A COMPARISON OF PROFITS FROM PULLETS AND YEARLING HENS WITH AND WITHOUT ARTIFICIAL LIGHTS

by

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TABLE OF CONTENTS

INTRODUCTION

The general practice in poultry production is to maintain a flock of one-third hens and two-thirds pullets. The pullets produce heavily during the fall season of high egg prices, while the hens normally are not productive at this season. They are kept principally to reproduce the flock during the spring. The rearing of chicks to a productive age is usually expensive and the depreciation in market value is also large the first year.

Apparently, if in some way, hens could be caused to produce profitably more fall eggs in their second and later laying years, a material saving could be made. Investigators have found that the use of artificial lighting is of some value in stimulating fall production. It has also been reported that confinement of the laying flock and the hopper feeding of scratch grain improve egg production.

An application of some of the newer methods of management was made in this experiment for comparing the net income from hens and pullets. This included the confinement of the flocks; the hopper feeding of both scratch grain and mash; and the use of artificial lights.

REVIEW OF LITERATURE

Hens Versus Pullets

According to Harris and Lewis (12) birds of high first year production may be expected to lay well the second year.

Atwood (4) found that White Leghorns decreased in production 20.1 per cent the second year, while Hall and Marble (11) reported that Leghorns declined only approximately 13 per cent annually. Brody, Henderson, and Kempster (7) reported that "the course of decline of egg production with age in the domestic fowl from time of laying begins up to and including eight years follows an exponential law, that is, each year's egg production is a constant percentage of the preceding year's production (88 per cent in the group of fowl studied)." According to Jull, (14) high first year producers will lay 35 to 41 per cent of their first two years' record the second year. He used Barred Plymouth Rocks, Rhode Island Reds, White Wyandottes, and White Leghorns.

Allen (1) found that an average of 30.8 more eggs per bird were produced by pullets than by hens on New Jersey farms during November, December, January, and February.

Range Versus Confinement

Kennard (16) pointed out that there was a trend, at that time, toward confinement chiefly because such a practice saves labor and gives the operator better control of environment of the birds. During a 10 months period, the same author (17) obtained an average production of 132 eggs from confined pullets, 122 from those on blue grass range, and 127 when they were allowed access to a screen sun parlor. However, his mortality was nearly 50 per cent in each lot.

Atwood (2) found it detrimental, both as to number of eggs laid and hatchability, to confine hens in their houses for two consecutive winters. However, Knandel, Callenbach, and Margolf (19) reported that eggs hatched very satisfactorily from fowls reared and maintained in confinement and that the chicks made uniformly good growth.

Hopper Feeding Grain and Mash

The Biennial report of the Oregon Agricultural Experiment Station for 1928-1930 (13) presents data on hopper feeding which showed a profit of 12 cents per bird for nine months in favor of litter feeding grain and hopper feeding mash as compared to hopper feeding both grain and mash.

Barred Rock pullets were used. Martin (20) also found litter feeding of scratch grain more profitable, for Barred Rocks, but his White Leghorns averaged about 10 eggs more per bird when scratch grains were hopper fed.

Charles and Stuart (8) stated that Rhode Island Reds were able to adjust their feed intake to their needs, either if the scratch grain was available in hoppers at all times, or if only for one hour before roosting time. Mash was available at all times.

Tomhave and Mumford (22) reported that birds do not have the ability or the natural instinct to select separate feeds necessary for their physiological needs. They point out that the unpalatable feeds in particular are best consumed when mixed with more palatable feeds.

Artificial Lighting

Cray (9) stated that "lights will materially increase both the winter and yearly egg production of pullets and hens." Continuing he stated that lights should not be used during the winter on hens to be used for breeding purposes.

Kable, Fox, and Lunn (15) found that all flocks which received lights in the experiment consistently maintained their production above that of unlighted flocks from October to February, but the unlighted flocks all forged ahead in

February and March. Lights increased the annual production of pullets from 0.6 to 6.6 per cent.

Kennard and Chamberlin (18) reported that all-night lights gave more winter eggs from both hens and pullets than did morning lights, but resulted in fewer spring eggs. All-night lights had no ill effect on fertility or hatchability.

Dougherty (10) stated that experiments and practical experience show that more eggs can be produced by using lights since it increases the length of the working day.

Egg Size

Atwood and Weakley (5) found that eggs and yolks from wheat fed fowls averaged somewhat heavier than those from corn fed fowls. The senior author (3) also reported that egg size depends, in part at least, upon the character of the ration fed. The feeding of whole grain alone during the winter reduced the weight of eggs about 12 per cent.

"The mean weekly egg weight when compared with the mean maximum weekly temperature showed a sharp decline when the temperature was above 85°F." was reported by Bennion and Warren (6).

Egg Quality

Atwood and Weakley (5) reported that the presence of a considerable amount of animal protein in the ration for

laying hens tends to weaken the vitelline membrane.

Taylor and Martin (21) state that lack of sufficient vitamin D causes thin or soft shelled eggs. Also, the lack of adequate calcium supply in chemical combination available to the hen, pathological condition of the oviduct, and inherited inability to produce heavy shelled eggs each may contribute to thin shelled eggs laid.

PURPOSE

The purpose of this experiment was to compare the costs and returns from yearling hens and pullets with and without artificial lights.

MATERIALS AND METHODS

The House

The house was an open front, straw-loft, uneven span roof, consisting of 4 pens, each 20 feet square. The equipment in all pens was the same in every respect except that automatic water fountains were used in lots I and II and water buckets were used in lots III and IV. Also lots III and IV had two 25-watt lights in each pen, each light being equipped with a reflector and placed 6 feet from the floor. These lights were located nearly equal distance from the end walls of the pen and from each other, in such

a way that the floor, hoppers and droppings boards were well lighted.

The Stock

Single Comb White Leghorn hens and pullets were used. At the beginning of the experiment, the hens were 18 months old. They had been used the previous year on a sorghum experiment. The pullets were reared at the farm in the regular way and were on the summer range until a few weeks before this test was started. They varied from five to six months of age.

These birds were all handled individually, banded and weighed October 1. Only healthy, vigorous pullets hatched on or after April 1 were used. The two pullet lots were as nearly identical as it was possible to select them.

One hundred pullets were placed in each of pens I and III, and 100 hens were placed in each of pens II and IV. Lot IV received morning lights from 4 o'clock until daylight from August 15, 1932 to April 1, 1933. The lights were started early on the hens to delay the fall molt. Lot III also received the morning lights beginning October 1 and continuing until April 1. An electric time clock with a dial switch was used to operate the lights.

PROCEDURE

The work was divided into eight periods of four weeks each. At the end of each period, the amount of feed consumed, the number of eggs produced, and their value were summarized. Records were also kept of the kilowatt hours of electricity used, temperature, mortality, and inventory value of the birds at the beginning and conclusion of the experiment.

