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Effect of Insulated Houses On Broiler Performance

William O. Sewell

To the Graduate Council:

I am submitting herewith a thesis written by William O. Sewell entitled "Effect of Insulated Houses On Broiler Performance." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Science.

O. E. Goff, Major Professor

We have read this thesis and recommend its acceptance:

B. D. Raskopf, R. L. Tugwell

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

March 9, 1964

To the Graduate Council:

I am submitting herewith a thesis written by William O. Sewell entitled "Effect of Insulated Houses On Broiler Performance". I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Poultry.

O. E. Goff
Major Professor

We have read this thesis
and recommend its acceptance:

R. L. Tugwell

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Accepted for the Council:

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Dean of the Graduate School

EFFECT OF INSULATED HOUSES ON BROILER PERFORMANCE

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

William O. Sewell

March 1964

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INTRODUCTION

During 1962 approximately 33.3 million broilers were produced in Tennessee that sold for over 16 millions of dollars. Tennessee ranks 16th in the United States in broiler production. Although Tennessee is not one of the larger broiler producing states, geographically it is adjacent to six major producing states. Competition in the broiler industry is keen. The trend in broiler expansion in states contiguous to Tennessee has been phenomenal during the past five to ten years. In Tennessee the broiler production from 1952 to 1962 has expanded from 8.8 million to 33.5 million birds. Lowering costs to meet competition is very real to the integrator and the grower. Lowering costs to meet competition by increasing efficiency in feeding, breeding, improved hatching facilities and pharmaceuticals may be expected to decrease in the degree of change that they might contribute. Advantages in area competition are also very real, but advantages of location are not as great, geographically, as some 20 years ago.

Tennessee and other states and areas are now considering other factors that might increase efficiency and decrease cost of production. This area of consideration envolves control of air movement, temperature, and humidity.

The degree of broiler house insulation can be complete or partial. One large Tennessee integrator in 1959 started a program of partial insulation of broiler houses on the Cumberland

Plateau. A more accurate description of these houses would probably be control ventilation with some insulation. Some of the houses might be termed "winterized", rather than insulated.

During 1960-61 this particular company was financing and supervising broiler growing operations in about equal numbers of "winterized" houses and "winterized" plus partial insulation. Most of the insulation was asphalt treated fiber board, others with materials possessing approximately the same insulation value. The R value of the insulated houses was estimated, for the ceilings, at roughly 3.21.[1] The side walls and window openings for all houses had the same R value. The windows on the north or west (depending on direction of ridge) sides of all houses were covered with 4 mil polyethelene from the time it turned cool in the fall until it turned warm in the spring. The polyethelene was fastened to the outside of the studs, therefore making an air space between it and Flex-O-Glass covered window frames on the inside of the stud. This contractor offered to pay fuel costs for all growers who would complete the job of partial insulation plus air control.

Since this large company, during the fall and summer of 1960 and winter and spring of 1961, had about an equal number of growers with each type house, data were available for a study of the effects of these two types of houses on various production factors. Some 48 growers were selected at random with a total

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[1]R = the rate of heat transmission through a material.

of 194 grow-outs; of these 95 grow-outs were in partially insulated houses and 99 in noninsulated houses. These 194 flocks represented 1,295,920 chicks started.

OBJECTIVES

To compare the response of broilers grown in insulated and noninsulated houses when measured in terms of percent mortality, average weight of broilers, feed conversion, performance efficiency index[2] and percent condemnations.

[2] Performance efficiency index = weight/feed conversion.

REVIEW OF LITERATURE

Mortality

Literature on mortality related directly to temperature and housing is limited. References concerning morbidity and the effects of disease on feed conversion, growth rate, and particularly poultry condemnations in processing plants is much more plentiful. The United States Department of Agriculture, Inspection Service (1963) reports that condemnations, due to the microorganism, _Mycoplasma gallisepticum_, cause a direct or indirect loss to American broiler growers of over 100 million dollars annually. Popularly called PPLO (Pleuropneumonia-like organism), _Mycoplasma gallisepticum_ causes chronic respiratory disease (C.R.D.) and air sac disease in chickens. In Tennessee during the period of August 1960 to July 1961 infections accounted for 51 percent of all condemnations under United States Government inspections, Figure 17.

Early mortality, that is mortality during the first week, has a different economic impact than does mortality or morbidity which might occur after five weeks. Early mortality losses may not be a great an economic loss as the condemnations which take place in the processing plant. In either case, the birds are a loss and involve brooding and labor costs.

Seigel and Coles (1958) found no significant differences in mortality rate to 9 weeks of age when broilers were kept during the first two weeks at two levels of humidity, 57-58 percent or 70-71 percent, and thereafter maintained at the same level of humidity.

Griffin (1959) states that air cooled houses (70°F.) did not show any advantage in reducing mortality during the summer months.

Prince et al (1961) reporting on a study involving birds vaccinated with bronchitis and with different rates of ventilation reported no significant differences in mortality due to bronchitis infection or ventilation rate. The broiler houses for each of two innoculated groups were ventilated at 3/4 and 2 cfm.[3] per bird respectively. Prince stated that percent mortality was unaffected by environmental temperatures of 45°F. or 75°F.

Weight and Gains

Kleiber and Daugherty (1934) indicated that the maximum growth rate of chicks, from 6 to 15 days of age, was secured at a temperature of 69.8°F. and minimum at 89.6°F. These investigators further showed that the total net energy produced per unit of food energy consumed was maximum at 89.6°F. and minimum at 69.8°F.

Kempster and Parker (1936) reported that it was apparent that when the mean maximum temperature reached 90°F. and the mean daily temperature exceeded 78°F., growth rate was markedly decreased. In both instances (1934 and 1935) maximum growth was observed in April, May, and June. In the above studies temperature, light and humidity were recognized as important but uncontrolled variables.

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[3]Cubic feet per minute.

According to Winchester and McKleiber (1938) the daily growth rate of chicks from 6 to 15 days of age was found to increase as the environmental temperature decreased. The experiments by Winchester and Kleiber (1938) were carried out over a temperature range of 60.8°F. and with chickens up to 16 days of age. Feed consumption was negatively related to environmental temperature.

Barott (1947) observed a definite variation in growth rate due to temperature. Maximum growth was obtained when the mean temperature was 91°F. and equaled at 59 percent increase over the original weight in 9 days. The environmental temperature was 94° - 95°F. the first day and thereafter temperature was decreased uniformly to 88°F. which was reached on the ninth day. The gain in chick weight was less at other temperatures studied and decreased the further the deviation below or above the temperature at which maximum growth occurred, until at a temperature of 82.5°F. (initial temperature of 85°F., final temperature 80°F.), the increase in weight was only 44 percent.

Barott and Pringle (1947) state that homoiotherms consume more food at low temperatures than at high temperatures. This must be true because at the lower temperatures more food must be metabolized to regulate body temperatures.

Barott and Pringle (1950) found that the best growth of chickens, between the 18th and 32nd days of age, was obtained when the temperature was 80°F. on the 18th day and dropped uniformly each day thereafter so that on the 32nd day it would be 66°F; as the temperature varied in either direction from this temperature the growth was less and it became poorer the greater the variation. They concluded that a variation in temperature was not nearly as critical through the 18 to 32 day period as from the zero to 18 day period. For chicks between zero and 18 days of age, a variation in temperature on the 18th day from 70°F. to 80°F. made a difference in growth of 35 percent, whereas with chickens between 18 and 32 days of age a variation from 55° to 65°F. made a difference of only 6 percent in growth.

Griffin (1959) reported that birds grown in non-cooled houses during the summer had about the same average gain per chick as those grown in the same houses during a mild period of the year when high temperature was not a problem. These data help to show that mechanical cooling did not increase gain.

Chicks in the air-cooled house (constant 70°F.) showed a slight advantage in weight gain over the conventional house during the two summer months when compared with those grown in the high temperature house (99°F.). Performance of the chicks in the cooler house exhibited a slight advantage over those in the open house one summer, but the chicks grown in the open house performed in a superior manner than did those retained in the cooler house the following summer, according to Griffin (1959).

Squibb et al. (1959) reported that 5 week old New Hampshire chicks demonstrated an accepted phenomenon, that high environmental temperature will significantly depress feed intake and growth, and increase water consumption. Comparisons were made for 99°F. and 70°F.

Prince et al. (1960) states that the additional feed consumed by chicks in the 45°F. cabinets was evidently used to maintain body temperature since there was no appreciable effect on weight gain.

Pope (1960) observed that increasing the energy content of the ration at high environmental temperatures improved the growth rate of chickens. Pope also showed that the addition of fat to chick diets at levels of 2, 4, 5 and 8 percent improved growth in a 90°F. environment, but doubling the mineral and vitamin content of the diet did not increase growth at this temperature.

Baxter and Shirley (1961) in reporting results of seven seasonal trials with three types of houses, conventional, solar, and windowless, found that broiler growth (rate of gain) was greatest in the conventional house while the gains of chicks in the windowless house was second and the solar third and last.

Adams et al. (1961) conducted three trials in two environmental temperatures, 70°F. and 90°F. to study the effect of temperature on growth and nutritional requirements of chickens grown from four to eight weeks and six to ten weeks of age. The higher environmental temperature reduced growth and voluntary feed intake. Increasing the energy level of the ration improved the growth rate and the efficiency of feed utilization in both temperature environments. Increasing the vitamin, mineral, or protein content of the ration failed to improve growth at either temperature. In none of the three trials did an increase in the energy, vitamin or protein content of the ration produce chick growth in the 90°F. temperature environment comparable to that in the 70°F. temperature environment.

Smith et al. (1962) reported significant differences in broiler growth rate between four types of housing in five of seven tests. The air conditioned and fan ventilated houses were superior to the conventional and aluminum houses during two of the three summer tests when measured in terms of chick response. The trend was reversed during the two fall tests and one of the two winter tests. No significant differences were found between the four types of housing in feed conversion and chick mortality.

Smith et al. (1962) stated that temperature appeared to account for some of the differences in chick performance of the four types of housing studied. Relatively high temperatures, especially during the last few weeks of the growing period, could interfere with the optimal growth of broilers.

Rokeby and Nelson (1962) reported that at present, mechanical ventilation in summer was not practical. They state that the fan capacity required to move enough air to maintain inside teperatures close to the outside air temperature is so great that installation and operating costs are bound to be high. Plenty of natural ventilation (summer) seems to be the better solution.

Rokeby and Nelson (1962) were of the opinion that in addition to saving fuel, insulation and mechanical ventilation would also reduce or eliminate the labor needed to adjust ventilating systems, while at the same time, it would give a warmer house in winter, a house in which it was comfortable to work, in which wet litter would not be a problem, and in which water would not freeze. The only problem he experienced was with dust. These workers felt that this could be eliminated with improved design of the ventilating system.

Rokeby and Nelson (1962) concluded that little, if any, increase in broiler productivity through insulation and mechanical ventilation should be expected under farm conditions, although closely controlled laboratory tests have indicated that increases are possible. The authors stated that further study was needed to determine the desirable environment for broilers under field conditions.

Rokeby and Nelson's (1962) description of satisfactory broiler house insulation and mechanical ventilation are: (1) The house is well insulated with at least two inches of rockwool or equivalent insulation, is tightly built so that ventilation can be controlled and is kept reasonably warm in winter. (2) The ventilating system will move sufficient air to remove excess heat, moisture, odors, and dust without creating drafts; and will adjust itself automatically to meet changing conditions. Rokeby and further state that the fuel required for brooding in the winter to be at least 50% less than required for a noninsulated house. In the larger houses (3200 broiler capacity), one noninsulated and one insulated with fan ventilation, the B.T.U. supplied per bird showed that the well insulated house used less than one-fourth as much heat energy as did the noninsulated houses. These broods were from November 3, 1961 to January 2, 1962, and January 24 - March 26, 1963.

Feed Conversion

Winchester and McKleiber (1938) demonstrated that environmental temperature affected growth, metabolic rate, feed consumption, gross feed efficiency and body composition of chicks. The amount of fat stored per gram increase in body weight was greatest at 95°F. and 100°F. At 65°F. no fat was stored. The gain of protein per gram of increase in body weight was greatest at the lowest environmental temperatures.

Barott and Pringle (1946) noted that the environmental temperature had an important effect on energy and gaseous metabolism of chickens. Baby chicks in an environmental temperature of 70°F. eliminated 2.35 times as much heat as at 95°F., 5 week old chickens 1.85 times as much at 45°F. as at 95°F., etc.

Griffin (1959) found that in most cases the chicks in the insulated air-cooled house showed advantages over the other two in feed conversion. Since there was an unequal number of males and females in the groups, the feed conversion figures do not indicate what might have been expected if only one sex of birds had been grown in a house.

Heniger (1960) observed that the decrease in thyroxine secretion rate of chickens is due not merely to a reduction in final body weight, as evidenced by the inverse relationship between environmental temperature and thyroxine secretion rate, but that the inverse relationship between temperature and weight gain can probably be explained on the basis of lower feed consumption at the higher temperatures, since the feed efficiencies at the three temperatures were similar. The three temperatures were 75°F., 95°F., and 105°F.

