This is especially true when two or more broods are started each year with at least one coming during the fall or early winter months. The reasons for this change even in summer brooded chicks are primarily labor requirements, use of land for other purposes, and more complete knowledge about nutrition.

Labor utilization is as important in poultry production as it is in other industries. The average farm wage rates in Michigan, per day without board or room, increased from $5.30 in 1945 to $8.00 in 1955 (Borum 1950, 1956). Therefore, any advantages which can be taken of mechanized equipment will be helpful in reducing labor expense. Most poultrymen have found that more labor is required for range rearing than for confinement rearing. This is partially due to more effective use of mechanical equipment in confinement. But of more importance is the range which is used as part of the crop rotation program. This type arrangement necessitates moving the equipment and fencing yearly.

In 1956 the Michigan farmer found his land worth more than it ever was before. Since 1945 farm land values have almost doubled (Borum 1956). Thus, the problem of most effective land use is a paramount one.

Much progress has been made in poultry nutrition in recent years. A few years ago poultry feeds consisted mainly of home grown grains plus the by-products from the farm and industry. The method of feeding was almost entirely by rule rather than scientific knowledge.

The present day feeding program is based largely on scientific knowledge of feeding. The practical nutrient requirements are largely known. Instead of wanting to know only the protein, mineral, and vitamin values of the feed, the nutritionist of today is interested in nearly fifty of the components of these general groups.

Other problems and costs involved in range rearing include the cost of fencing and maintaining range shelters, losses from predators, and loss of hay and pasture. Usually during the spring and early summer months the range must be clipped in order to keep it in usable condition. Then, in the hot summer months the lack of rain and dormant condition of some grasses results in little or no herbage.

All the disadvantages and problems are not limited to range rearing. The primary problem encountered in confinement rearing is one of space requirements. Additional space will be required if pullets are raised indoors. Also, such

management problems as cannibalism and feather picking become more prevalent. Closer attention must be given to the feeding system, ventilation and space requirements.

There are many problems involved in both methods of rearing. However, the objective of this investigation was not to try and solve these problems, but rather to secure additional information about these two methods of rearing. Particular emphasis was placed on labor requirements, growth, feed consumption, egg production, egg size, and livability.

REVIEW OF LITERATURE

The cost of raising a pullet to laying age is a substantial one. In New York the net cost of rearing a pullet to maturity[1] varied from $1.64 to $2.10 (Lee 1956). This variation was not only due to the season of the year in which the chicks were started, but also to feed costs, labor requirements, and mortality.

If a lower rearing cost could be realized without a sacrifice being made in the laying house performance, it would be worthy of consideration. Therefore, the following comparisons were made between confinement and range rearing: (1) the value of green feed, (2) feed consumption during the growing period, (3) body weight at the end of the growing period, (4) mortality during the growing period, (5) length of time required to reach sexual maturity, and (6) laying house performance.

The Value of Green Feed

Chickens have utilized pasturage in one form or another ever since their origin. Mussehl *et al.* (1921) suggested that the addition of green feed to the ration improved its physical condition and increased feed consumption. Payne

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[1] Maturity considered as 150 days.

(1937) emphasized the indispensability of grass for the health and growth of poultry.

From the standpoint of utilization, the pasture should contain palatable, tender shoots. During the spring and early summer months forages will tend to become fibrous and unpalatable. At this time they should be clipped to a height of four to six inches.

The fertility and type of soil will determine to a great degree the number of pullets which can be raised per acre. Normally the range should be located on a medium heavy loam as this allows good drainage. Heavy soils tend to restrict drainage and, if combined with low, flat land, natural drainage becomes difficult. On an average loam soil up to 500 pullets can be ranged per acre.

Little work has been done on the palatability of various pasture crops. However, Wood (1956) did make an extensive study of chickens' preferences for various forages. He found among the individual forages that bromegrass and ryegrass were preferred to the others, and birdsfoot trefoil was the least palatable. The combinations of Ladino-bromegrass and Ladino-orchardgrass were found more palatable than any of the individual forages alone. There were five species which were eaten in significantly greater quantities than Kentucky bluegrass which is generally used for the standard poultry pasture. This is not in agreement with Jull and Rice (1942) who reported from Maryland that Kentucky bluegrass was the best grazing

grass of all. They reported that, except in midsummer, bluegrass recovers quickly when grazed, is highly nutritious, and keeps in a green condition throughout the season.

From the work done on forage preference it would seem that palatability of plant species should be considered before establishing a pasture.

Feed Consumption During the Growing Period

There are many varied reports concerning the amount of feed consumed during the growing period by range and confined pullets. This seems to be due primarily to the degree of feed restriction on range.

Under a restricted feeding program Heuser, Norris and Bruckner (1945) reported in one trial a savings of 23 percent in feed by ranging the pullets. In this case, however, the development of the birds was also delayed. They concluded from this study that feed restriction on pasture, but not to the extent of affecting growth or other development factors, saved from three to eight percent on feed. Also following a restricted feeding program on range, Henderson, Whelden and Wood (1953) obtained a savings of 14.3 percent in purchased feed. These results were realized in a range and confinement study made with White Plymouth Rock pullets between 16 and 24 weeks of age.

Both of these studies were carried out under a restricted feeding program on range. Therefore, feeding programs which

do not restrict feed on range should also be considered.

Hoffmann(1945) concluded from his work that when pullets were on an unrestricted, balanced diet they did not consume enough herbage to make an appreciable savings in the mixed feed consumed. In this study a comparison was made between one group of pullets in confinement, one on bare ground and four on range with different types and mixtures of forages. In Missouri Kinder, Yoes and Stephenson (1956) found no difference in feed requirements for confined and range reared pullets between eight and twenty-four weeks. A free choice system of feeding was followed which consisted of a 20 percent protein growing mash, with corn and oats. It was found, however, that the birds in confinement ate 59 percent mash while those on range ate 51 percent.

These studies indicate that in order to reduce the amount of feed required on range some degree of feed restriction must be followed. If no attempt is made to restrict feed on range the total amount required will be similar to that required by confined birds.