In several of the tables presented, reference is made to the eight periods into which the 32 weeks of the experiment was divided. The dates for the beginning and end of each period were as follows:

Period	Date
1	Oct. 1 - Oct. 28
2	Oct.29 - Nov. 25
3	Nov.26 - Dec. 23
4	Dec.24 - Jan. 20
5	Jan.21 - Feb. 17
6	Feb.18 - Mar. 17
7	Mar.18 - Apr. 14
8	Apr.15 - May 12

FEED CONSUMPTION

The ration consisted of whole yellow corn, whole wheat, a mash mixture, oyster shell, and coarse sand as grit. Each of these were hopper fed separately ad libitum. Clean, fresh water was supplied at all times.

The mash mixture was as follows:*

Yellow corn meal	100 lbs.
Wheat, ground fine	100 lbs.
Oats, ground fine	100 lbs.
Meat and bone scraps	50 lbs.
Dried buttermilk	25 lbs.
Alfalfa leaf meal	25 lbs.
Salt	4 lbs.
Cod liver oil	4 lbs.
Total	408 lbs.

The amount and cost of total feed consumed is presented in table 1. In each lot, the combined pounds of corn, wheat, mash, oyster shell, and grit are included. Also during the fourth, fifth, sixth, and seventh periods, 56 pounds of semi-solid buttermilk were included for each lot. Semi-solid buttermilk was added to promote healthfulness and to reduce the winter pause.

At the end of each period, a local feed dealer** was called to determine the current retail prices of each ingredient in the ration. These prices are listed in the Appendix.

In calculating the pounds per bird and cost per bird in table 1, the "average number of birds" given in table 6 were used.

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*Eight pounds of tobacco dust were added to the above ration for the first 4 weeks.

**The Farmers' Union Cooperative Association, Manhattan, Kansas furnished the feed prices.

Table 1. Amount and Cost of Total Feed Consumed in Four-week Periods

Period	Lot	Pounds		Cost	
		per lot	per bird	per lot	per bird
1	I	530	5.30	$4.29	$0.0460
	II	499	4.99	3.87	.0387
	III	515	5.15	4.20	.0420
	IV	539	5.42	4.65	.0468
2	I	542	5.44	4.20	.0412
	II	511	5.18	3.39	.0385
	III	570	5.86	4.63	.0476
	IV	581	5.91	4.28	.0435
3	I	619	6.42	4.84	.0502
	II	514	5.31	3.29	.0339
	III	653	6.87	5.27	.0556
	IV	532	5.54	3.97	.0416
4	I	693	7.21	5.39	.0562
	II	578	6.09	4.25	.0448
	III	717	7.70	5.60	.0602
	IV	654	6.94	4.77	.0507
5	I	747	7.78	5.92	.0617
	II	636	7.06	4.92	.0547
	III	746	8.04	5.94	.0640
	IV	662	7.05	5.09	.0541
6	I	751	8.06	6.05	.0648
	II	685	7.74	5.44	.0615
	III	733	8.17	5.95	.0664
	IV	703	7.54	5.65	.0606
7	I	721	7.78	6.72	.0725
	II	686	7.72	6.18	.0696
	III	695	7.56	6.25	.0681
	IV	681	7.10	6.18	.0645
8	I	606	7.56	7.67	.0956
	II	526	6.52	6.70	.0831
	III	479	5.56	5.64	.0655
	IV	555	6.36	6.88	.0787

The number of pounds of the shelled corn, wheat, and mash consumed for each lot during the eight periods of the experiment are given in table 2. These results indicate the choice of feeds made by the birds in the various groups.

A comparison of the mash consumed and the eggs produced per bird is made for each lot in Figure I. The solid lines represent the mash consumption and the dotted line the number of eggs produced.

The amount of feed consumed per bird and the average egg production per bird for the entire experiment is given in Figure II for each lot. These averages include corn, wheat, and mash. The solid part represents the wheat consumption, the cross-checked portion, the mash, and the small portion which is clear, the corn consumed.

The pounds of feed consumed during the first period was approximately the same for each lot. Apparently this was due to a comparatively small difference in egg production by each lot.

During the remaining seven periods, however, a greater variation developed. Each lot increased in the amount consumed per bird rather regularly up to the seventh period with but one exception. Lot IV did not consume as much feed during the third as during the second period. This decline in consumption cannot be accounted for by the needs for egg

Table 2. Feed Consumption for 32 Weeks, October 1, 1932 to May 12, 1933

	Lots							
	I		III		II		IV	
	Pounds per lot	Pounds per bird	Pounds per lot	Pounds per bird	Pounds per lot	Pounds per bird	Pounds per lot	Pounds per bird
Shelled corn	304	3.22	284	3.04	598	6.48	544	5.73
Wheat	2629	27.89	2539	27.24	2265	24.54	2235	23.57
Mash	1646	17.47	1621	17.39	1154	12.51	1486	15.67
Total	4579	48.58	4444	47.67	4017	43.53	4265	44.97