Prince *et al.* (1960) reported on two experiments conducted to determine the effect of environmental temperature on feed consumption and weight gain of broilers between the age of 4 and 8 weeks. The four groups of chicks were housed at 45°F. and 65°F. It was found that increasing the temperature from 45°F. to 65°F. reduced feed consumption 9.4 percent and increased feed efficiency a corresponding 11.4 percent. These cumulative feed consumption and feed efficiency effects were significant at the 1 percent and 5 percent levels of significance, respectively.

Baxter and Shirley (1961) found that feed efficiency of chicks was approximately the same in all three houses - conventional, solar, and windowless, and concluded that it was questionable whether the extra cost of a solar or windowless house would be justified.

Prince (1961) observed that when White Plymouth Rock male chicks were innoculated with infectious bronchitis at four weeks of age and kept in environmentally controlled cabinets at 75°F. until they were eight weeks old, feed consumption was significantly reduced due to the bronchitis infection. The decrease amounted to 0.58 pounds per bird or 11.4 percent. Weight gain was also significantly reduced as a result of the bronchitis infection and amounted to 0.24 pounds per bird. Furthermore Prince (1961) studied the response of chicks under two rates of ventilation and found that feed consumption tended to be greater for the chicks in the presence of the higher ventilation rate, but the differences were not significant. Differences in weight gain due to ventilation rate were not significant. Feed efficiency was not significantly affected by the bronchitis infection or ventilation rate.

Condemnations

Ota and McNally (1960) pointed out the higher broiler condemnation rates during the winter months, as compared with the remainder of the year, in some Southern broiler producing states. The authors pointed out that this might be related to the frequently inadequate insulation and ventilation of many broiler houses in the South during the winter months which caused moisture condensation and wet litter situations conducive to outbreaks of disease. They further pointed out the familiar observation that a poultry house for broilers must be sufficiently flexible to allow satisfactory operation in extreme weather conditions in both summer and winter.

Cover (1960) in considering the number of chicks per stove, found that with 400-500 birds per stove 60.86 percent of the flocks had 4.00 percent condemnations or less, with 501 to 600 chicks per stove - 75.00 percent had 4.00 percent condemnations or less (9 of 12), and with 701-800 birds per stove - 57.14 percent had 4.00 percent condemnations or less (4 of 7).

Cover (1960) reported that there was no difference in the condemnation rate of flocks where they were divided into 1100 to 1500, 1600 to 2000 or 2100 to 3000 birds per pen.

Cover (1960) showed that in brooding with individual gas stoves there was a much higher percentage of flocks with less than 4.00 percent condemnations than for those brooded under individual oil stoves. Actually 43.00 percent of the flocks brooded under oil burning brooders had less than 4.00 percent condemnations (6 of 14), but 18 out of 23 flocks, or 78.00 percent brooded with individual gas stoves had less than 4.00 percent condemnations.

Clarke _et al._ (1961) reporting on 53 broiler flocks surveyed during the period from February through May 1960 indicated that of 167 factors surveyed 33 were correlated to high condemnations. Among these thirty-three were (1) houses with inadequate ridge ventilators, (2) houses longer than 150 feet, (3) flocks showing poor feed conversion and (4) birds under five weeks of age when outside temperature dropped to a daily low of 13°F. or lower.

Clarke et al. (1961) further reported that in a particular study of flocks of a dealer with high condemnations that among other things the condemnation percentages were higher in broiler flocks over 7,000 in number and higher in broiler flocks grown out during the time of the year when the average weekly low temperature dropped below 45°F.

Clarke et al. (1961) also found in a comparison study of respiratory diseases that the combination of adverse environmental (management and weather) conditions with the presence of a disease resulted in higher condemnation percentages.

Performance Efficiency Index

According to United States Department of Agriculture Research Service (1962) the performance efficiency index is determined by dividing the body weight of broilers by the feed conversion. They indicate that a high performance efficiency index reflects efficient production.

Results of the Tenth Central Canadian Meat Test (1961) show the relationship of the performance efficiency index to good (low) feed conversion to weight of broilers. The highest performance efficiency index was equal in two commercial entries, each having a 168.4 index. One of these two entries had a 2.30 feed conversion; the males averaged 4.38 pounds each and the females 3.32 pounds each at 9 weeks of age. The other entry had a 2.39 feed conversion with the males weighing an average of 4.34 pounds each and the females 3.42 pounds each. This contrasted with a commercial entry with an index of 152.5 in which the males averaged 3.92 pounds each and the females 3.17 pounds each. The lowest performance efficiency index in the test was an experimental entry (Ottawa Meat Control) with a feed conversion of 2.39; the male averaged 2.89 pounds each and the females 2.35 pounds each at 9 weeks of age. The index for this entry was only 110.0, indicating the importance of having both a low feed conversion and high average weight per bird to secure a high performance efficiency index.

PROCEDURE

Data for this study were taken from office records of the contractor Dixie Grain Company, Shelbyville, Tennessee. Schedules were furnished (see Appendix) for this purpose. The schedules were completed by the fieldmen in each county - Fentress and Grundy. Records were taken at random from the files. Over one hundred grow-outs (broods) were selected for each type which involved 1,295,920 day-old chicks.

All broiler houses in this study were 40 feet wide. Regardless of the form in which the feed was fed it was mixed and delivered by the Dixie Grain Company. All chicks were supplied by the contractor. During the first nine months of the study, the chicks were of four stocks. Sixteen percent of all the chicks started consisted of Arbor Acre White Rock females X Vantres males; 22 percent Arbor Acre females X Indian River #4 males; 26 percent Nichols 108 females X Vantres males; and 36 percent Nichols 108 females X Indian River #4 males. During the last three months of the study some of the chicks started were Arbor Acre #50 White Rock females X Vantres males.

The first schedules secured were from chicks started August, 1960, and the last from chicks started July, 1961.

Supervision of brooding was by two men and their two co-workers who appeared to be comparable in experience and ability. All broilers in this study were processed in plants under United States Government inspection. The vaccination and medication program was carried out in all houses in a similar manner depending upon the situation prevailing at that particular time or season.

All houses were located on the Cumberland Plateau (Tennessee) at an elevation between 1500 and 2000 feet. There was on the average usually not more than 3 or 4°F. difference in the outside average weekly temperature between locations of houses in the two counties as determined from U. S. Weather Bureau Station reports. Temperatures used were secured from the weather stations at Alardt (Fentress County) and Monteagle (Grundy County), Tennessee.

The number of flocks involved in this study was as follows: insulated houses - 24, grow-outs - 95, and chicks started 707,000. For noninsulated houses there were 24 houses, 99 grow-outs, and 588,920 chicks started.

Linear regression curves were calculated for the data according to Snedecor (1956). The relationships of insulated and noninsulated houses to the outside average minimum temperature by months, for the five criteria of: percent mortality, weight of broilers sold, feed conversion, performance efficiency index, and percent condemnations were calculated.

All data were further tabulated to show interrelationships of insulated and noninsulated houses on the criteria such as type of brooder, length of house and number of chicks started per hover.

All calculations on feed conversion were based on live weight of broilers after condemnations loss were deducted. All tables and figures were based on the month the chicks were started in the brooder houses.

RESULTS

Mortality

A statistical study of brooder house chick mortality failed to significantly associate mortality with types of houses or with outside temperature. In relating broiler mortality to outside temperature in the two types of houses the simple gross correlation coefficient (r) for the groups in insulated houses was .413 while it was .433 for the group in the noninsulated ones. Regardless of the type of house the highest percent mortality occurred in broods started during the month of January while April ranked second in this characteristic. The broilers in the noninsulated houses had a mortality of 2.97 percent while those in the insulated houses averaged 2.75 percent (Figure 1, 2, 3).

The lowest percent mortality for any month was for broilers grown in the insulated houses and started in October. Chicks started in October in the insulated houses had a mortality of 0.8 percent, compared with a mortality of 2.2 percent for those reared in the noninsulated houses.

In comparing the mortality of broilers grown in insulated and noninsulated houses, the death loss was greatest for broilers produced in the noninsulated houses seven months out of twelve, during one month out of twelve the percent mortality was the same (Figure 3 and Appendix, Table I). The average percent mortality for broilers brooded in the insulated houses was 2.75

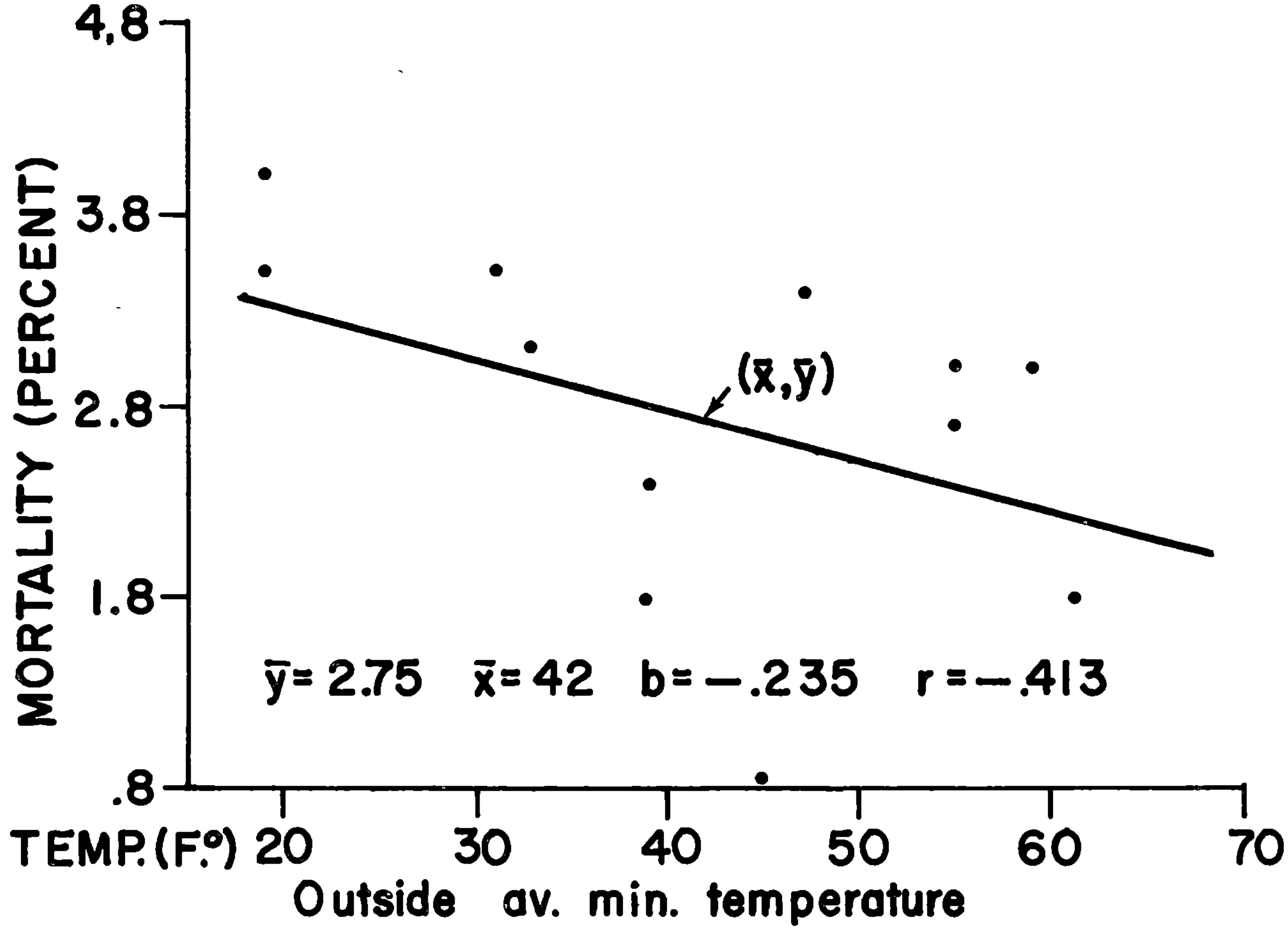

Figure 1. Relationship of broiler mortality percentage to outside av. min. temperature, insulated houses. Source: Table 1.