Body Weight at the End of the Growing Period

The body weight at the end of the growing period is another comparison which should be considered. Body weight is important as it indicates the amount of reserve with which pullets start the laying period.

With no attempt being made to restrict feed, Tomhave

(1939), and Winter and Schlamb (1948) found no difference between the body weights of pullets raised in confinement or on range. However, under a similar feeding program Kinder, Yoes and Stephenson (1956) reported confinement reared pullets to be five percent heavier at housing time.

When restricted feeding was practiced on range Henderson, Whelden and Wood (1953) found the body weight of pullets when housed to be 5.3 pounds for those raised in confinement and 5.2 pounds for those raised on range. Hoffmann (1945) concluded that feed intake for pullets on pasture cannot be reduced to 75 percent of that fed an unrestricted group without growth being retarded. Also, Heuser, Norris and Bruckner (1945) reported pullets which had their feed greatly restricted did not gain as well as the lot that received free choice of feed.

In a comparison between three types of pasture ranges and a bare range, Parker and McSpadden (1944) found the pasture reared pullets to be consistently heavier than those reared on the bare range. This was especially evident on an alfalfa range where the pullets averaged three-tenths of a pound heavier at the end of 28 weeks.

The experimental evidence seems to point out little difference at the end of the growing period between the body weights of confinement and range reared pullets. The exception seems to be when feed is greatly restricted on range. Then the confinement reared group is heavier.

Mortality During the Growing Period

When costs are considered during the growing period, mortality may often turn up as a hidden expense. This is especially true when heavy losses occur during this period.

Heuser, Norris and Bruckner (1945), Winter and Schlamb (1948), and Kinder, Yoes and Stephenson (1956) reported no significant difference in mortality between pullets grown on range or in confinement. In analyzing the losses suffered by both methods of rearing, Kinder, Yoes, and Stephenson (1956) found a larger number of birds died from disease in confinement than on range. On the other hand, they observed a greater incidence of pickouts and missing birds on range.

When different types of ranges were compared, Kennard and Chamberlin (1934) found mortality to be considerably higher on a contaminated range than a fresh range. Parker and McSpadden (1944) found in a comparison between a bare range and three different types of pasture ranges, that the average mortality over a three year period was 9.5 percent for the pasture range and 13.0 percent for the bare range.

These results seem to indicate little difference in mortality between confinement and range rearing. However, mortality appears to be greater on bare and contaminated ranges than on fresh pasture ranges.

Length of Time Required to Reach Sexual Maturity

Sexual maturity is the time when a pullet starts to lay. From a cost standpoint this is very important to the producer as little or no income is realized until this time.

Heuser, Norris and Bruckner (1945), and Hoffmann (1945) reported no difference in the length of time required by range and confinement pullets to reach sexual maturity. These results were found when a marked feed restriction was not practiced during the growing period.

In terms of time, Kinder, Yoes and Stephenson (1956) found sexual maturity of range reared pullets to be 178.4 days and confinement reared pullets 174.8 days. This indicates that sexual maturity was four days earlier in the confined group.

The evidence obtained from these trials suggests there is little or no difference in the length of time required to reach sexual maturity. This is provided, of course, there has not been a drastic restriction of feed during the growing period.

Laying House Performance

The ultimate consideration of any egg producer is the response that is received from the pullets after they have been placed in the laying house. At this time returns are expected. This income is influenced by (1) egg production,

(2) egg size, and (3) mortality.

Winter and Schlamb (1948) found during the age period 21 to 66 weeks that the egg production of range reared pullets exceeded that of confinement reared birds. The percent production, on a hen day basis, was 41.5 percent for range and 36.6 percent for confinement. Egg production by range reared pullets was also found superior by Kinder, Yoes and Stephenson (1956) in Missouri. They reported egg production from sexual maturity to 44 weeks as 71.9 percent for range and 65.8 percent for confinement.

Egg size was studied very extensively by Bletner and Cunningham (1953). In all, 27 different groups of confinement and range reared pullets were observed over a six year period. They found egg size varied with the length of time required for the groups to start laying. The earlier maturing lots usually laid smaller eggs, although the late maturing lots laid the largest eggs. Restricting range grown pullets to about 76 percent of the feed consumed by full-fed range lots delayed the start of egg production. They concluded that pullets fed in this way generally laid the largest eggs. Pullets confined to a house during the growing period were the first to come into production and laid the smallest eggs. Full-fed range pullets were usually intermediate in production and egg size. Range reared pullets also laid the largest eggs in seven out of ten comparisons made by Winter and Schlamb (1948). These results were realized by taking a

random sample of each hen's eggs beginning with the ninth week in the laying house. The sample was one egg in each six laid by the hen.

In laying house mortality Kinder, Yoes and Stephenson (1956) reported greater death losses among confinement reared pullets. The viability in range reared birds was 95.1 percent as compared with 92.7 percent for those reared in confinement. Winter and Schlamb (1948) also found greater mortality among the confinement reared groups. During a 44 week laying period and on a hen day basis, the range reared group's mortality was 11.3 percent as compared with 21.5 percent for the confinement groups.

From the scant literature on laying house performance it seems as though egg production is somewhat greater for pullets raised on range. Also, the eggs from range reared birds are slightly larger. The mortality in the laying house, although varied, appears to favor range rearing.

PROCEDURE

On May third 503 sexed pullets and 278 straight run Single Comb White Leghorn day old chicks were divided into three groups and placed in the brooder house. The straight run chicks were started as a single group, but the sexed pullets were divided into two groups. These chicks were hatched in the Poultry Husbandry Department and were from college flocks.

Four days later another group of 208 day old sexed Single Comb White Leghorn pullets was purchased from a commercial hatchery. This brought the total number of chicks started to 989. A starting mash in crumbled form was fed all groups through eight weeks of age (Table I).

When the chicks were four weeks old they were weighed as a group and wing banded. All of those in each group were banded consecutively, before moving to the next pen. Also, 98 males were removed from the pen containing the straight run chicks. This was not all of the males, but it was all of those which could be identified by comb size at this age. The others were removed at eight weeks.

Feather picking and cannibalism occurred in several of the groups during the fifth week. In order to alleviate crowded conditions, which seemed to be the problem, 100 birds from each group were moved to a larger pen.