Fig. I Pounds of Mash and Number of Eggs Produced per Bird

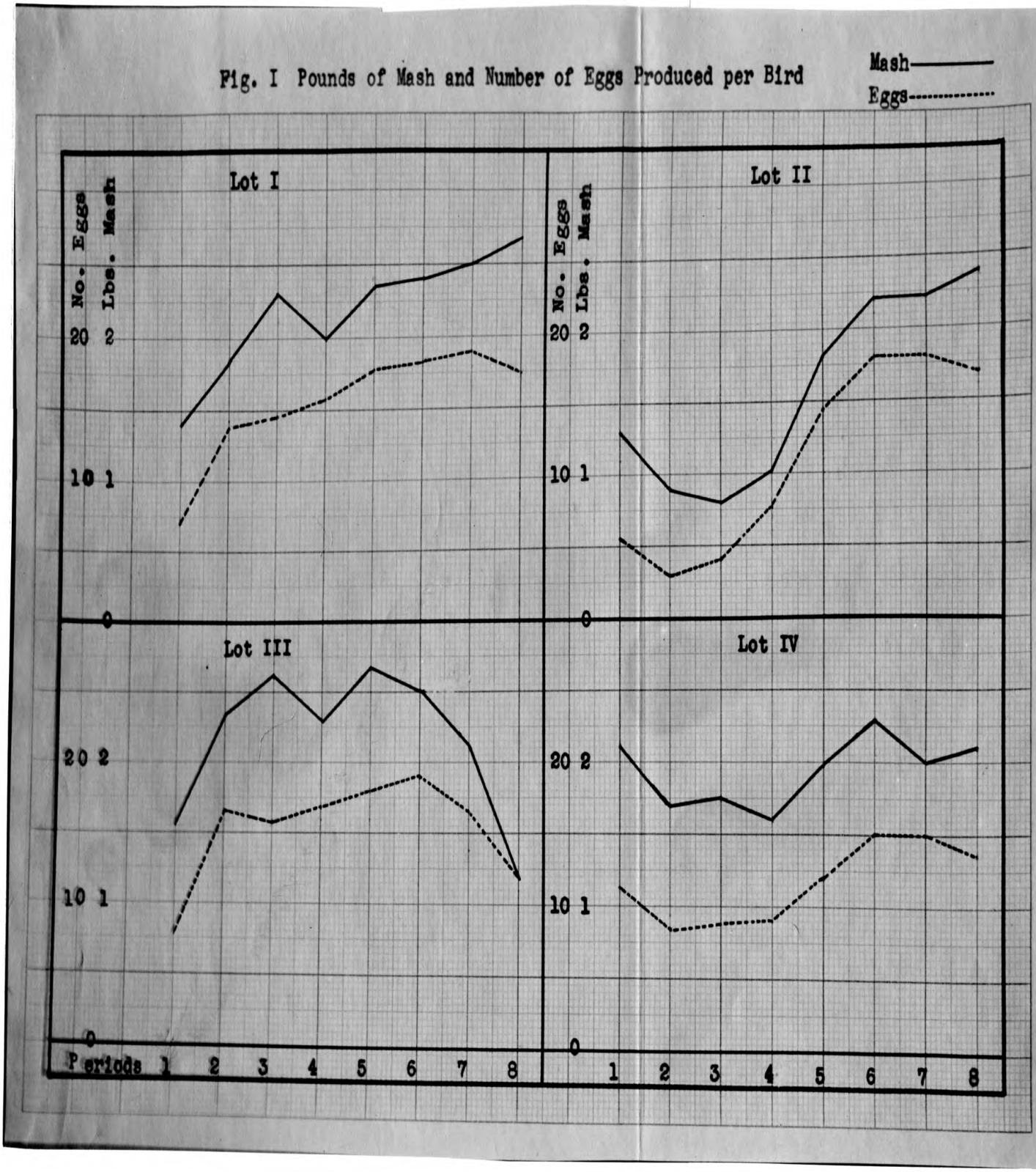
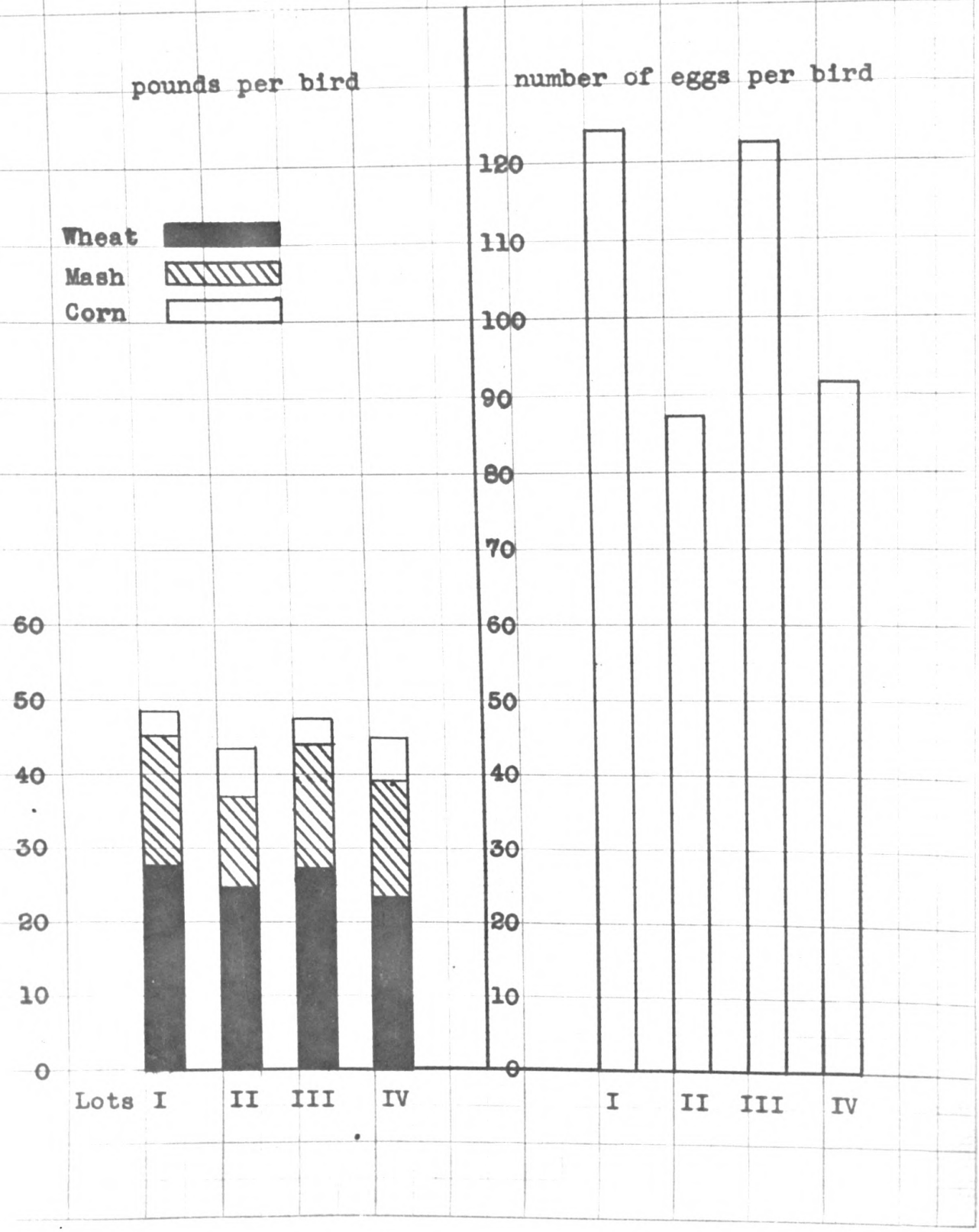


Fig. II Amount of Feed Consumed and Eggs Produced per Bird for Period of Experiment (32 weeks)



production, since production increased slightly the third period. No detailed checks on molt or other physical conditions were made at this time. The gradual increase in the average amount consumed per bird up to about the end of the sixth period for lots I, II, and III and a decline during the remainder of the experiment seems to be in accordance with the needs for egg production.

Table 2 and Figure II gives the total consumption of each of the three feeds for each lot during the entire experiment. The hens consumed nearly double the pounds of shelled corn per bird as did the pullets. The grain consumption was approximately the same for hens and pullets, and therefore, the pullets consumed more wheat than did the hens. The mash consumed per bird was about the same for each group of pullets. More mash was consumed by the pullets than the hens. The lighted hens consumed more mash than did the unlighted hens. All these variations in mash consumption are directly proportional to egg production, as shown in Figure I. These mash consumption and egg production curves do not correspond entirely. Since feed weights and egg production were summarized at the end of each period only, possibly all the changes are not shown accurately. If summaries were made at more frequent intervals, it might smooth out the curve and show the relationship more nearly correct. Near the close of the experiment, lot III declined

in egg production. Apparently this in turn caused a smaller consumption of mash. This is one explanation for these two lines intersecting.