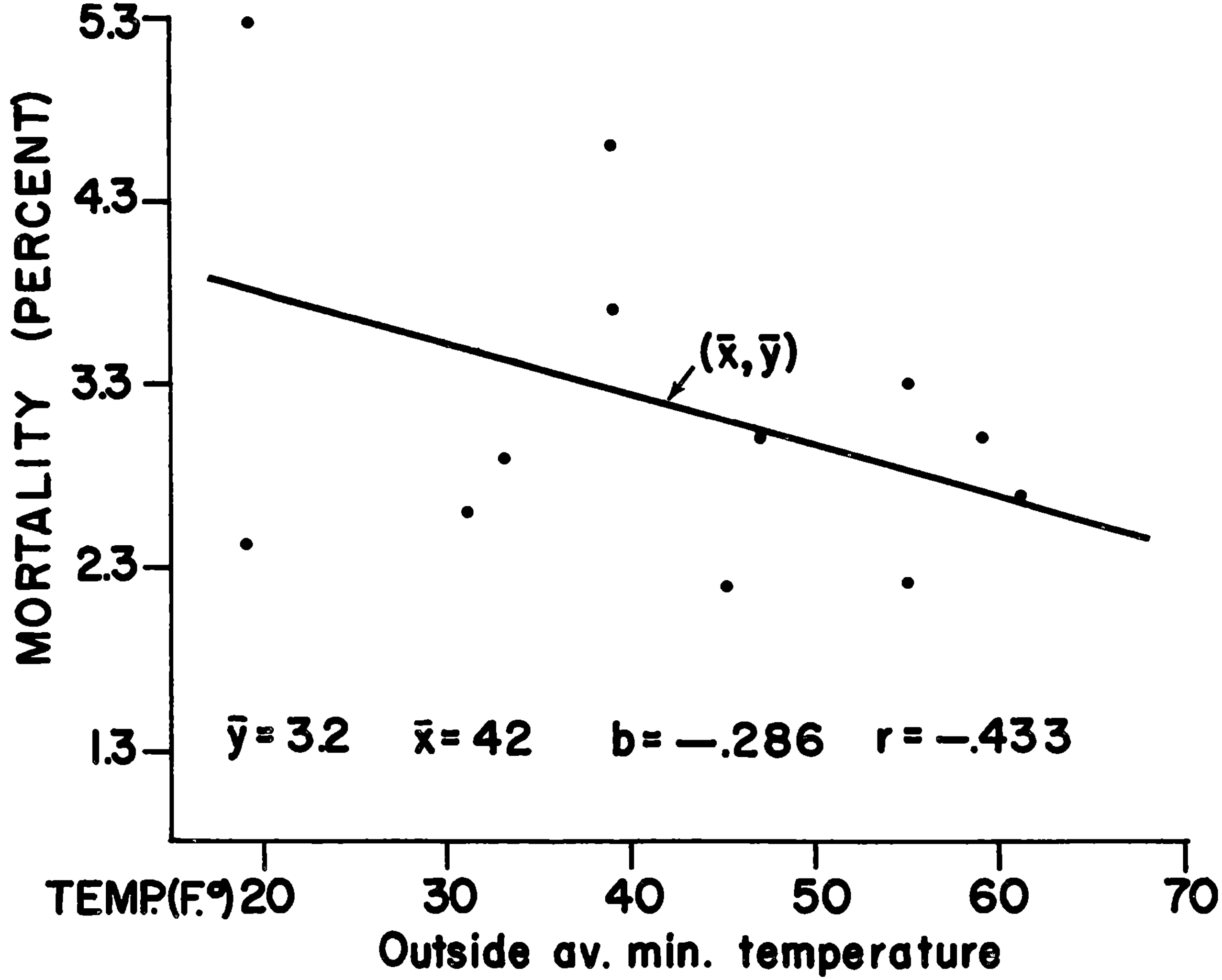

Figure 2. Relationship of broiler mortality percentage to outside av. min. temperature, noninsulated houses. Source: Table 1.

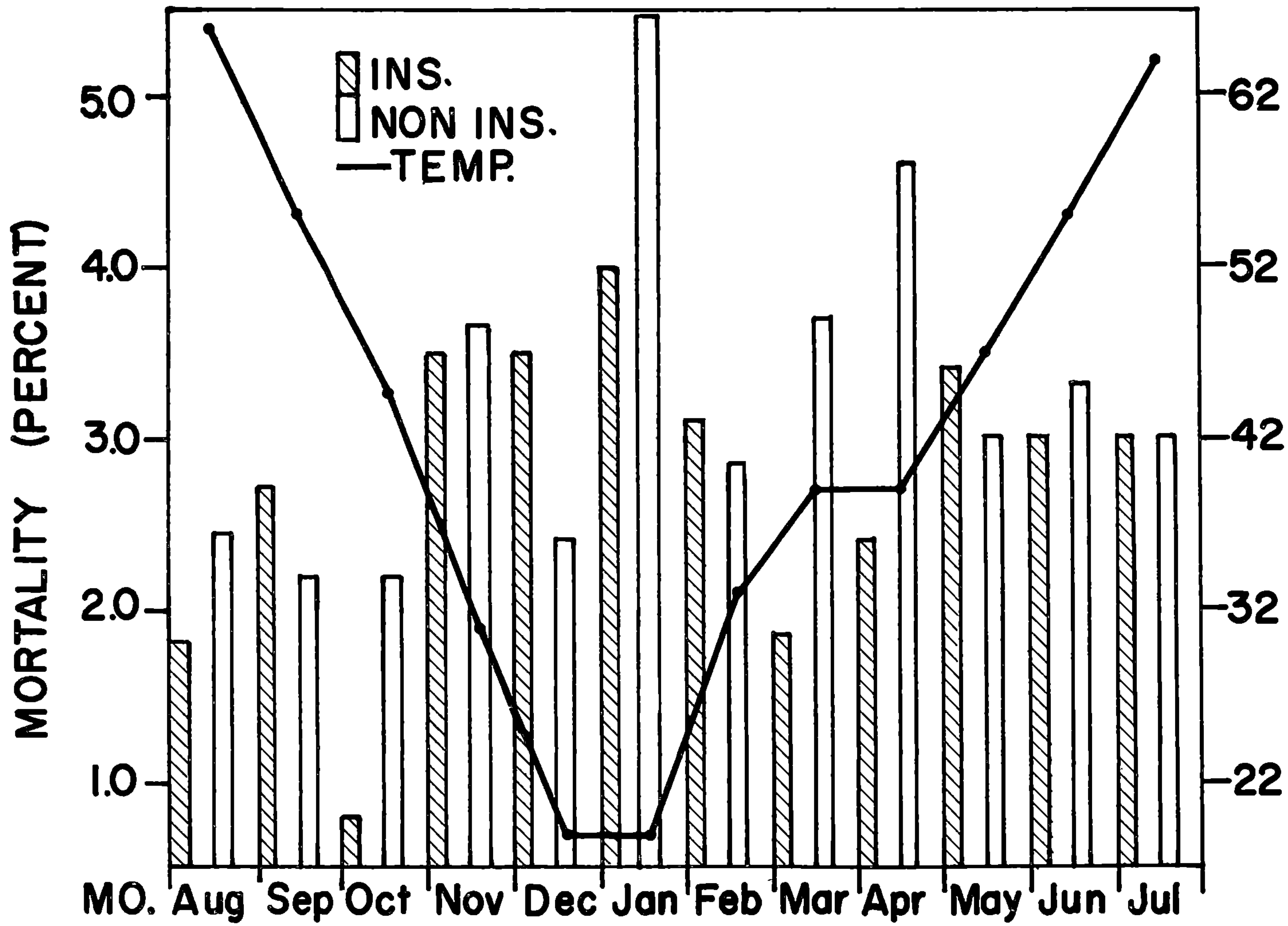

Figure 3. Broiler mortality percentage by month of starting 194 broods, and outside av. min. temperature, insulated and noninsulated houses. Source: Table 1.

percent while the broiler mortality in the noninsulated houses was 3.20 percent (Appendix, Table I).

As shown in Appendix, Table I and II, the percent mortality generally was greatest for chicks started during the periods of low temperature and smallest for chicks started when the temperature was high.

Data indicate, that on the basis of chick mortality a greater loss may be expected to occur when chicks are started in cold weather, October through March, but the insulation of houses tends to decrease the mortality rate four out of six of these months (Figures 1, 2, 3).

These observations are confounded by type of brooder or source of heat, length of house, and number of chicks started under each hover.

The lowest percent mortality for the year occurred in insulated houses in which coal brooders were used, while the next lowest percent mortality occurred among broods where a central heating system was used. Broiler mortality under coal type brooders in noninsulated houses and oil brooders in insulated houses ranked third. This ranking was not influenced by type of house. A factor for consideration is that gas brooders were supplemented by additional heat (coal) in houses where gas brooders were used.

The number of chicks started under a hover had no direct relation to percent mortality whether under 600 or 800 and over were started per hover, or whether the chicks were brooded in insulated or noninsulated houses.

The length of house showed no direct relationship to percent broiler mortality as shown in Appendix, Table I.

Weight

Weight of broilers at market time was associated with type of housing used in broiler production. Figure 4 and 5 shows the relation of weight to outside temperature by type of houses. This difference is evidenced by the r of .318 for insulated houses and an r of .677 for the noninsulated. This latter r value of .677 is significant at the 5 < P.E.

As shown in Figure 4, the average weight of broilers at market time was in favor of the noninsulated houses 9 out of 12 months. The greatest variation of average weight per broiler was for the chicks started in the months of September and February, when the difference was approximately .4 pound per bird in favor of broilers grown in noninsulated houses. Only for the chicks started during October, December, and March did the average weight per bird favor broilers grown in the insulated houses. The maximum differences in bird weight, which occurred during those 3 months was 0.25 pound, and occurred in the October started chicks (Figure 4, 5, 6).

The greatest average weight per broiler was for those grown in noninsulated houses under gas type brooders. While there were only 13 broods in this group, they averaged 4.00 pounds each.

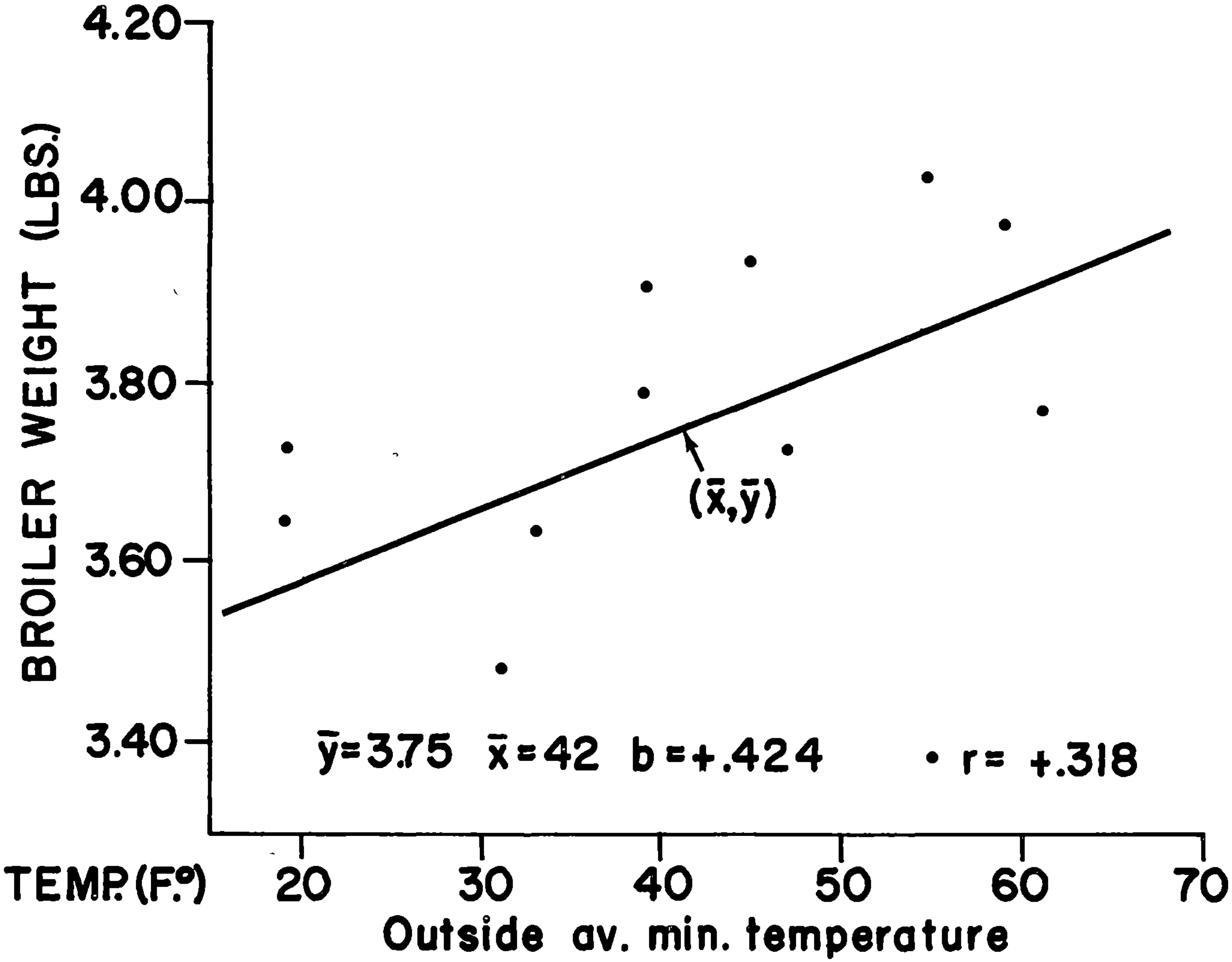

Figure 4. Relationship of broiler weight to outside av. min. temperature, insulated houses. Source: Table 4.