At eight weeks of age all the pullets were weighed individually and divided into two groups. The birds with even wing band numbers were continued in confinement and those with odd numbers were moved to a grass range. Those remaining in confinement were divided and placed in two adjacent pens. In all, 374 pullets were moved to the range and 382 remained in confinement. The feeding program was changed for both groups from a starting mash to an all mash growing mash (Table II).

At 12 weeks all the pullets were vaccinated with a killed virus for Newcastle disease and those in confinement were also vaccinated against fowl pox. The pullets on range had been vaccinated for pox when moved outside at eight weeks.

During the last two weeks in August, a time study was conducted. The following range functions were timed: (1) feeding, (2) cleaning waterers, (3) locking and unlocking shelters, and (4) moving shelters. In confinement rearing the time was measured for: (1) feeding, (2) cleaning waterers, and (3) stirring the litter. It was not possible to utilize the same person for all the jobs. However, as much as possible, one person performed all the range tasks and another all the work in confinement.

All the pullets were individually weighed at 16 weeks of age. At this time the feed was changed for both groups from the all mash grower to an all mash laying mash (Table III).

The growth part of the experiment was terminated at 20 weeks when all the pullets were individually weighed and the range reared birds were housed. The available laying quarters were not sufficient to handle all of the pullets reared so some had to be discarded. This was accomplished by using a random sample table for selection, and did not involve the usual method of culling. One hundred sixty range reared pullets were moved into one pen and 160 confinement reared birds were placed in another. A third or intermingled pen consisted of 80 pullets reared in confinement and 80 reared on range.

The laying house performance was measured for 26 weeks and records were kept for egg production, egg size, mortality, and feed consumption. The pullets in all three pens were trap nested seven days a week during the entire laying period. Also, beginning with the third week in the laying house, egg size was measured in the two pens containing all confinement and range reared pullets. The eggs laid by these two groups on Thursday were weighed on Friday.

Records of feed consumption and mortality were kept during the entire experiment. At the end of the study, 46 weeks of age, all the pullets were again individually weighed.

TABLE I

CHICK STARTING MASH

Ingredients	Pounds
Ground yellow corn	900
Ground heavy oats	100
Wheat bran	100
Wheat standard middlings	100
Alfalfa meal, dehydrated, 17 percent protein	100
Meat and bone scraps, 50 percent protein	100
Soybean oil meal	400
Fish meal	50
Dried whey	50
Dried yeast	50
Ground limestone	30
Steamed bone meal	20
Salt (iodized)	6
Vitamin A and D feeding oil, 2250-A, 300-D	5
Manganese sulfate, feeding grade	0.4
Choline chloride, 25 percent dry mixture	3
Antibiotic, B_{12} supplement[1]	1
Coccidiostat[2]	1
	2016.4

Actual Composition: (July 11, 1956)

Protein	- 21.56 percent	Calcium	- 1.73 percent
Fat	- 3.45 percent	Phosphorus	- 0.96 percent
Fiber	- 4.26 percent		

Calculated Composition:

Protein	- 20.9 percent	Riboflavin	- 1.8 mg./lb.
Fat	- 3.3 percent	Niacin	- 19 mg./lb.
Fiber	- 5.4 percent	Pantothenic acid	- 5.9 mg./lb.
Calcium	- 1.6 percent	Choline	- 730 mg./lb.
Phosphorus	- 0.9 percent	Vitamin A	- 6000 U.S.P. units/lb.
Calories per pound	- 780	Vitamin D	- 340 I.C.U./lb.
		Vitamin B_{12}	- 4.7 micrograms/lb.

[1] Merck Pro Pen "2:3"

[2] Dr. Hess and Clark - Nitrofurazone

TABLE II

GROWING ALL MASH

Ingredients	Pounds
Coarsely ground wheat	200
Ground yellow corn	900
Ground heavy oats	300
Wheat bran	100
Alfalfa meal, dehydrated, 17 percent protein	100
Soybean oil meal	300
Meat and bone scraps, 50 percent protein	50
Fish meal	25
Dried whey	25
Limestone, ground	25
Steamed bone meal	15
Salt, iodized	2.5
Manganese sulfate, feeding grade	0.13
Vitamin A and D feeding oil, 2250-A, 300-D	3
Antibiotic, B_{12} supplement[1]	2
Calcium pantothenate	4 gm.
Coccidiostat[2]	1
	2048.63

Actual Composition: (August 24, 1956)

Protein	- 16.0 percent	Calcium	- 1.27 percent
Fat	- 3.78 percent	Phosphorus	- 0.78 percent
Fiber	- 5.14 percent		

Calculated Composition:

Protein	- 17.0 percent	Pantothenic acid	- 5 mg./lb.
Fat	- 3.2 percent	Choline	- 450 mg./lb.
Fiber	- 6.0 percent	Vitamin A	- 4470 U.S.P. units/lb.
Calcium	- 1.3 percent		
Phosphorus	- 0.7 percent	Vitamin D	- 136 I.C.U./lb.
Energy	- 850 cal./lb.	Vitamin B_{12}	- 2 micrograms/lb.
Riboflavin	- 1.1 mg./lb.		
Niacin	- 13 mg./lb.	Salt	- 0.25 percent

[1] Merck Pro Pen W/B12 "2:3"

[2] Dr. Hess and Clark - Nitrofurazone

TABLE III

ALL MASH LAYING MASH

Ingredients	Pounds
Coarsely ground wheat	200
Ground yellow corn	924
Ground heavy oats	300
Wheat standard middlings	100
Alfalfa meal, dehydrated, 17 percent protein	80
Meat and bone scraps, 50 percent protein	50
Dried whey	50
Soybean oil meal	200
Fish meal	25
Ground limestone	25
Steamed bone meal	50
Salt	7
Vitamin A and D feeding oil, 2250-A, 300-D	7
Manganese sulfate, feeding grade	.5
Choline chloride, 25 percent dry mixture	3
Calcium pantothenate	3 gm.
Riboflavin	1.5 gm.
Vitamin B_{12}	3 mg.
	2051.5