It is also shown in Figure II that lots I and III averaged more eggs than did lots II and IV. The unlighted pullets averaged 1.56 more eggs than did the lighted pullets, but the lighted hens (lot IV) produced 4.42 more eggs per bird for the 32 weeks than did lot II, the unlighted hens.

OBSERVATION OF BIRDS UNDER LIGHTS

The first group study of the birds under lights was made December 22, 1932, from 4 o'clock until daylight. Both lots III and IV were observed at the same time through the open front of the house. When the lights flashed on at 4:00 a.m., the birds appeared blinded a few seconds, then they began to hop to the floor as rapidly as space would permit. A few remained on the roost throughout the period of observation. At first wheat was preferred to shelled corn to such an extent that space was not adequate for all the birds seeking it. A few, however, did eat mash and corn. It seemed that as soon as the birds satisfied their appetites for wheat and what little corn they might care for, they would then eat of the mash.

The thirst of the birds appeared to be very intense since from one to six or seven were drinking throughout the

observation.

In general, the activity of the birds was much the same as it would be in sunlight. They appeared to be entirely contented as they ate, drank, and moved about in the pen.

The unlighted groups were observed also, beginning at daylight and lasting for about one hour. Due to the semi-darkness in the pen at the beginning, the movements of the birds were not easily seen. Only a few birds hopped to the floor at first, but these seemed to be able to see, as they ate and drank with as much ease as though the pen had been well lighted. As the pen grew lighter, more birds jumped to the floor and ate. In 15 minutes not more than one-third of each lot were off the roosts, but by 30 minutes nearly all were down and eating. Their activity while eating, drinking, and moving about the floor was very similar to the lighted birds.

The second observation was made March 25, 1933 and was characterized by much less activity than before. The birds were much slower to hop to the floor and more stayed on the roost. The preference for wheat was not so evident. About four minutes after the lights came on, all the space at the mash and grain hoppers was in use except in lot III where only one-fourth of the mash hopper eating space was in use. Activity decreased more quickly than the first observation.

Water was craved by the birds, the same as on December

22. From one to seven were drinking at every moment.

The unlighted birds were observed for nearly one hour again and they behaved much as they did during the first observation. They came to the floor about as rapidly and their preference for feed and drink was unchanged.

The kilowatt hours of current used for artificially lighting both lots III and IV were 8.5, 7.5, 9.5, 8, 10, 7.5, 3, and 0 (zero) for periods 1, 2, 3, 4, 5, 6, 7, and 8, respectively. The total is 54 hours for the two lots, and at three cents per hour, the cost was $0.81 each for lots III and IV during the entire experiment.

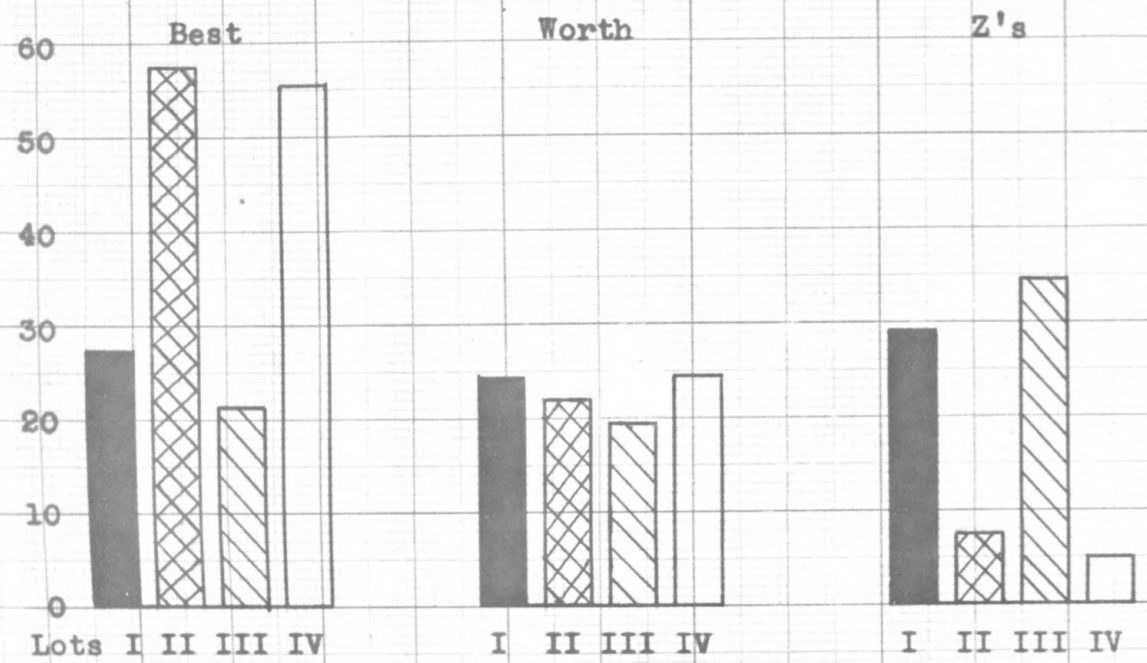
The percentage distribution of the eggs as they were placed in each of the grades for the entire experiment is illustrated by lots in Figure III.

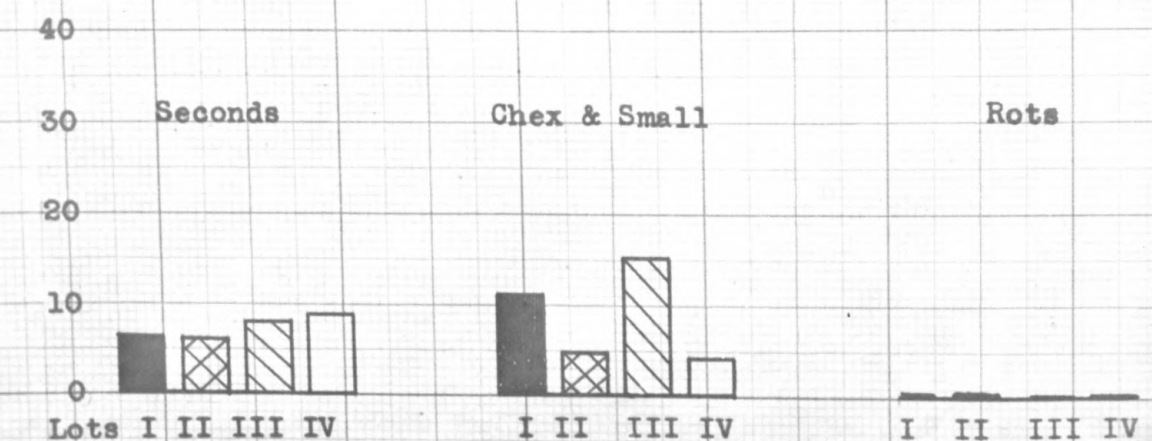
EGG PRODUCTION

Hens Versus Pullets Without Lights

Each of the eight periods in table 2 of the Appendix is characterized by a greater total egg production by the pullets (lot I) than the hens (lot II). During the fall periods of high egg prices, the differences are very large. Greater production and higher egg prices during these fall months account for the larger egg income for the pullets. During the spring periods, very little difference was ob-

Fig. III Percentage of Eggs in Each Grade for the Entire Experiment.





tained either in the total egg production or the income from eggs. Even though the pullets lead in egg production, the income was slightly greater from the hens (lot II), for the sixth period. This is due to a larger size of the hen eggs.