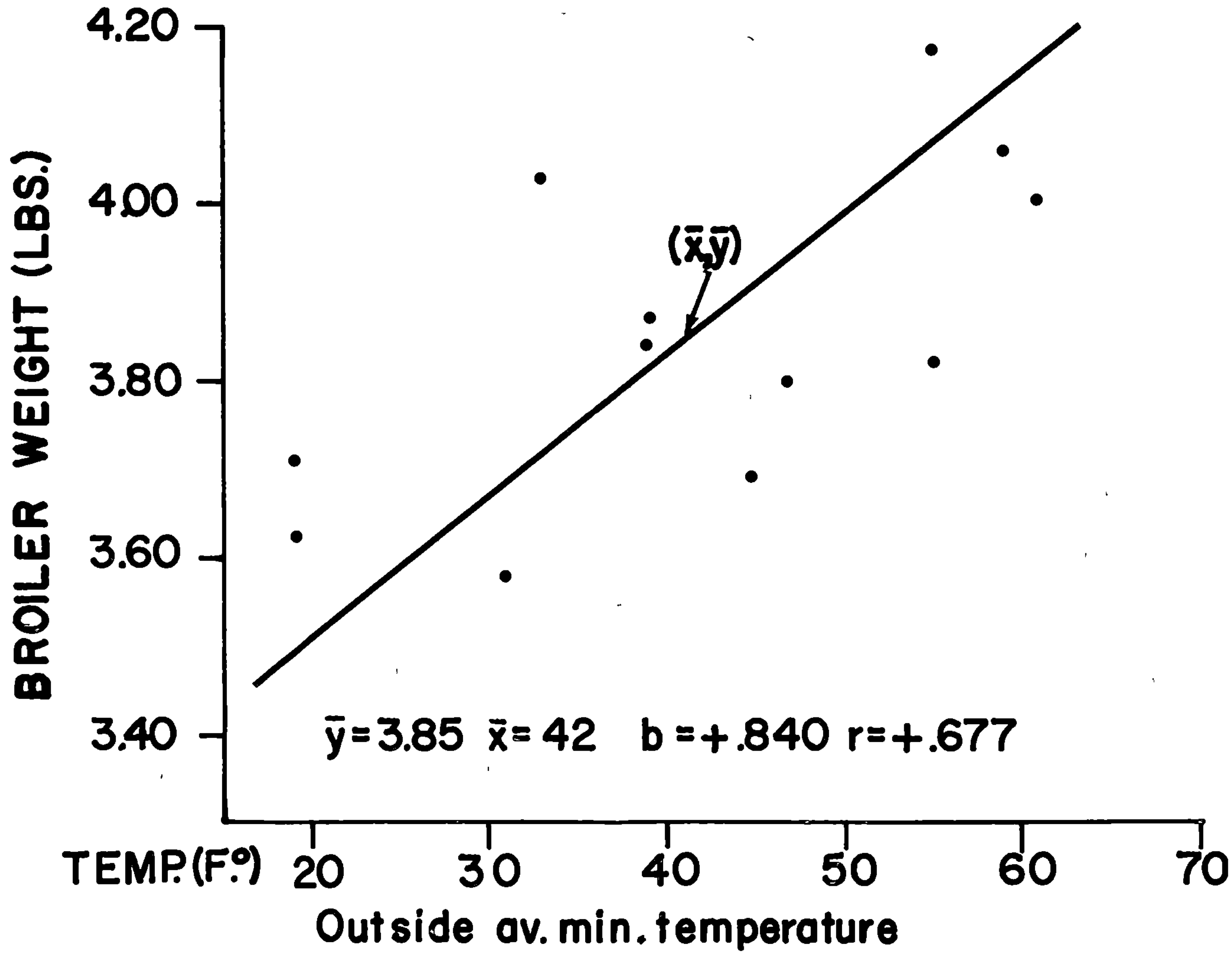

Figure 5. Relationship of broiler weight to outside av. min. temperature, non-insulated houses. Source: Table 4.

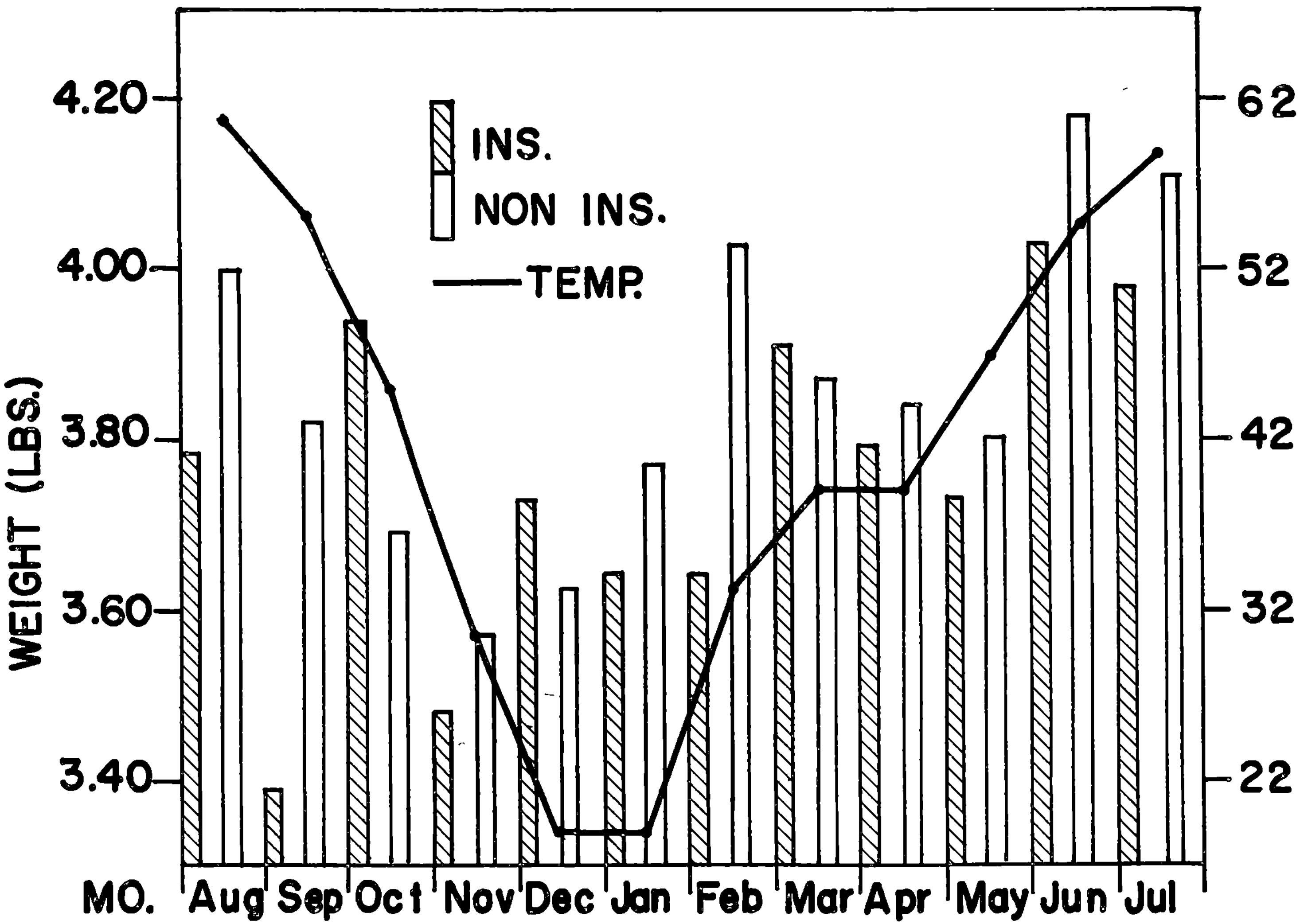

Figure 6. Average broiler weight by month of starting 194 broods, and outside av. min. temperature, insulated and noninsulated houses. Source: Table 4.

The heaviest birds grown in insulated houses were those produced under the oil brooders, with an average weight of 3.89 pounds each. The use of coal brooders in the insulated houses resulted in the smallest average weight per bird, 3.70 pounds. The average weight of broilers grown in all other brooders was fairly close to the average for all broods with no definite trend above or below that average (Appendix, Table IV).

For the year, the heaviest broilers, averaging 3.96 pounds per bird, were produced in noninsulated houses 100-149 feet in length. The lowest average weight of 3.48 pounds per broiler was for those grown in noninsulated houses 200 feet or longer in length. In the noninsulated houses, there was a trend toward lighter weight broilers the longer the length of the houses. No definite trend was evidenced in the insulated houses, (Appendix, Table V).

The number of chicks per hover showed little relationship to average live weight of broilers produced, regardless of the type of house. The heaviest birds (4.00 pounds per broiler) were produced in noninsulated houses under hovers with 800 chicks or more per hover. The lightest birds (3.65 pounds per broiler) were grown in the insulated houses with 600 to 699 chicks per hover (Appendix, Table VI).

Feed Conversion

Feed conversion was significantly associated with outside temperature in noninsulated houses. Figure 7 shows a simple regression correlation of .264 for feed conversion related to outside minimum temperature in the insulated houses. Figure 8, in contrast, shows a correlation of .554 for the noninsulated houses. This latter r value of .554 is significant at the $10 < \text{P.E.}$

Figure 9 shows that the poorest feed conversion for broilers grown in insulated and noninsulated houses occurred for those started during the month of December. For insulated houses, the poorest feed conversion was for the chicks started in October. For noninsulated houses, the poorest feed conversion was for those chicks started in December (Figures 7, 8, 9).

Broilers showing the highest feed conversion were generally those started during the months when the outside average minimum temperature was decending.

The greatest contrast in feed conversion, by type of house, was found for chicks started in April and September. In September, there was an average of .16 pound per bird difference in favor of noninsulated houses. For chicks started in April, there was an average of .2 pound per bird difference in favor of the insulated houses. Chicks started in all other months exhibited little difference between feed conversion of broilers grown in insulated and noninsulated houses, regardless of month or outside temperature.

Type of brooder showed no defininte relationship to feed conversion for broilers produced in insulated or noninsulated

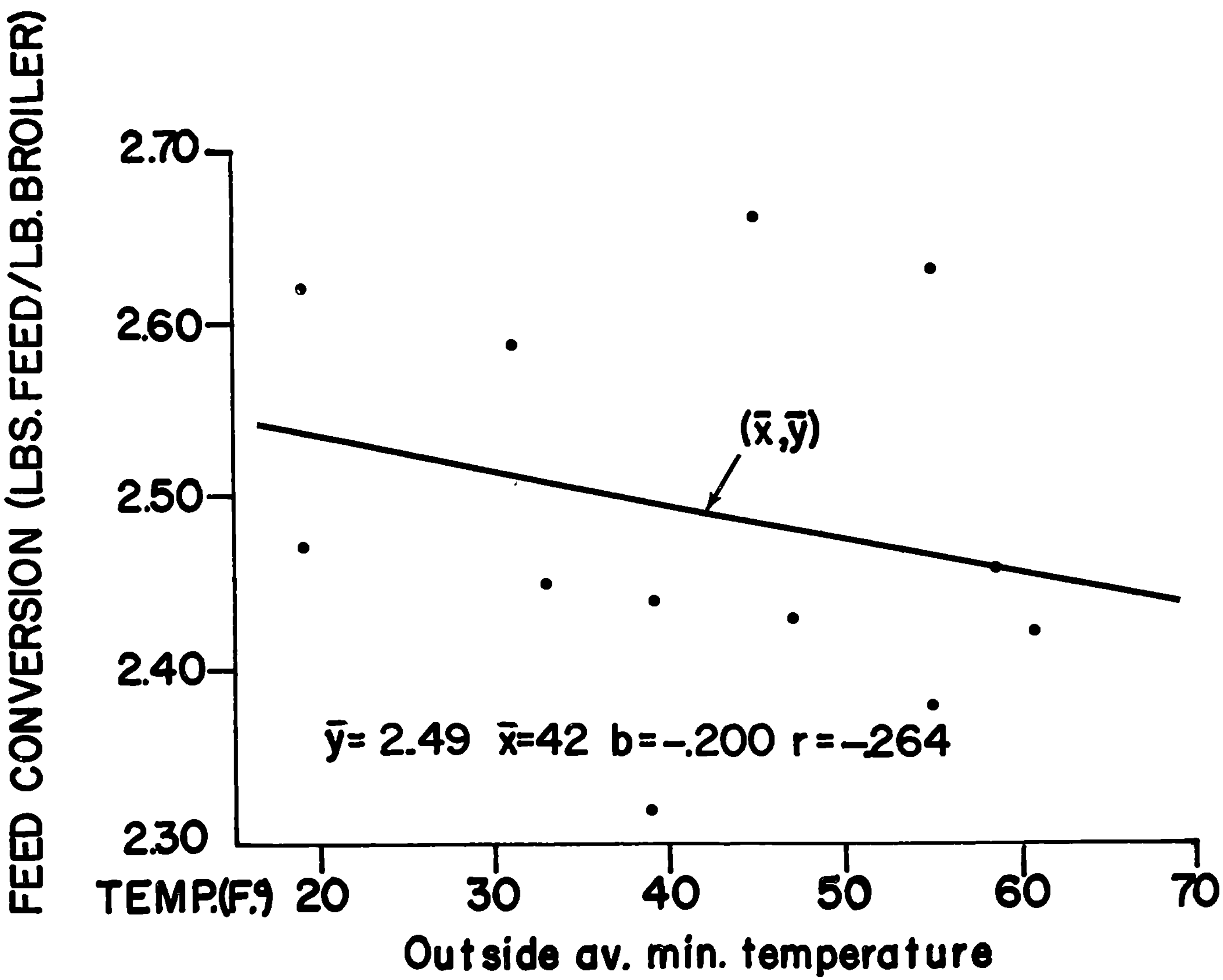

Figure 7. Relationship of feed conversion to outside av. min. temperature, insulated houses. Source: Table 7.