Actual Composition: (August 24, 1956)

Protein	- 15.94 percent	Calcium	- 1.53 percent
Fat	- 3.22 percent	Phosphorus	- 0.912 percent
Fiber	- 4.27 percent		

Calculated Composition:

Protein	- 15.4 percent	Pantothenic acid	- 5.5 mg./lb.
Fat	- 3.4 percent	Choline	- 570 mg./lb.
Fiber	- 5.3 percent	Vitamin A	- 6200 U.S.P. units/lb.
Calcium	- 1.6 percent		
Phosphorus	- 0.8 percent	Vitamin D	- 470 I.C.U./lb.
Energy	- 850 cal. per lb.	Vitamin B_{12}	- 2.3 micrograms/lb.
Riboflavin	- 1.8 mg. per lb.		
Niacin	- 11.9 mg. per lb.	Salt	- 0.35 percent

RESULTS

Growth Period:

The weight gains for both groups of pullets were approximately the same between eight and sixteen weeks. Those on range gained 1.44 pounds and those in confinement 1.41 pounds. This general trend, however, did not continue for the next four week period. Between sixteen and twenty weeks, the range group gained an average of 0.57 pound and the confined group increased their average weight by 0.69 pound. The difference during this last period seems to have resulted from a greater consumption of forage and a reduction in mash consumed by the range reared pullets. Over the entire sixteen week period, the range reared group gained 244 percent of their original weight at eight weeks while the pullets in confinement gained 249 percent.

Growing and laying mash were fed during the growth period. The growing mash was fed from eight to sixteen weeks, and the laying mash was fed after the sixteenth week (Tables II and III). Both groups were fed an all mash ration throughout the experiment, with no attempt being made to restrict feed for either group.

TABLE IV

WEIGHTS, FEED CONSUMPTION, AND MORTALITY

DURING THE GROWTH PERIOD

Observation	Range Reared	Confinement Reared
Average weight of pullets	Pounds	Pounds
At 8 weeks	1.40	1.41
16 weeks	2.84	2.82
20 weeks	3.41	3.51
Average feed consumption per pullet	Pounds	Pounds
From 8 to 16 weeks	9.85	8.65
16 to 20 weeks	4.97	5.36
8 to 20 weeks	14.82	13.98
Mortality	Percent	Percent
From 8 to 16 weeks	5.88	5.50
16 to 20 weeks	2.84	3.88
8 to 20 weeks	8.56	9.16

Feed consumption was figured on a hen day basis. From eight to sixteen weeks the range and confined pullets consumed 9.85 and 8.65 pounds of mash, respectively (Table IV). The additional feed required by the range group may have resulted from more exercise on range. At any rate, the forage utilization appeared to be very low during this period. In the succeeding period - sixteen to twenty weeks - the birds on range each consumed 4.97 pounds of feed and those in confinement 5.36 pounds (Table IV). This suggests that more forage was consumed between sixteen and twenty weeks than had been previously. During the entire period of eight to twenty weeks, the pullets on range each consumed 14.82

pounds of mash and the pullets in confinement 13.98 pounds (Table IV).

The mortality was higher in the confined pullets than among those on range. Thirty-two of 374, or 8.56 percent, on range died during the growth period. In confinement 35 of 382, or 9.16 percent, died. In both cases, the greatest amount of mortality resulted from cannibalism.

The labor required to perform the functions on range and in confinement was measured over two 5 day periods between August 20 and 31. The daily requirements varied greatly. The time to care for 353 pullets on range fluctuated from seventeen to fifty-seven minutes per day, with a mean of twenty-eight minutes. This wide variation resulted mainly from moving the range shelters which required forty minutes one day. The labor required for 361 pullets in confinement varied from twelve to twenty-two minutes, with a mean of twenty minutes per day.

Laying House Performance:

The laying house performance is considered as the period of time after the pullets were housed at twenty weeks. It includes their performance through forty-six weeks of age.

Sexual maturity was measured by the date of the first egg. For the range group, the average was 172.1 days and for the confined group 177.4 days (Table V). Maturity varied for 113 pullets raised on range from 142 days to 225

days. One hundred fourteen confined pullets varied from 145 to 240 days. Not all the pullets were considered when maturity was computed, as sone never laid, and others laid in an irregular pattern, which indicated they were laying a large number of floor eggs. Those pullets purchased from a commercial hatchery were also excluded.

TABLE V

LAYING HOUSE PERFORMANCE

Observations	Range Reared	Confinement Reared	Intermingled (Confinement and Range)
Average number of days to reach sexual maturity	172.1	177.4	
Total egg production (percent)	50.17	44.61	43.47
Average egg size (grams)	51.99	51.92	
Mortality (percent)	14.38	16.88	18.13
Feed consumption per pullet for 26 weeks (pounds)	49.25	47.50	46.62
Average body weight (pounds) At 20 weeks	3.44	3.58	3.51
46 weeks	4.40	4.35	4.46

Egg production as shown in Table V and Figure 1 is based on a hen day basis. The range birds laid a total of 13,716 eggs, of which 1,171 were floor eggs. The confinement group laid 12,332 eggs and 1,346 of these were floor eggs.