Since many small eggs were laid, a large proportion of the pullet eggs fell in the lower grades, especially at the beginning. In each succeeding period, an increasing number of the pullet eggs were placed in the upper grades. The hen eggs improved gradually in the proportion being placed in the upper grades during each succeeding period also, so that the pullets did not have a higher percentage of eggs placed in the upper grades at any time. A comparison by lots of percentage of eggs in each grade for the entire experiment is given in Figure III. In the case of these two unlighted groups, 30.22 per cent more eggs were placed in the Best grade from lot II (hens) than lot I (pullets).

The average production per bird in each lot for each period is shown in table 3 of the Appendix. As is shown graphically in Figure II also, the average production was 124.12 for lot I and 87.38 for lot II for the 32 weeks.

The percentage production for the entire experiment was 55.41 $\pm$ .231 for lot I and 39.01 $\pm$ .230 for lot II. The difference between the two lots was 16.40 $\pm$ .325 and the error is small enough to indicate this difference is statistically significant.

Hens Versus Pullets With Lights

These two groups are somewhat similar to the two corresponding groups not receiving morning lights. The hens (lot IV) laid more eggs than did the pullets (lot III) during the first and the last periods. During the other periods, the pullets led the hens, although not by as large a margin as the unlighted groups. Apparently, the response of the hens to lights was greater than that of the pullets.

A gradual increase in the number of eggs that were placed in the upper grades occurred up to the end of the sixth period, but declining the last two.

The production per bird was 122.56 for lot III and 91.80 for lot IV for the 32 weeks of the experiment. This is also given in the total of table 3 of the Appendix and shown graphically in Figure II.

For the 32 weeks of the experiment, the percentage production was 54.71 $\pm$ .232 for lot III, the lighted pullets, and 40.98 $\pm$ .228 for lot IV, the lighted hens. The difference of 13.73 $\pm$ .325 is sufficiently larger than its error to indicate that the results found here are significant.

Pullets With and Without Lights

The differences in these two groups are not very outstanding. Practically no difference exists in the way the eggs were distributed in the grades. Production was greater in the lighted group (lot III) to the end of the sixth period, but the group not receiving lights (lot I) led during the last two periods.

Both of these pullet groups produced few eggs which were placed in the upper grades, during the first three periods. A gradual increase in percentage placed in the upper grades occurred, but not until prices had declined, were the numbers concurrent to the two groups of hens. This considerably handicapped both groups of pullets as far as egg income was concerned.

The percentage production was 55.41 $\pm$ .231 for lot I, the unlighted pullets and 54.71 $\pm$ .232 for lot III, the lighted pullets. The difference of .70 $\pm$ .327 is too small to have any significance.

Hens With and Without Lights

During the fall period, the hens which had lights (lot IV) laid more than double the number of eggs produced by the unlighted group (lot II). However, beginning with the fifth period, on through the eighth period, the unlighted group

began to forge ahead. During the last period, the unlighted group produced more eggs thus giving a larger egg income for that period. Thus the seasonal production was changed by the use of morning lights on hens. This is in accordance with results of Kable, Fox, and Lunn (15).

It is shown in table 2 of the Appendix that more than one-fourth larger income was obtained from the lighted group. Apparently, this is due entirely to lights. The eggs from each group graded about the same.

The percentage production was 40.98 $\pm$ .228 for lot IV and 39.01 $\pm$ .231 for lot II; giving a difference of 1.97 $\pm$ .323. The difference here is sufficiently larger than its error to indicate that the results are significant.

In order to determine the loss or gain during the experiment, two inventory values of pullets were considered on October 1, 1932. They were valued at $0.75 each, the price they could have been sold for and also at $0.50 each, or the cost of rearing them. The hens were valued at market price both October 1, 1932 and May 12, 1933. The pullets were valued at market price on May 12 only. The actual paying prices in Manhattan for the following dates were used:

October 1 - Hens under 4 lbs. 7¢; 4 lbs. and over, 10¢
May 12 - Hens under 4 lbs. 6¢; 4 lbs. and over, 8¢

Lots I and II each had 80 birds remaining at the close of the experiment, 20 birds having died in each lot. In

lot III, 14 birds were lost, leaving 86. The mortality in lot IV was 13 birds, thus leaving 87 at the close of the experiment. The birds which died during the experiment were valued at the October 1 price.

When pullets were purchased at $0.75 each and hens at market price on October 1 and both hens and pullets were sold at market price May 12; the inventory loss was $51.50, $6.04, $55.96, and $4.75 for lots I, II, III, and IV, respectively.

At $0.50 each for pullets October 1, instead of $0.75; the inventory loss was $26.50, $6.04, $29.46, and $4.75 for lots I, II, III, and IV, respectively.

Figure IV is a cumulative histogram or column graph showing the return above feed costs per bird to date at the end of each of the eight periods.

In table 3 is shown the return above feed cost and depreciation. In table 3-A the pullets are estimated at $0.75 each October 1 and at market price May 12. In table 3-B the pullets are valued at $0.50 each on October 1 and at market price May 12. Hens are valued at market price on both October 1 and May 12 throughout the table.

Some cumulative comparisons are made of percentage production in Figure V. It will be noted that hens compare more favorably with pullets when lighted. The percentage production of the lighted hens is much higher during the

Table 3. Return Above Feed Costs and Depreciation

A. Pullets valued at 75 cents each October 1 and market price May 12; hens at market price at beginning and conclusion of test.