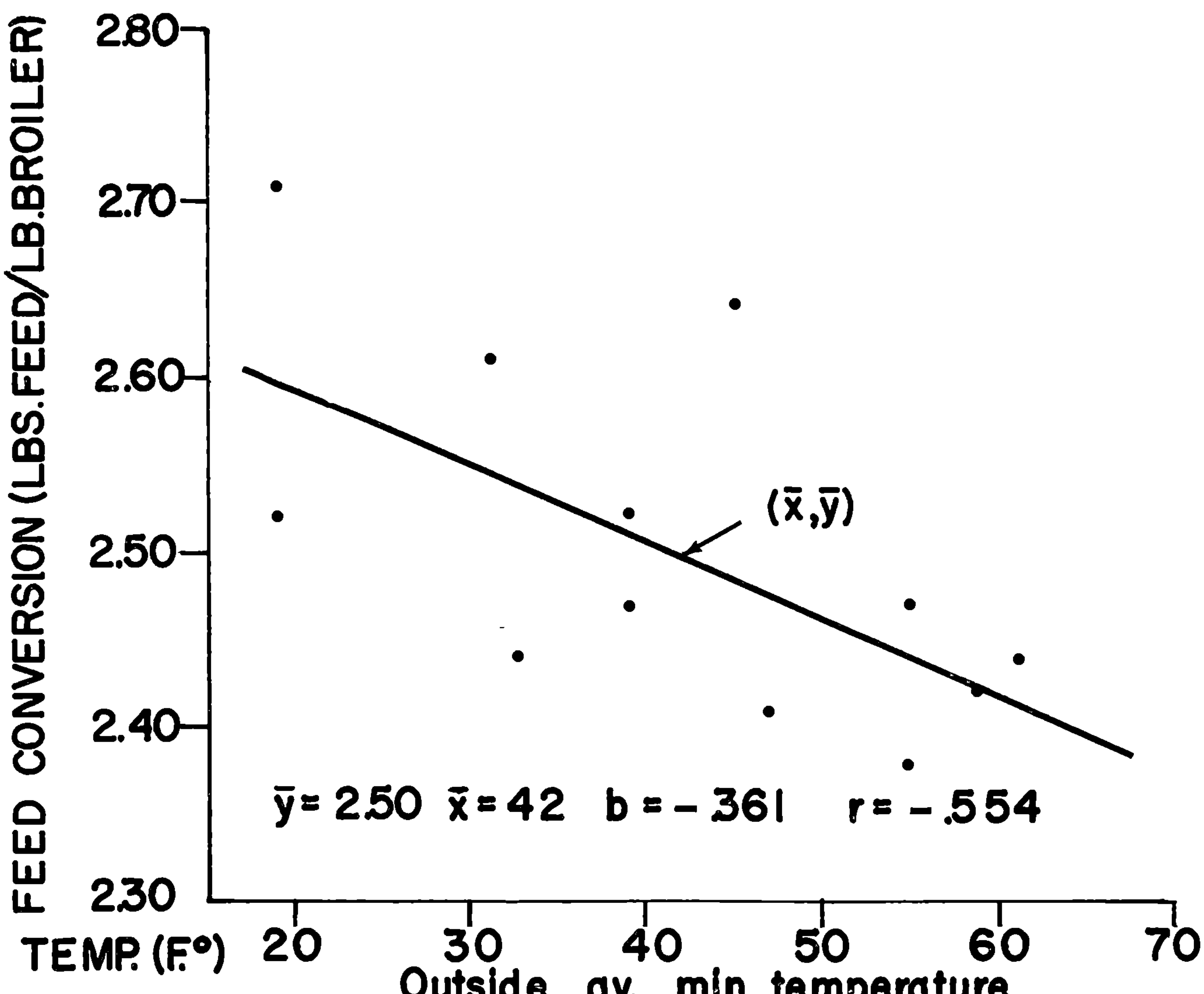

Figure 8. Relationship of feed conversion to outside av. min. temperature, noninsulated houses. Source: Table 7.

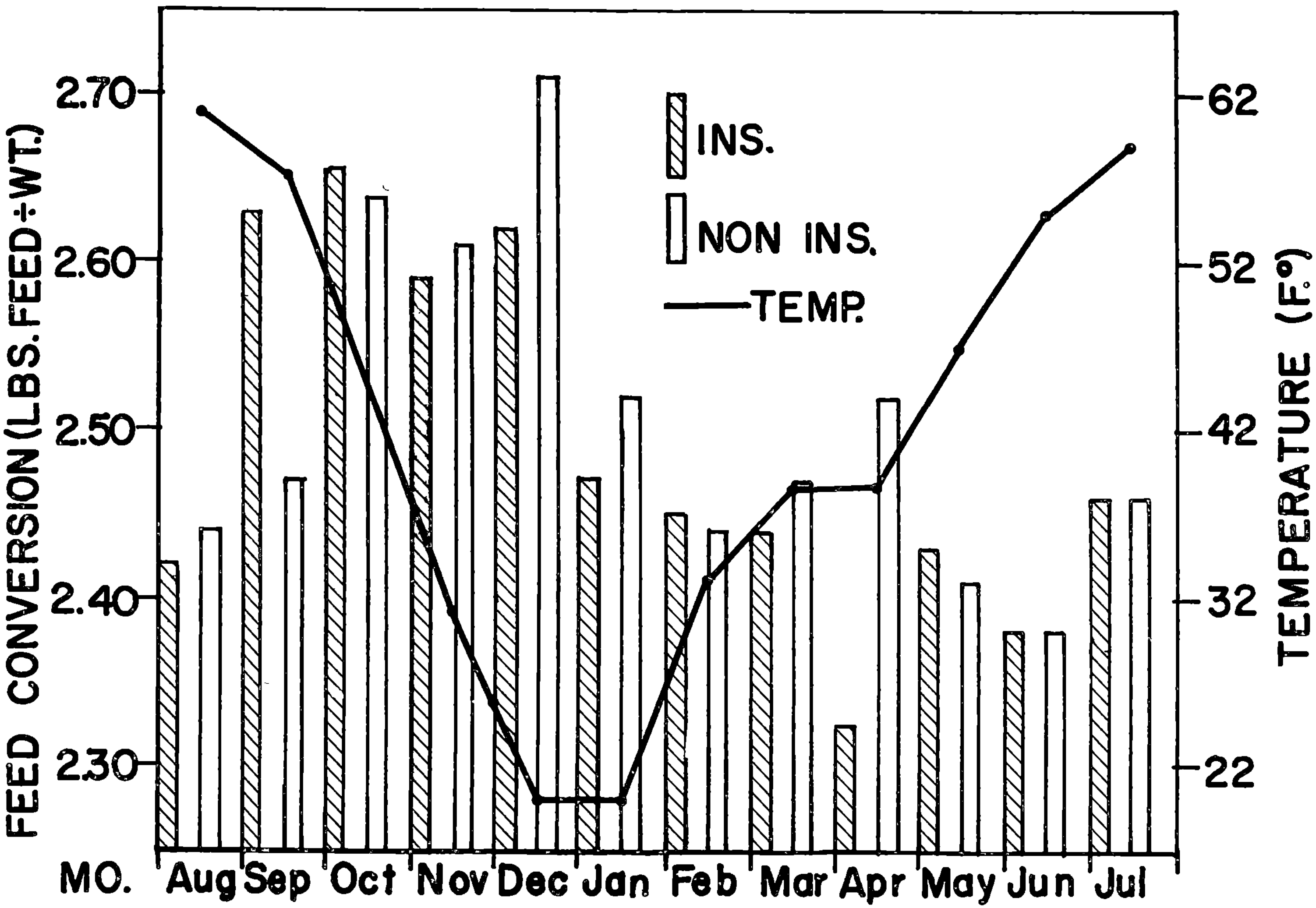

Figure 9. Feed conversion by month of starting 194 broods, and outside av. min. temperature, insulated and noninsulated houses. Source: Table 7.

houses. The best feed conversion (2.40 pounds) was obtained under oil brooders in insulated houses, the poorest (2.54 pounds) was under gas brooders in noninsulated houses (Appendix, Table VII).

Feed conversion of chicks grown in noninsulated houses showed a slight trend in favor of broilers brooded in shorter length houses (Appendix, Table VIII). Broilers in the insulated houses, 100-149 feet in length, had the lowest feed conversion of all houses, either insulated or noninsulated. There was no direct relationship between length of house and feed conversion of broilers in insulated houses.

When broods were divided in groups, by number of chicks per hover, no significant relationship was found between the number of chicks per hover and feed conversion. The difference in feed conversion between groups ranged from a low of 2.40 for under 600 chicks per hover, to 2.54 with 600-699 per hover, in insulated houses; in noninsulated houses the range was from 2.43 with 600 to 699 per hover, to 2.53 for those with 800 and above per hover.

Performance Efficiency Index

A tabulation was made of the relationship of broiler performance efficiency index to outside temperature. The simple gross regression correlation between these two factors was .561 for broilers grown in insulated houses and .678 for those grown in noninsulated houses, shown in Figures 10 and 11. These correlations were significant at the 10 and 5 < P.E., respectively.

The eleven top performance efficiency index ratings, as an average for all broods, were when chicks were started in August and from February to July (Appendix, Table X). The highest production efficiency indices in both insulated and noninsulated houses occurred during the month of June, being 172 and 170, respectively (Appendix, Table X). In Figure 12, it is further observed that for all houses, regardless of type, the very lowest performance indices were when chicks were started in November and December. The lowest index (133) was for chicks started in noninsulated houses in December (Figures 10, 11, 12).

Figure 12 shows the trend toward higher performance efficiency for chicks started during the months when outside average minimum temperatures were ascending. A similar relationship existed for broiler weight (Figure 6) and for feed conversion data as shown in Figure 9. It was expected to find these factors to be closely related since performance efficiency index is determined by dividing the average broiler weight by average feed conversion.

When considering type of brooder and performance efficiency index, as an average for all broods for 12 months, the broilers grown under the coal brooders had the best performance. The average performance efficiency index for the coal type brooders was 160, as contrasted with a 145 index for the central heating system. This is a 15 point difference in favor of coal brooders over central in noninsulated houses. There was no significant

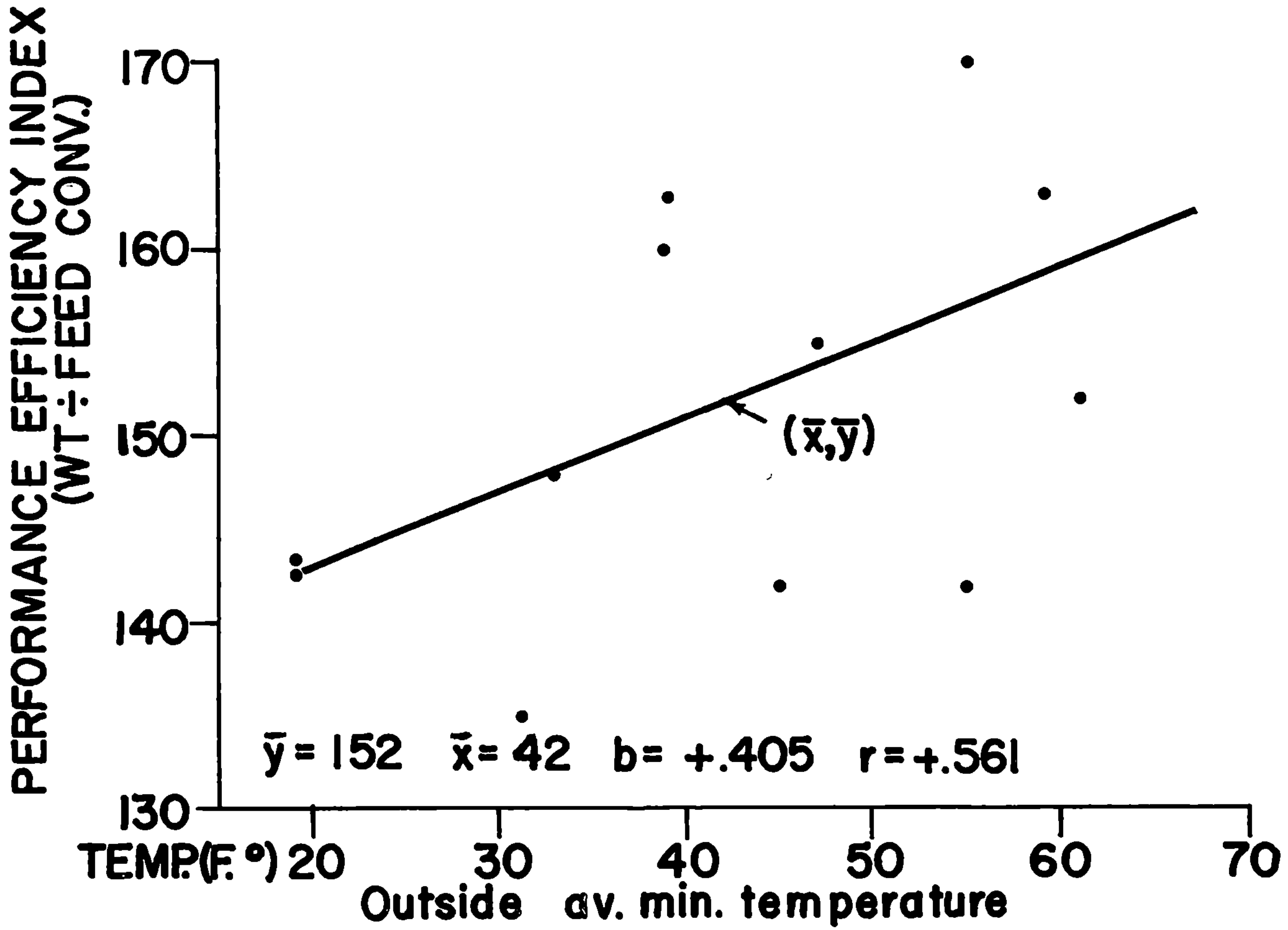

Figure 10. Relationship of performance efficiency index to outside av. min. temperature, insulated houses. Source: Table 10.