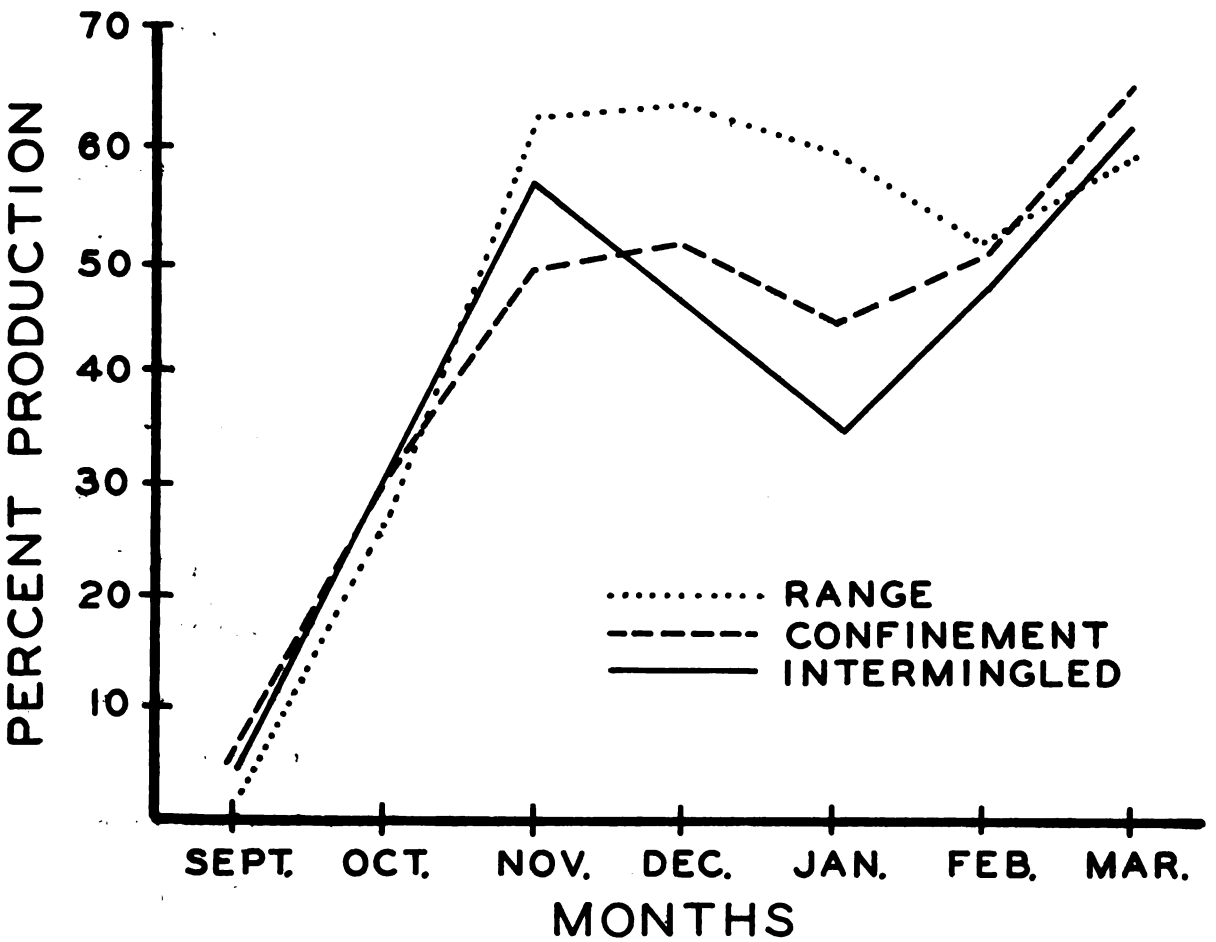


FIGURE I. PRODUCTION BY MONTHS ON HEN DAY BASIS.

FIGURE 1. PRODUCTION BY MONTHS ON TWO
DAY TRACTS.

An intermingled group, consisting of 80 range reared pullets and 80 confinement reared pullets, laid 11,902 eggs, of which 858 were laid on the floor. In this last pen the range segment of the population laid 5,838 eggs as compared with 5,206 for the confined birds. It was not possible to determine how many of the floor eggs were laid by each group in this last pen. The percent production is shown in Figure 1 by months for each of the three groups. Over the entire twenty-six week laying period, on a hen day basis, the range group laid 50.17 percent, the confined group 44.61 percent and the intermingled group 43.47 percent (Table V).

Egg size, as shown in Figure 2, did not vary much between the two groups. Throughout the twenty-six week laying period the eggs were weighed twenty-two times. In the process, 1,656 eggs were weighed from the range group and 1,446 from the confined group. The average size over this period was 51.99 grams and 51.92 grams, respectively, for range and confinement (Table V). During the last three weeks, March 1 to March 15, the distribution of egg size was computed for the two groups (Figure 3). A total of 233 eggs from the range group and 258 from the confined group were weighed.

The laying house mortality varied from 14.38 percent in the range reared pen to 18.13 percent in the intermingled pen (Table V). Of the 160 pullets in each group at the start, the death losses amounted to: 23 for range, 27 for