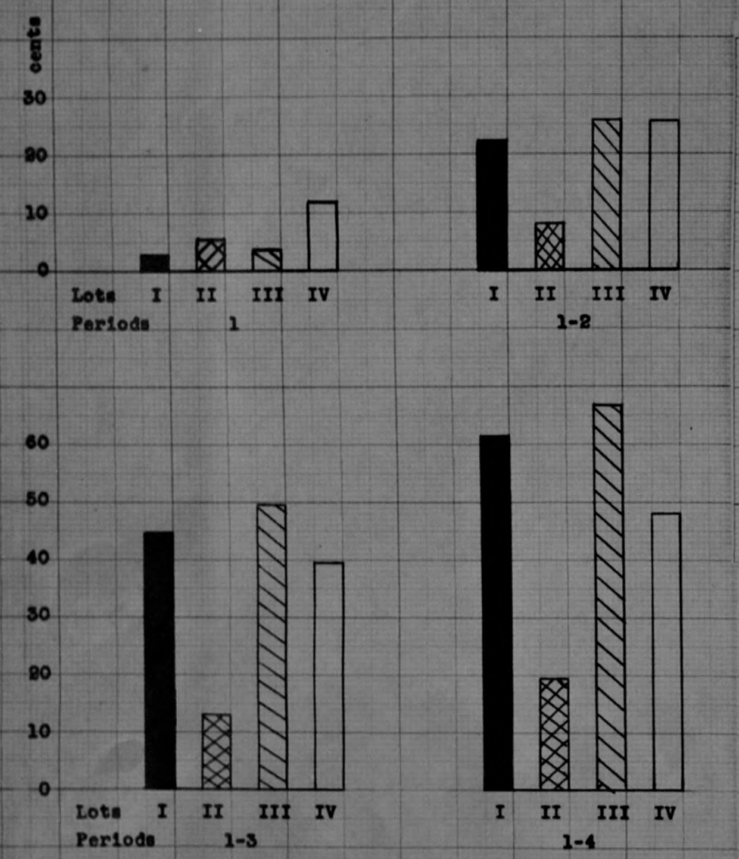
	Lots			
	I	II	III	IV
Return above feed costs	$82.91	$42.11	$82.37	$61.52
Depreciation loss	-51.50	- 6.04	-55.96	- 4.75
Net return above feed cost and depreciation:	$31.41	$36.07	$26.41	$56.77

B. Pullets valued at 50 cents each October 1 and market price May 12; hens at market price at beginning and conclusion of test.

	Lots			
	I	II	III	IV
Return above feed costs	$82.91	$42.11	$82.37	$61.52
Depreciation loss	-26.50	- 6.04	-29.46	- 4.75
Net return above feed cost and depreciation:	$56.41	$36.07	$52.91	$56.77

fall than hens not receiving lights, as is shown by the height of the line representing the lighted hens during the autumn periods. The difference in lighted and unlighted pullets was small, since these curves lie more closely than did any of the others.

Fig. IV Profits Above Feed Costs per Bird (Cumulative)



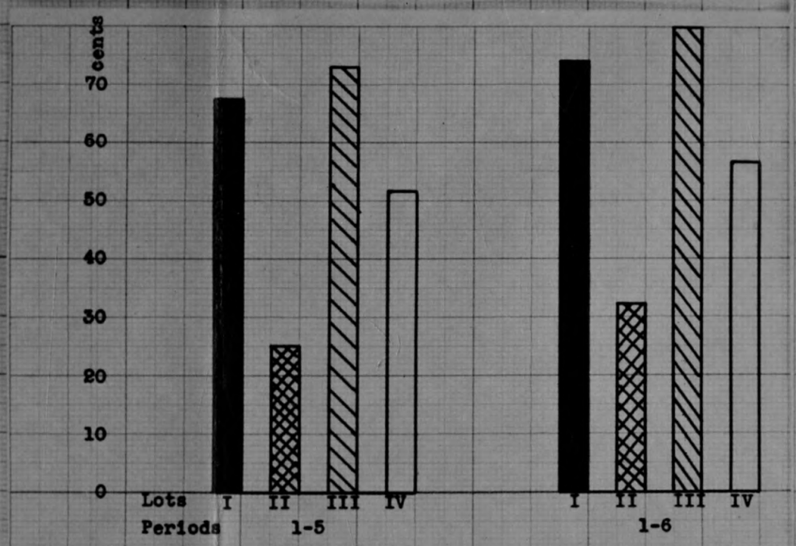
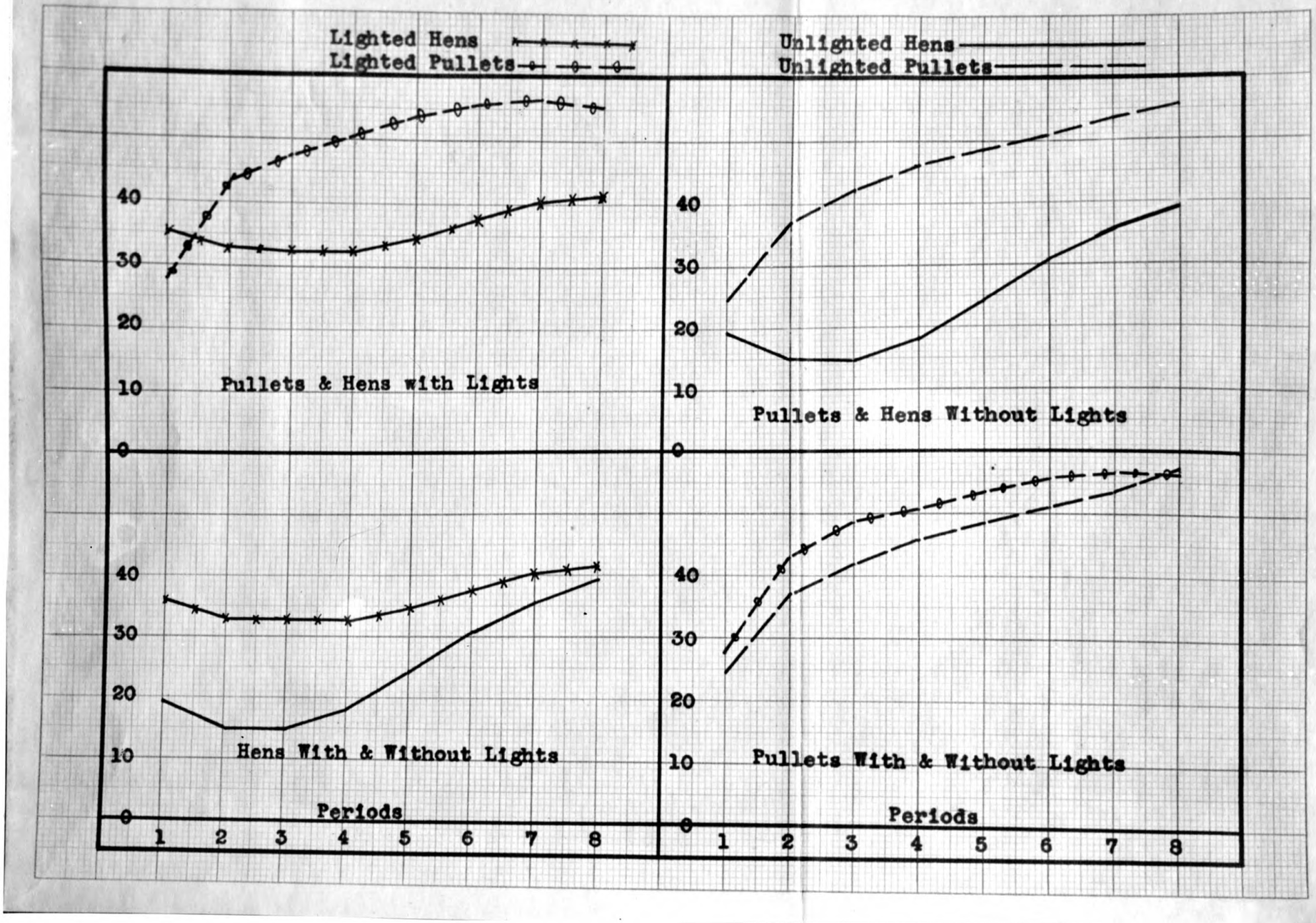


Fig. V Comparisons of Percentage Production (Cumulative Polygon)



RETURN ABOVE FEED COSTS AND DEPRECIATION

According to table 3-A, the hens receiving morning lights (lot IV) were the most profitable group. Less mortality occurred in this lot, but even without that difference, they proved to be the most profitable. The unlighted hens (lot 11) showed the second largest return. The net return from the pullet groups was much smaller. Most all the difference in the two pullet groups was due to larger depreciation on the lighted pullets (lot III). This gives the unlighted pullets some advantage.