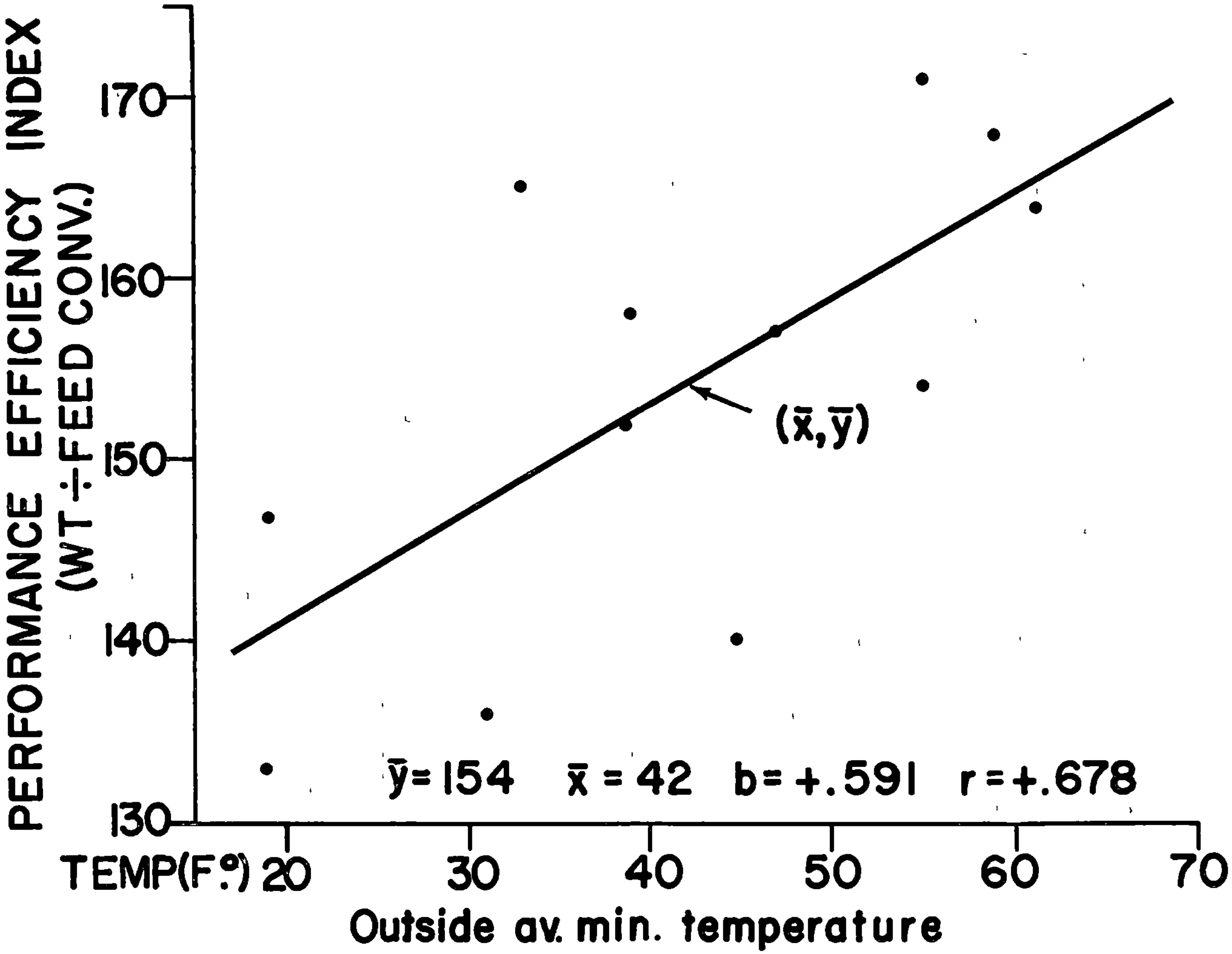

Figure 11. Relationship of performance efficiency index to outside av. min. temperature, noninsulated houses. Source: Table 10.

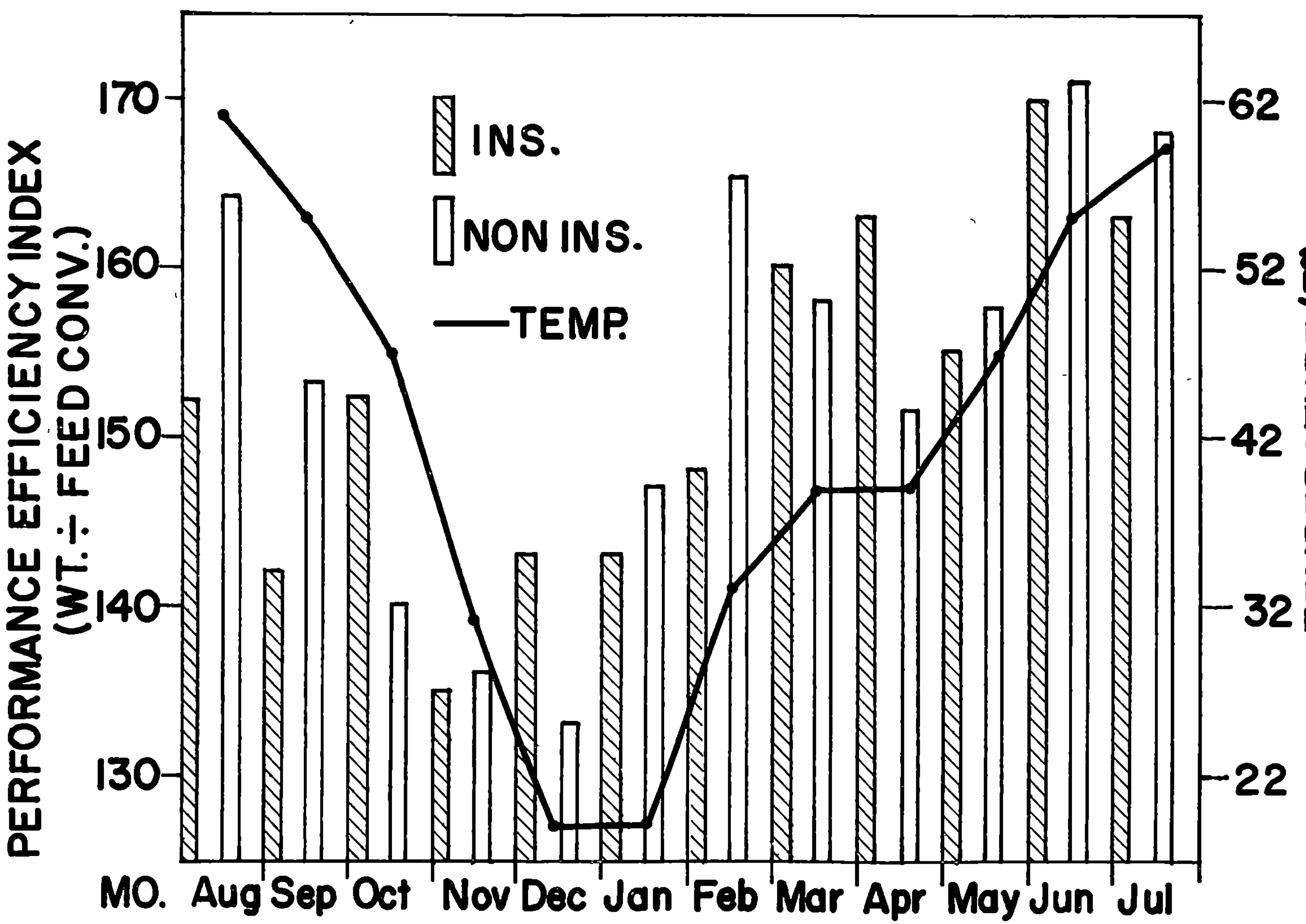

Figure 12. Performance efficiency index by month of starting 194 broods, and outside av. min. temperature, insulated and noninsulated houses. Source: Table 10.

difference in the performance efficiency index for broilers grown by type of brooder in the insulated houses (Appendix, Table X). First ranking was for oil brooders in insulated houses, with 161. The second ranking brooder, for high index, was for gas with 158 in noninsulated houses. With the exception of the 161 index for chicks grown under oil brooders (only 5 reported) in insulated houses, the other type brooders produced broilers giving an index of 151 or 152 (Appendix, Table X).

Although the differences are not great, there is a trend in performance efficiency index in noninsulated houses to be related to house length from the shorter to the longer houses. There was a significant difference between those broilers grown in houses 100-149 and those grown in houses 200 feet and over (Appendix, Table XI).

Number of chicks per brooder and performance efficiency index showed no consistant relationship. For example, the broilers in insulated houses, with under 600 chicks per hover, had an index of 157, while the birds in noninsulated houses, with 800 chicks and over per hover had an index of 160. In insulated houses, the performance efficiency index decreased from 157, for the houses with under 600 chicks per hover, to 145 for those houses with either 600-699 or 700-799 chicks per hover. In noninsulated houses, the highest performance efficiency index (160) was in houses with 800 and over chicks per hover, while the houses with 700-799 chicks per hover had the lowest index (153), (Appendix, Table XII).

When considering type of brooder and performance efficiency index, as an average for all broods for 12 months, the broilers grown under the coal brooders had the best performance.

Condemnations

Percent condemnations are determined after broilers leave the house and the chickens are either condemned ante-mortem or post-mortem at the processing plant. Not all, but most condemned birds are a total loss. Some may be salvaged in the plant, but this salvage operation requires extra labor and adds extra cost to the finished product. As stated in the review of literature, condemnations cost the United States broiler industry over 100 million dollars annually. This loss is absorbed by the industry and by the consumer.

When broiler condemnation percentages were correlated to outside temperature, no significant relationship was found to exist in either insulated or noninsulated houses. The simple gross correlation coefficient for the above relationship was .220 in insulated houses and .160 in noninsulated houses (Figures 13, 14, 15). This observation is comparable to data presented in Figure 17 which shows a correlation of .095 for Tennessee broiler condemnations,[4] as related to average minimum outside temperature. In contrast, the United States average condemnations for the period, August 1960 to July 1961, shows a regression

[4]Broilers processed in Tennessee under USDA Inspection Service.