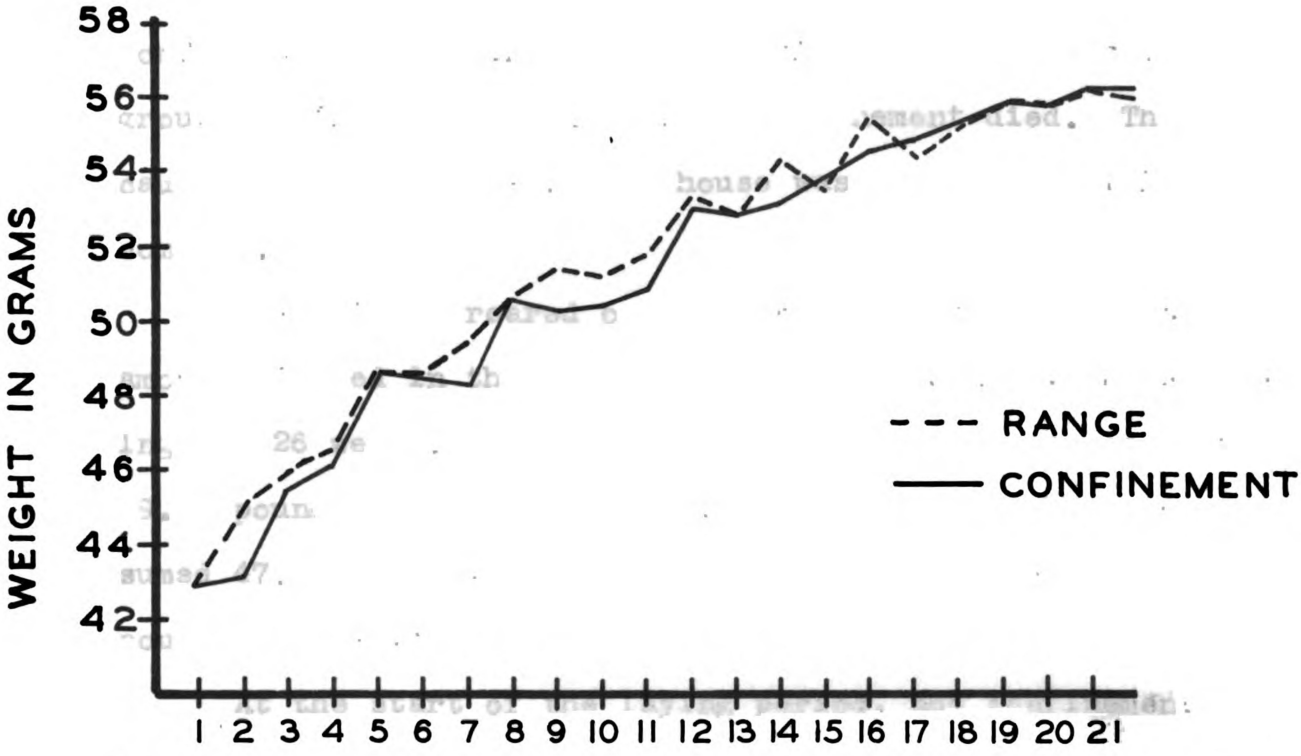


FIGURE 2. EGG SIZE MEASURED AT 7 DAY INTERVALS BETWEEN OCTOBER 12 - MARCH 15

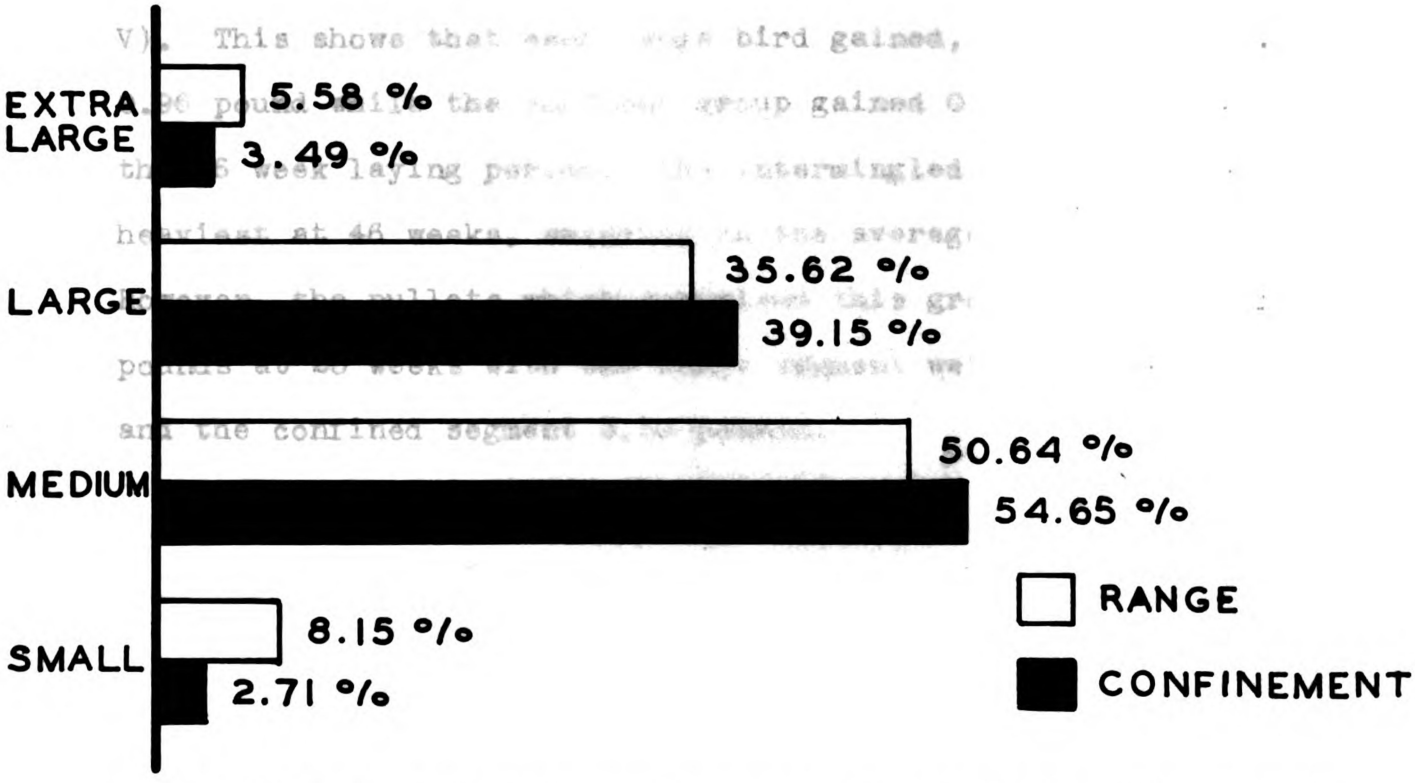
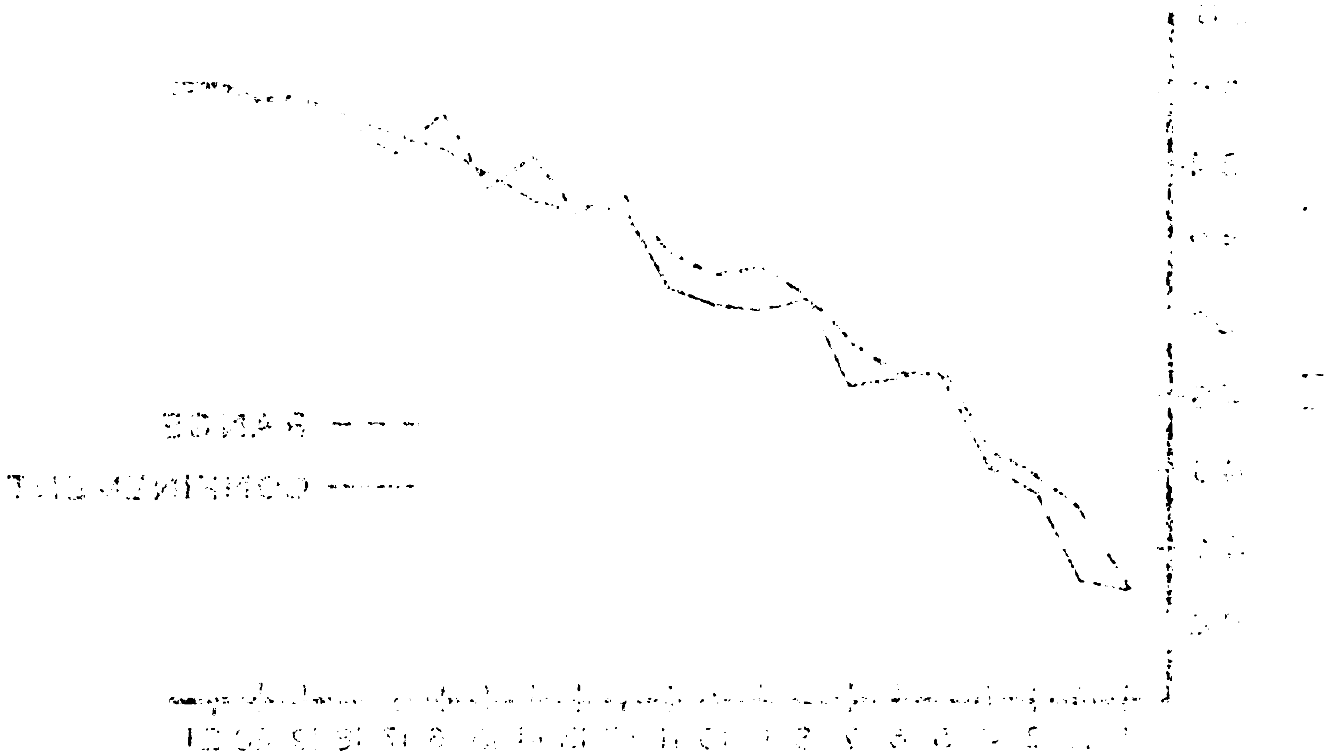
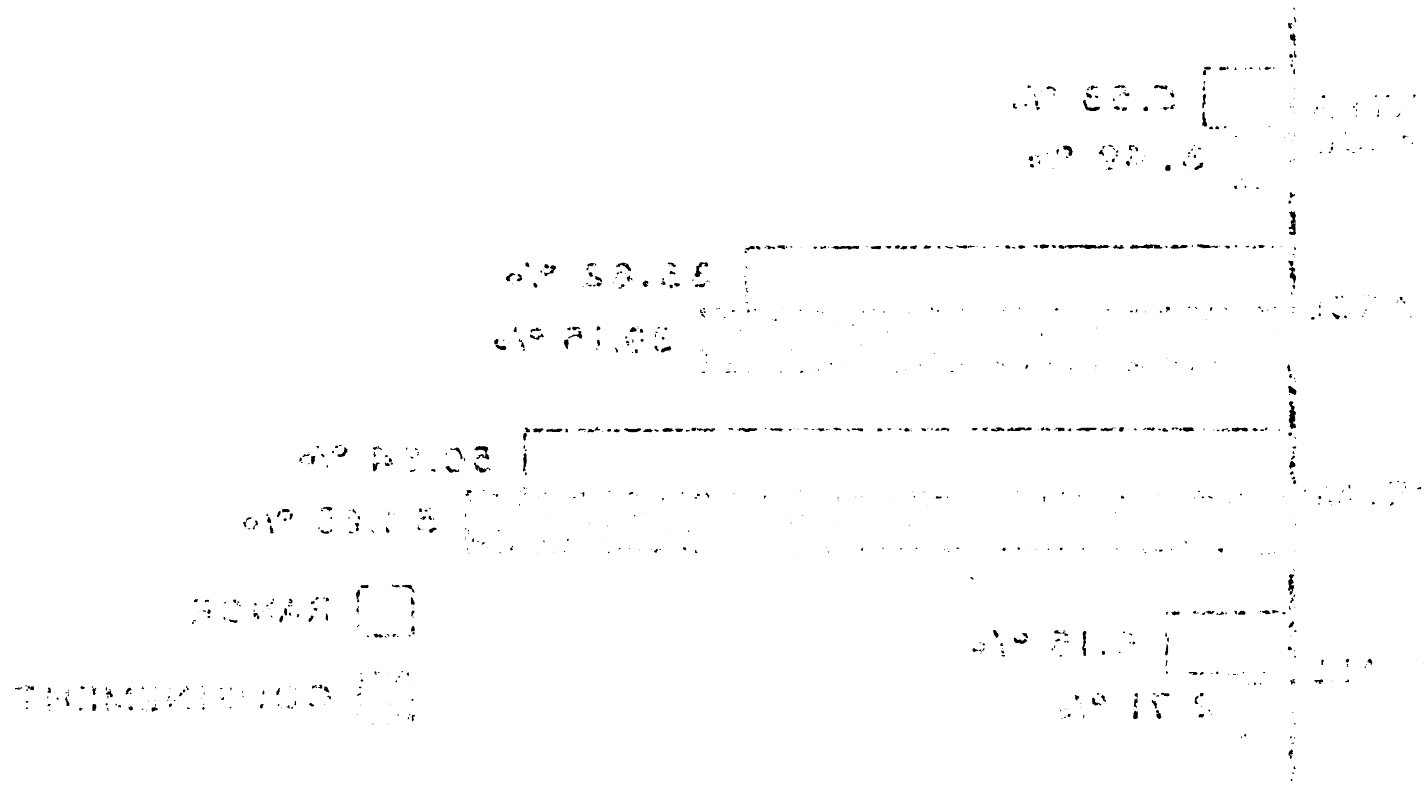


FIGURE 3. COMPOSITE DISTRIBUTION OF EGG SIZES ON MARCH 1, 8, AND 15


RANGE
CONTINENT


RANGE
CONTINENT

confinement and 29 in the intermingled pen. In this last group, 14 from range and 15 from confinement died. The main cause of death in the laying house was from the fowl leukosis complex.