In table 3-B, the evaluation change effects only the pullets, so that the two hen groups remain the same. The lighted hens again gave the largest net return. However, the unlighted pullets are only a few cents less. Due principally, to a higher mortality, the lighted pullets show a smaller net return than the unlighted ones. The unlighted hens are very much lower in net return than any of the other groups.

Method of Handling the Eggs

The eggs from each lot were gathered five times daily, stored in a cool place over night after which they were placed in separate cases and numbered to correspond to the lot numbers.

The eggs were taken to a local packing plant* once or twice each week, where they were stored for 24 hours at 50 to 60°F. The eggs from each lot were then graded separately and the report sent to the College Poultry Department.

In table 5 is given the maximum and average temperatures for each of the eight periods. The record was made by means of a thermograph, which was placed on the partition wall of pen II. This table was summarized from the graphs.

Table 4 describes the grades upon which the eggs were sold. It should be noted that each grade corresponds to a particular U.S. standard grade, except for weight. These U.S. standard grades are listed in the second column.

The lowest temperature recorded was 10°F. and the highest temperature was 85°F. The average temperature for the entire experiment was 44.21°F. Since only summaries are available, not enough detail is presented to observe the effect of temperature on egg production.

Table 6 records the data on mortality and average number of birds for each period. These figures on "average number of birds" were used in calculating the amount of feed per bird and cost per bird in table 1.

The birds which died during the experiment were taken to the Department of Bacteriology for autopsy. The results

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*The Perry Packing Company of Manhattan, Kansas graded and purchased all the eggs during the test.

Table 4. Grades Under Which Eggs were Sold

Name of grade	Equivalent in U. S. Grades	Specifications: Shell condition	Air cell	Yolk	White	Germ
Perry Best	U.S. Special Minimum weight 23 oz. per doz.	Clean; sound	One-eighth inch or less in depth; localized; regular	Dimly visible	Firm; clear	Not visible
Perry Worth	U.S. Extras Minimum weight 22 oz. per doz.	Practically clean; sound	Two-eighths inch or less in depth; localized; regular	May be visible	Firm; clear	Not visible
Perry Z's	U.S. Extras Weight 19-21 oz. per doz.	Practically clean; sound	Two-eighths inch or less in depth; localized; regular	May be visible	Firm; clear	Not visible
Perry Seconds	U.S. Dirties No. 1 & No. 2	May be dirty	Any size	May be freely mobile	May be watery	May be visible but no blood
Chex & Small	U.S. Check (No wt. required)	Cracked; clean or dirty	May be three-eighths inch in depth and mobile	May be plainly visible; dark; freely mobile	May be weak and watery	May be clearly visible but with no blood
Rots	Kinds: (1) blood ring, (2) white rot, (3) mixed rot, (4) black rot, (5) bloody rot, (6) moldy egg.					

Table 5. Temperatures as Recorded in Lot II

Period	Maximum	Minimum	Average
1	85	38	59.90
2	69	29	46.10
3	68	16	40.00
4	58	30	44.80
5	63	18	41.50
6	75	30	51.80
7	58	10	31.21
8	59	20	38.36

are summarized in table 7.

The retail feed costs were obtained from a local feed dealer* at the end of each period. These were used in calculating the value of the feed consumed. The prices of feed and cod liver oil are presented in table 1 of the Appendix.

*The Farmers' Cooperative Association furnished the feed prices used.

Table 6. Mortality and Average Number of Birds for Each Period

Period	Lots							
	I		II		III		IV	
	No. died	Ave. No. birds	No. died	Ave. No. birds	No. died	Ave. No. birds	No. died	Ave. No. birds
1	0	100.00	0	100.00	0	100.00	1	99.32
2	2	99.50	2	98.46	4	97.28	3	98.32
3	2	96.32	5	96.89	3	95.04	1	95.96
4	0	96.00	3	94.86	0	93.00	1	94.18
5	0	96.00	0	90.00	2	92.79	0	94.00
6	6	93.21	5	88.43	2	89.61	1	93.25
7	9	92.75	4	88.89	3	91.82	4	95.89
8	1	80.11	1	80.68	2	85.89	2	87.36
1-8	20	94.24	20	92.28	16	93.18	13	94.79

Table 7. Diseases Causing Mortality During the Experiment

Name of disease*	No. cases	Per centage
Leukemia	15	19.24
Prolapse of oviduct	11	14.10
Taeniosis	8	10.26
Ascariosis	3	3.85
Cholera	4	5.13
Ruptured ova	3	3.85
Picked by other birds	3	3.85
Peritonitis	2	2.56
Pericharditis	1	1.28
Coccidiosis	1	1.28
Lymphomotosis	1	1.28
Lymphosarcoma	1	1.28
Generalized tumor	1	1.28
Tumor of ovaries	1	1.28
Collibaccillosis	1	1.28
Impaction of crop	1	1.28
Abscessation	1	1.28
Cystic ovaries	1	1.28
Cystic kidneys	1	1.28
No diagnosis	1	1.28
Reported at farm:		
Cold	1	1.28
Roup	1	1.28
Broken down in back	1	1.28
No record on	14	17.96
Total	78	

*Several birds had two or more diseases

CONCLUSIONS

1. When mortality and depreciation losses were considered, lighted hens proved to be more profitable than pullets, either with or without morning lights.