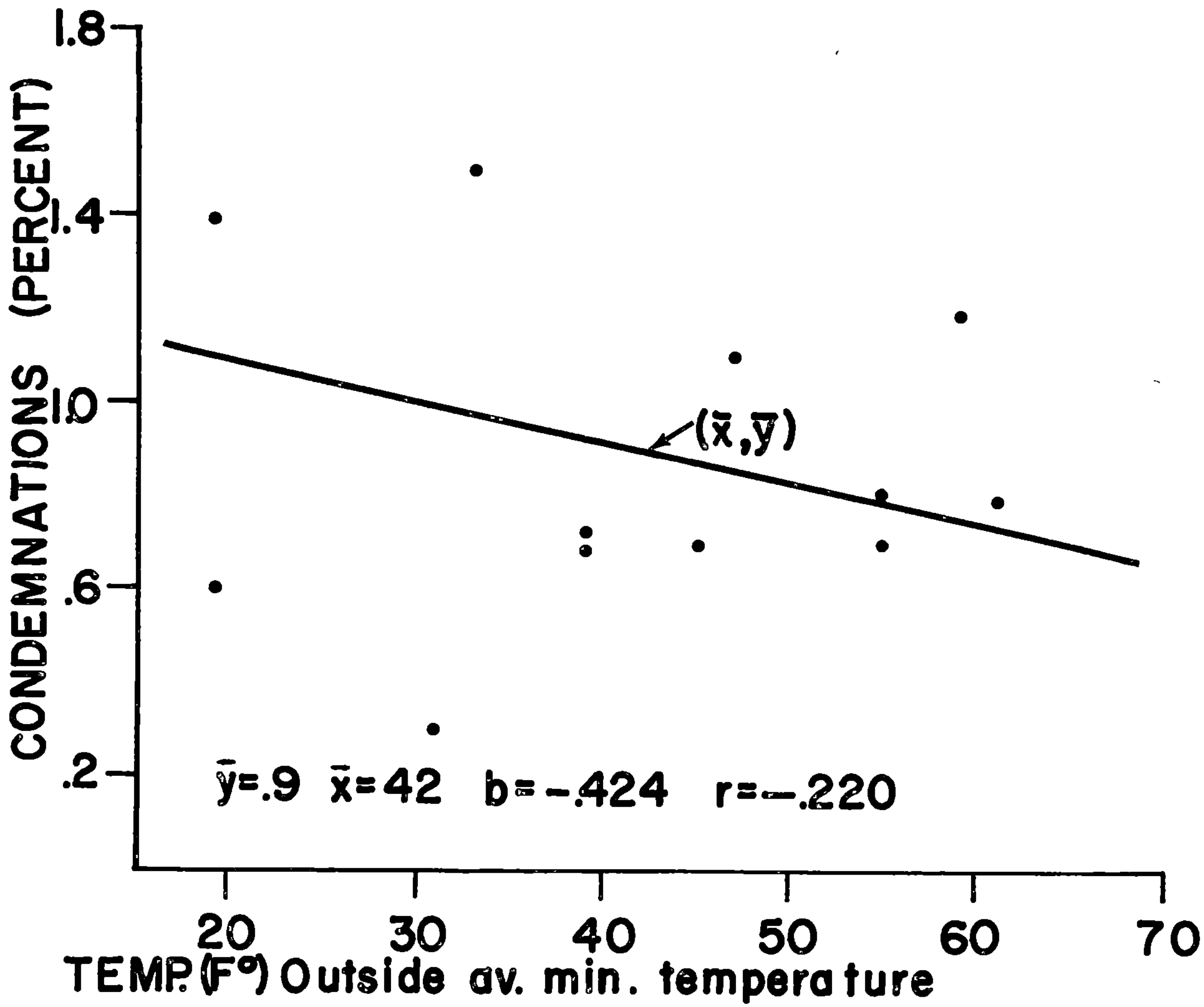

Figure 13. Relationship of percent condemnations to outside av. min. temperature, insulated houses. Source: Table 13.

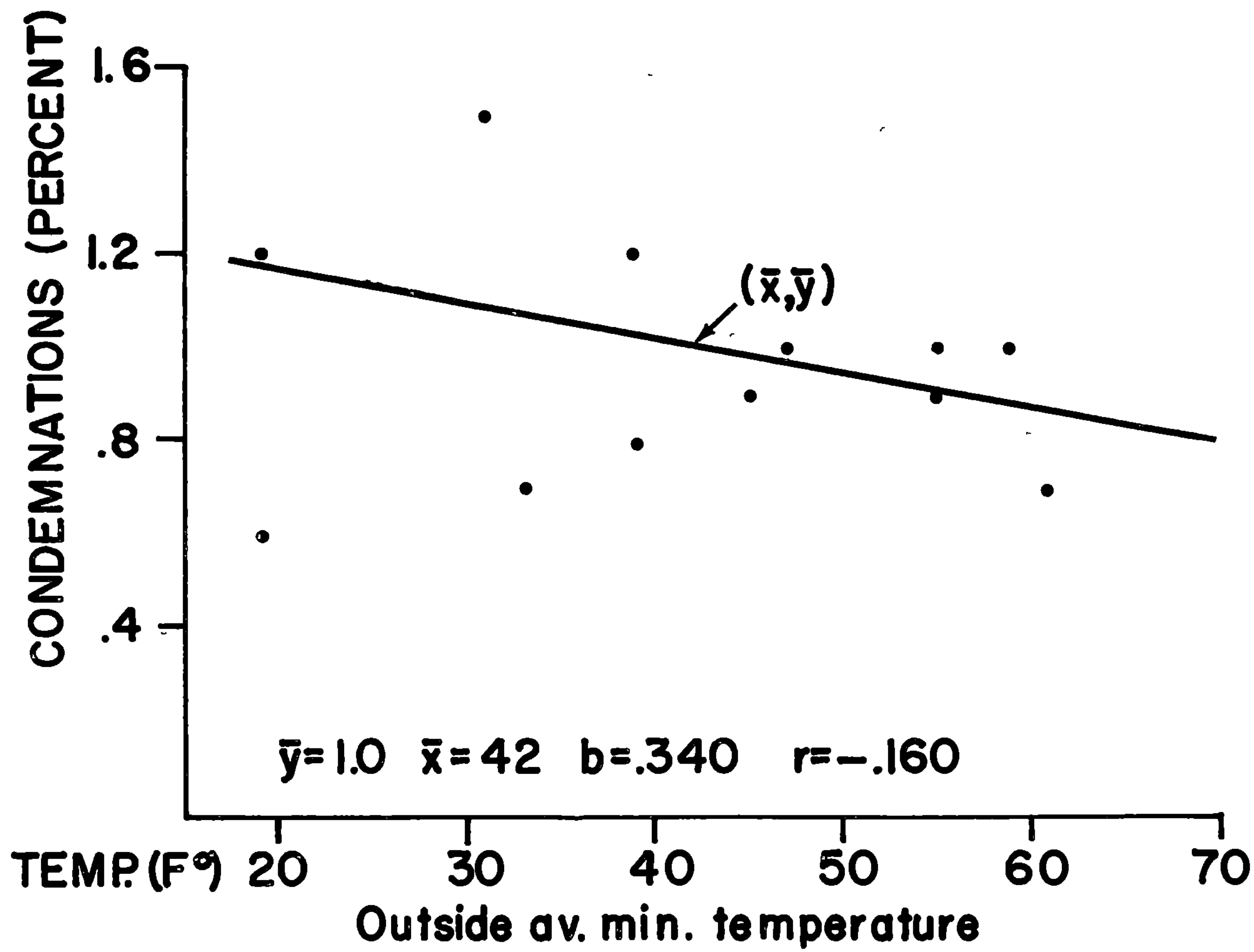

Figure 14. Relationship of percent condemnations to outside av. min. temperature, noninsulated houses. Source: Table 13.

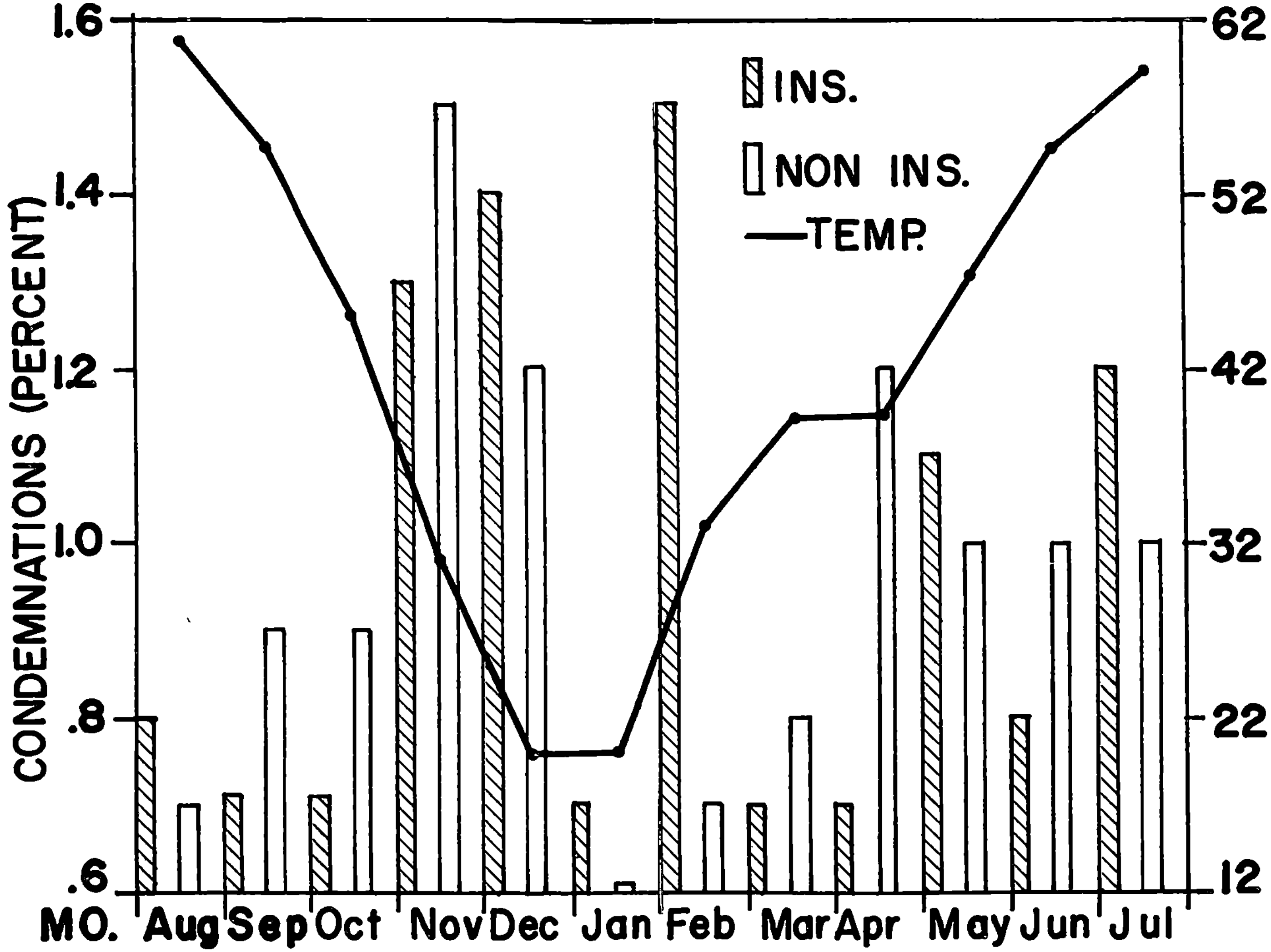

Figure 15. Condemnations percentage by month of starting 194 broods, and outside av. min. temperature, insulated and noninsulated houses. Source: Table 13.

correlation of .765 (about 58 percent of the variability in condemnations was associated to outside average minimum temperature). This is highly significant at 1 < P.E. (Figure 18). The influence of type of house and temperature on percent condemnations of broilers, according to the month in which the 194 broods were started, is shown in Figure 15 and Appendix, Table XII.

The overall percentage of condemnations for the year in this study was low, averaging less than 1 percent. The greatest percent condemnations for any one month, considering all types of houses, was 1.5 percent. This loss was reported for chicks started during November, in noninsulated houses, and during February in insulated houses. The percent condemnations, by months when chicks were started, had no consistant relationship to type of house (Figure 15 and Appendix, Table XIII).

Even though eratic, all condemnation rates reported in this study are well below the averages for Tennessee and the United States for the same period; the averages in both Tennessee and the United States being 2.1 percent (Figures 17 and 18).

The average percent condemnations during the year of this study for broilers, supervised by the Dixie Grain Company, was .96 percent. Condemnations due to airsacculitis accounted for some 51 percent of all condemnations in Tennessee during the year 1961 (Figure 16). Condemnations due to air sac infections showed a high degree of correlation with outside temperature

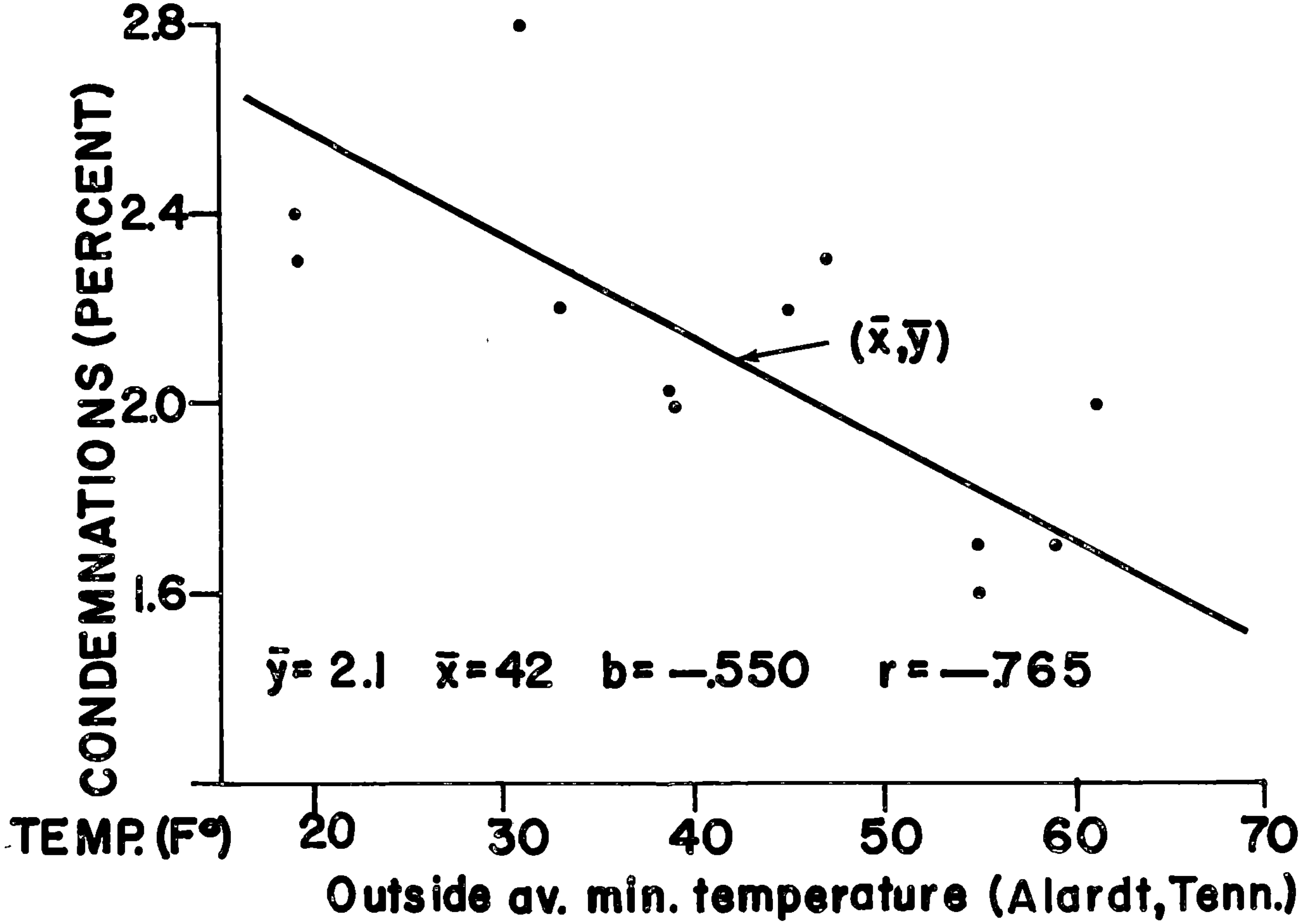

Figure 16. Relationship of condemnation percentage to outside av. min. temperature, U. S., August 1960 to July 1961. Source: USDA Statistical Reporting Service.