The pullets reared on range consumed the greatest amount of feed in the laying house. On a hen day basis during the 26 week laying period, these pullets each consumed 49.25 pounds of mash (Table V). The confined pullets consumed 47.50 pounds, while the intermingled birds ate 46.62 pounds (Table V).

At the start of the laying period, the confinement reared pullets were the heaviest (Table V). However, at 46 weeks, the range reared pullets weighed 4.40 pounds as compared with 4.35 pounds for the confinement group (Table V). This shows that each range bird gained, on the average, 0.96 pound while the confined group gained 0.77 pound during the 26 week laying period. The intermingled group was the heaviest at 46 weeks, weighing on the average 4.46 pounds. However, the pullets which comprised this group weighed 3.51 pounds at 20 weeks with the range segment weighing 3.44 pounds and the confined segment 3.59 pounds.

DISCUSSION

Contrary to popular belief, the range reared pullets were reared no more economically than those in confinement. They were smaller at 20 weeks of age, and consumed almost one pound more mash per bird (Table IV). The weight difference between groups, although only one-tenth of a pound, was highly significant. This indicates that the pullets on range were not utilizing their feed as efficiently as those in confinement. The birds in confinement consumed only 94 percent as much mash as those on range.

The range consisted of a sod of grass and legumes, and would have been considered of average quality. The Farm Crops Department at Michigan State University made a plant estimation and found the range contained 20 percent alfalfa and Ladino clover, 75 percent bluegrass, and 5 percent weeds. The size of the range was 40,468 square feet or approximately nine-tenths of an acre.

Henderson, Whelden and Wood (1953), and Kinder, Yoes and Stephenson (1956) also found the body weight at housing to be greater for confinement reared pullets than range reared pullets. However, in neither case was a significant difference reported. Mash consumption for pullets raised in confinement or bare lots was greater than for those on range according to Parker and McSpadden (1944), Winter and Schlamb

(1948) and Kinder, Yoes and Stephenson (1956).

Mortality during the growth period was practically the same for both groups and statistically there was no difference between the two methods of rearing. This is in agreement with the findings of Heuser, Norris and Bruckner (1945), Winter and Schlamb (1948) and Kinder, Yoes and Stephenson (1956).

Sexual maturity or date of the first egg was found to be five days earlier for the range reared pullets. This difference was enough to be significant at the five percent level. Earlier maturity by the range reared birds may have resulted from a longer light day on range. Artificial lights were not used inside until after the pullets were housed at 20 weeks. This finding is not in agreement with Heuser, Norris and Bruckner (1945), and Hoffmann (1945) who reported no difference in the length of time required for confinement and range reared pullets to reach sexual maturity.

Egg production in all cases was greater for the range reared pullets. The differences, however, were not great enough to be statistically significant. Production was compared by two different methods. One method used was a comparison between pens containing all range reared stock and all confinement reared stock. That, in itself, was not a complete comparison as the environmental change was not as great for the pullets reared in confinement as it was for those reared on range. Therefore, a third pen was compared

which contained both confinement and range reared birds. By housing these pullets together, the conditions were made more comparable.

Greater egg production by range reared pullets was also found by Payne and Gish (1943), Winter and Schlamb (1948), and Kinder, Yoes and Stephenson (1956). No difference in egg production was reported by Stephenson and Bryant (1944) and Hoffmann (1945). On the other hand, Heuser, Norris and Bruckner (1945) reported greater egg production from birds which had been reared on a bare lot than from those which had been reared on range.

Egg size varied from week to week between the two groups (Figure 2). One week the eggs from the range group would be the largest and the next week the confinement reared pullets would lay the largest eggs. As can be seen in Table V, the average egg size was practically the same for both groups. There was no significant difference between the two groups over the entire laying period.

The difference in mortality in the laying house was not enough to be significant. What little difference there was favored the range reared birds. Their viability was 85.6 percent as compared with 83.1 percent for the confined group. The viability of the two groups was even closer in the intermingled pen - 82.5 percent for the range reared stock and 81.3 percent for the confinement reared birds. Stephenson and Bryant (1944) and Hoffmann (1945) also reported that

range or confinement rearing had no influence on laying house mortality.

The amount of feed consumed in the laying house was directly related to egg production. The range reared pullets consumed the most feed, but they also laid the greatest number of eggs. The confined group consumed approximately 97 percent as much as the range group and the intermingled lot consumed 94 percent as much.

Although there was a significant difference in body weight at 20 weeks, this difference did not manifest itself at 46 weeks. There was no significant difference at this time between the range and confinement reared pens or between the range and confinement reared birds in the intermingled pen.

SUMMARY

1. The average weights at 20 weeks were 3.41 pounds for the range reared pullets and 3.51 pounds for the confinement reared birds. This difference was statistically significant at the one-half percent level.
2. Feed consumption from eight to twenty weeks on a hen day basis per bird was 14.82 pounds for the range group and 13.98 pounds for the confined group.
3. Mortality during the growth period was 8.56 percent for the range reared pullets and 9.16 percent for the confinement reared birds. This difference was not statistically significant.
4. Sexual maturity was reached in 172.1 days by the range birds and 177.4 days by the confined pullets. This difference is significant at the five percent level.
5. During a 26 week laying period on a hen day basis, the range reared birds laid at a rate of 50.17 percent and the confinement reared birds 44.61 percent. The difference was not statistically significant.
6. The average egg size was 51.99 and 51.92 grams, respectively, for range and confinement reared pullets.
7. The laying house mortality varied from 14.38 percent in the range group to 16.88 percent in the confined group. The difference was not significant.

8. Mash consumption in the laying house varied according to egg production. On a hen day basis for 26 weeks the range reared pullets each consumed 49.25 pounds and the confinement reared pullets 47.50 pounds.
9. At 46 weeks the average body weights were 4.40 pounds for the range reared pullets and 4.35 pounds for the confined pullets. This difference was not statistically significant.
10. There does not seem to be one best system of rearing for all cases. The method used will depend upon the (a) time of year when brooding is done, (b) cost of labor, (c) alternative uses for land, and (d) operator's experience and skill.

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