2. Morning lights for pullets were not economical.

3. On farms where lighting is not possible, pullets are more profitable than hens for the production of market eggs.

4. The Leghorns used in this experiment preferred whole wheat to shelled yellow corn or dry mash.

5. The hens used in this experiment consumed more corn than did the pullets.

6. The four lots consumed mash directly proportional to egg production during the entire experiment.

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APPENDIX

Table 1. Retail Feed Costs per Hundred Pounds

Feed	Periods							
	1	2	3	4	5	6	7	8
Yellow corn meal	$ 0.70	$0.50	$0.50	$0.50	$0.50	$0.65	$0.65	$ .75
Ground wheat	.75	.75	.75	.80	.75	.85	.95	1.15
Ground oats	.85	.75	.75	.75	.75	.85	.95	1.00
Meat & bone scraps	1.50	1.50	1.50	1.60	1.60	1.75	1.95	2.65
Dried butter milk	4.50	4.50	4.50	4.50	4.00	--	--	7.00
Alfalfa leaf meal	1.00	.75	.75	.75	.80	.85	.80	.85
Salt	1.50	1.25	1.50	1.50	1.25	1.25	1.25	1.25
Cod liver oil (per gal)	1.25	1.10	1.00	1.00	1.00	1.05	1.00	1.10
Mash	1.25	1.14	1.13	.94*	.93*	1.05*	1.12*	1.67
Shelled corn	.60	.45	.35	.45	.45	.50	.55	.71
Whole wheat	.65	.65	.65	.66	.67	.65	.85	1.17
Oyster shell	.85	.85	.85	.85	.85	.85	.90	.90
Tobacco dust	10.00							

* Without dried buttermilk.

Table 2. Market Grades and Value of Eggs Produced

Period	Grades	Eggs per lot								Value of eggs per lot			
		I		II		III		IV		I	II	III	IV
		No. doz.	No. eggs	No. doz.	No. eggs	No. doz.	No. eggs	No. doz.	No. eggs				
1	Best	0	1	23	11	0	4	34	3	$ 0.02	$ 5.93	$ 0.08	$ 8.48
	Worth	0	6	11	7	1	2	27	3	.10	2.18	.23	5.16
	Z's	20	5	4	10	17	5	10	8	3.22	.72	2.73	1.60
	Seconds	3	5	2	1	4	1	7	11	.52	.31	.64	1.18
	Chex & Small	33	4	2	4	41	9	3	7	3.33	.23	4.17	.34
	Rots			0	5	0	4	0	2				
	Total	57	9	45	2	65	1	83	10	$ 7.19	$ 9.37	$ 7.85	$16.76
2	Best	1	5	13	1	1	1	37	6	$ 0.41	$ 3.70	$ 0.31	$10.59
	Worth	4	3	6	1	4	6	19	2	1.04	1.40	1.11	4.50
	Z's	62	5	1	6	59	9	5	2	11.41	.34	13.85	1.18
	Seconds	11	2	1	11	7	3	3	10	2.18	.35	1.47	.74
	Chex & Small	34	10	1	3	60	3	2	10	5.55	.19	9.60	.34
	Rots	0	4	0	7	0	2	0	1				
	Total	114	5	24	5	133	0	68	7	$23.59	$ 5.98	$26.34	$17.35
3	Best	11	11	21	3	11	7	45	5	$ 3.06	$ 5.63	$ 2.98	$12.08
	Worth	19	8	5	0	18	4	15	3	4.48	1.19	4.23	3.55
	Z's	64	3	2	8	67	10	3	0	15.04	.62	15.72	.71
	Seconds	10	4	1	11	9	3	3	0	2.08	.39	1.88	.61
	Chex & Small	11	7	1	10	18	9	3	0	1.99	.31	3.24	.52
	Rots	0	6	0	6	0	3	0	4				
	Total	118	3	33	2	126	0	70	0	$26.65	$ 8.14	$28.05	$17.47
4	Best	35	6	43	9	28	8	46	2	$ 6.47	$ 7.65	$ 5.21	$ 8.52
	Worth	32	11	9	1	27	3	15	6	5.32	1.47	4.41	2.59
	Z's	45	1	2	10	56	5	1	0	7.95	.51	9.66	.17
	Seconds	6	10	1	10	10	2	5	1	.96	.27	1.39	.71
	Chex & Small	6	6	3	1	7	10	2	10	.85	.36	1.11	.40
	Rots	0	2	0	7	0	10	0	2				
	Total	127	0	61	2	131	2	70	9	$21.55	$10.26	$21.78	$12.39
5	Best	53	3	75	8	43	5	58	4	$ 5.33	$ 7.57	$ 4.34	$ 5.83
	Worth	41	6	18	6	35	7	18	10	3.44	1.52	2.95	1.55
	Z's	25	3	5	5	43	2	2	11	2.04	.42	3.43	.22
	Seconds	7	1	4	1	12	1	6	10	.44	.25	.76	.43
	Chex & Small	6	1	4	2	5	8	6	2	.38	.26	.36	.38
	Rots	0	8	0	11	0	8	0	8				
	Total	133	10	108	9	140	7	93	9	$11.63	$10.02	$11.84	$ 8.41
6	Best	58	11	88	7	50	7	71	8	$ 5.87	$ 8.83	$ 5.03	$ 7.12
	Worth	49	11	25	11	35	2	23	8	3.98	2.06	2.80	1.86
	Z's	17	4	7	1	39	9	5	7	1.17	.48	2.67	.36
	Seconds	9	3	5	3	11	5	9	2	.51	.27	.60	.48
	Chex & Small	5	1	6	0	5	0	5	11	.27	.32	.26	.32
	Rots	0	11	1	2	1	0	1	3				
	Total	141	5	134	0	142	11	117	3	$11.80	$11.96	$11.36	$10.14
7	Best	59	11	68	11	42	5	64	0	$ 6.23	$ 7.21	$ 4.44	$ 6.69
	Worth	46	10	36	5	39	5	30	6	3.96	3.06	3.30	2.58
	Z's	22	8	10	9	25	10	4	7	1.69	.81	1.95	.33
	Seconds	10	1	10	11	15	5	15	9	.55	.58	.82	.87
	Chex & Small	5	8	7	3	3	9	5	3	.31	.38	.19	.27
	Rots	0	9	1	2	0	4	0	8				
	Total	145	11	135	5	127	2	120	9	$12.74	$12.04	$10.70	$10.74
8	Best	46	10	52	6	25	11	46	5	$ 5.37	$ 6.05	$ 2.97	$ 5.37
	Worth	44	2	36	5	26	11	28	3	4.21	3.48	2.57	2.69
	Z's	27	5	16	6	20	2	4	4	2.19	1.32	1.62	.35
	Seconds	9	2	16	0	8	3	14	5	.58	1.05	.53	.93
	Chex & Small	7	6	7	6	3	9	5	9	.49	.48	.24	.39
	Rots	1	1	0	11	0	9	1	1				
	Total	136	2	129	10	85	9	100	3	$12.84	$12.38	$ 7.93	$ 9.73
Grand total		974	9	671	11	951	8	725	2	$127.99	$80.15	$125.85	$102.99

Table 3. Average Number of Eggs Per Bird

Lots	Periods								Total
	1	2	3	4	5	6	7	8	
I	6.93	13.80	14.73	15.88	17.67	18.21	18.98	17.33	124.12
II	5.42	2.98	4.11	7.74	14.50	18.18	18.28	16.88	87.38
III	7.81	16.41	15.91	16.92	18.18	19.14	16.60	11.98	122.56
IV	10.13	8.40	8.75	9.01	11.97	15.09	15.11	13.77	91.80