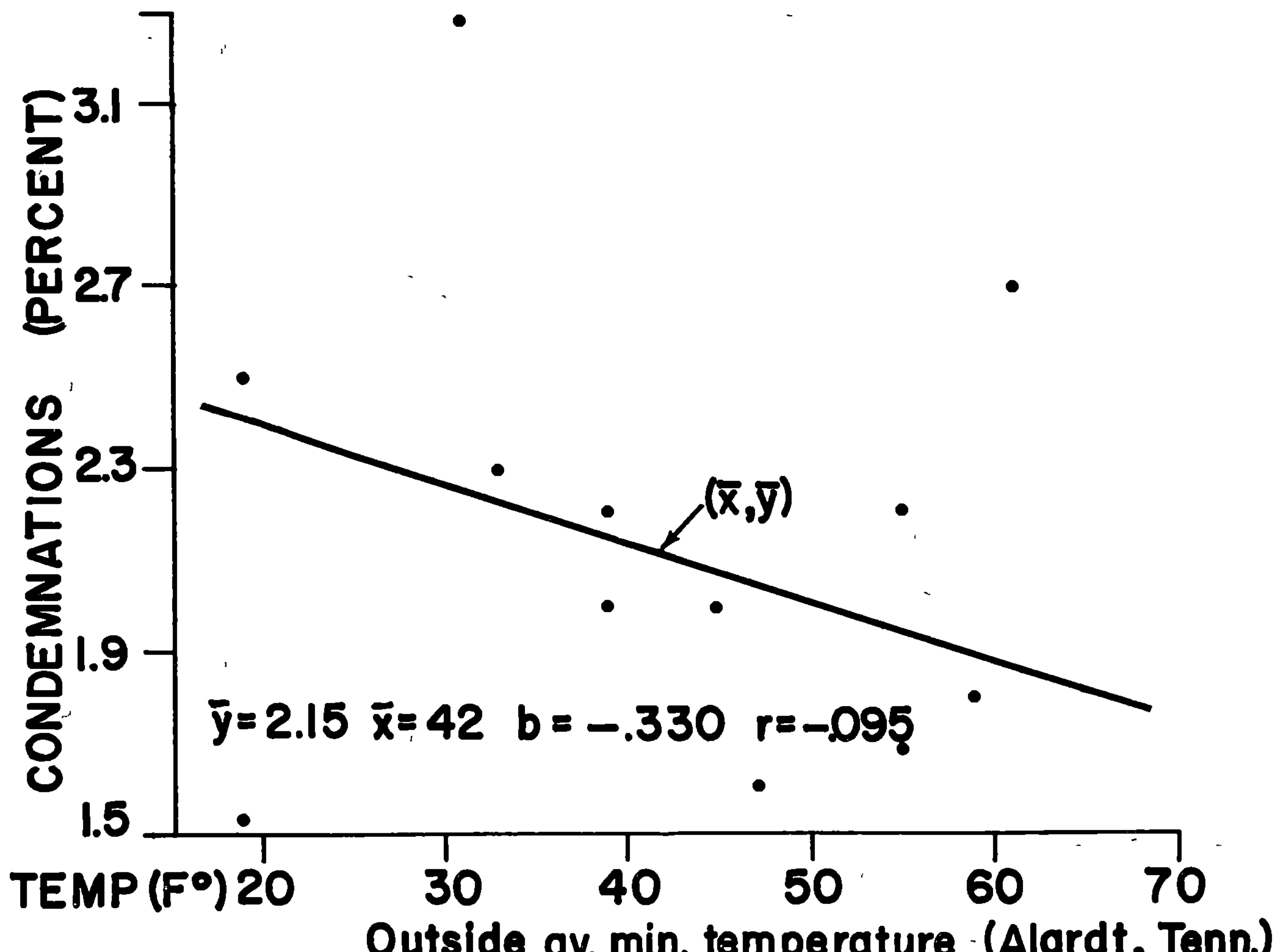

Figure 17. Relationship of condemnation percentage to outside av. min. temperature, Tennessee, August 1960 to July 1961. Source: USDA Statistical Reporting Service.

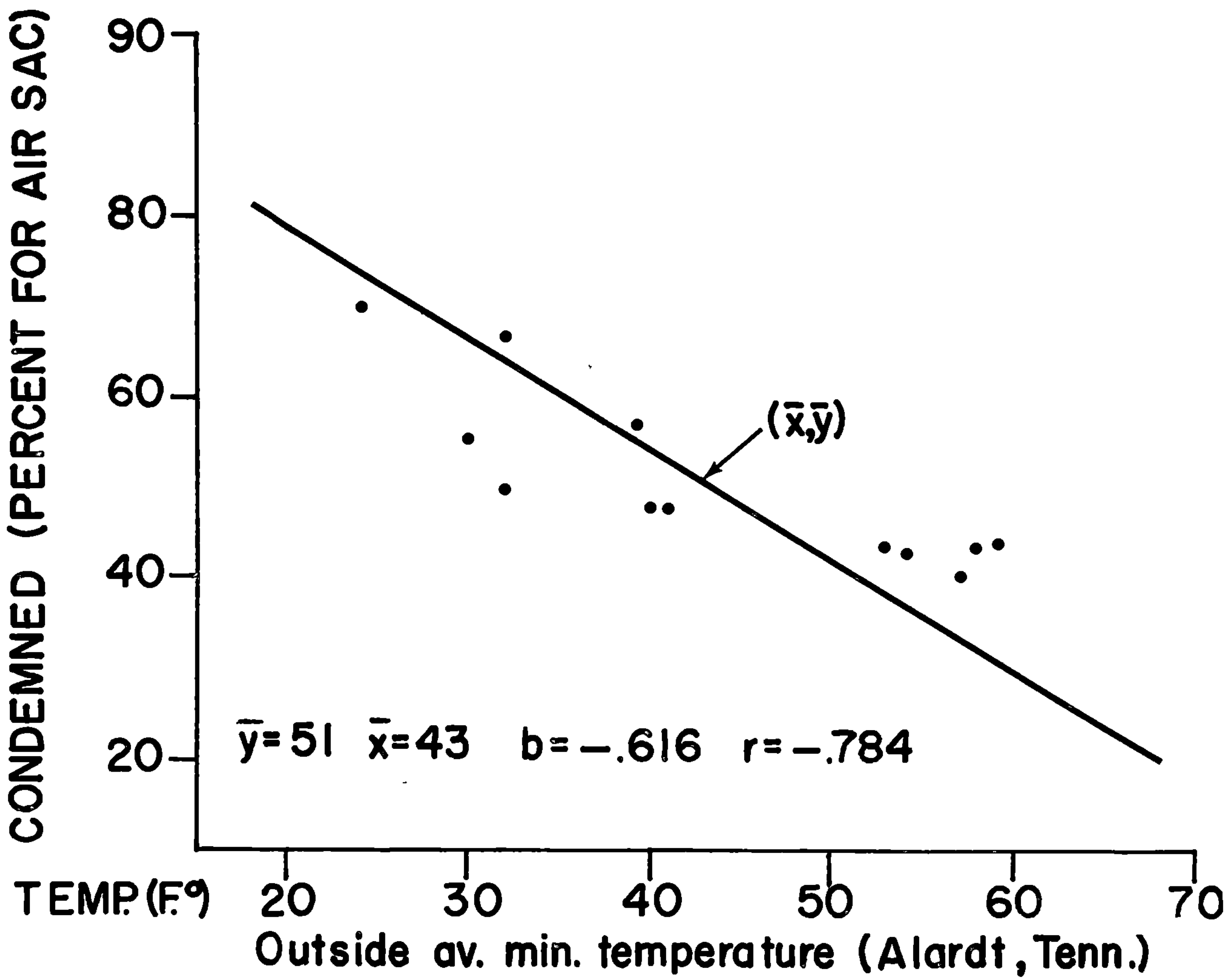

Figure 18. Relationship of condemnation percentage due to air sac infection is of total condemnations, Tennessee, 1961, and outside av. min. temperature. Source: USDA Statistical Reporting Service.

(Figure 16). The simple gross correlation coefficient of .784 is highly significant (1 < P.E.).

No significant difference in percent condemnations for broilers was found between insulated and noninsulated houses, being .95 percent and .96 percent, respectively (Appendix, Table XIII).

No significant relationship between percentage condemnations and type of brooder in insulated houses was found (Appendix, Table XIII). In noninsulated houses, the percentage condemnations were highest (1.0 percent) under the coal brooders and lowest (.7 percent) under the central system of heating.

Percentage condemnations as related to number of chicks per hover showed no conclusive trends in either type house. Chicks reared in insulated houses, with 800 chicks and over per hover, had the lowest (.7 percent) condemnations. Ranking second in insulated houses was a condemnation rate of .8 percent, when there were 600 or under chicks per hover. The same eratic picture was found for noninsulated houses, where 700-799 chicks per hover ranked first, with a .6 percent condemnation rate and under 600 chicks per hover ranked second with .9 percent.

DISCUSSION

In this study, chick mortality was not found to be related to type of broiler house (insulated or noninsulated) or to outside temperature (Figures 1 and 2).

Prince *et al.* (1961) found that mortality was unaffected by environmental temperatures of 45°F. or 75°F. Prince also found no difference in percent mortality of birds vaccinated against bronchitis and maintained in houses ventilated at 3/4 and 2 cfm. per bird.

Weight gain of broilers was found to be associated with type of house and outside temperature. In the insulated houses the correlation was only .318, but for noninsulated houses the correlation was .677. This is about 46 percent of the weight difference associated with outside temperature in the noninsulated houses. This might have been anticipated in light of the prior reports. Kleider and Daugherty (1934), Kempster and Parker (1936), Winchester and McKleiber (1938), Squibb, *et al.* (1961) and Adams *et al.* (1961) reported adverse effects of higher temperatures on broiler weight gain or growth rate.

The higher outside temperatures in these studies were above the temperatures of 60°F. or 70°F. which are often recommended by poultrymen for broilers four to five weeks of age. However, the temperatures recorded during the winter months are below those suggested.

Prince *et al.* (1960) pointed out that even though additional feed was consumed by chicks to maintain body temperature when held in cabinets at 45°F., there was no appreciable effect on weight gain. This additional feed would adversely effect feed conversion. This relationship has been shown by others and is assumed to have occurred in this study, but since no records of temperature were kept inside the houses such a conclusion in this study would be invalid.

Baxter and Shirley (1961) reported broiler growth (rate of gain) was greatest in a conventional brooder house, compared with a windowless and a solar house.

Rokeby and Nelson (1962) stated that not much, if any, increase in broiler productivity (growth) through insulation and mechanical ventilation should be expected. Although laboratory tests under closely controlled conditions have indicated increased productivity might be possible, these authors also state that further study is needed to determine the most desirable environment for broilers under field conditions. Until such information is available, improved production through better houses may not result, but the advantages in reduced fuel cost and reduction of some management problems are well defined. The writer agrees with this statement based upon data reported in this thesis.

A linear regression correlation of feed conversion to temperatures, of .264 in insulated houses and .554 in noninsulated houses was found in this study. Feed conversion averages were slightly higher in noninsulated houses. This was in contrast to average weights, where during nine of twelve months, noninsulated houses had higher average broiler weights than did the broilers grown in insulated houses. These results are in agreement with the work of Baxter and Shirley (1961).

Research workers and poultrymen report, that within reasonable limits, brooding in a cooler temperature results in more favorable weight gains but requires more feed per bird, thus resulting in poorer feed conversion.

Prince _et al._ (1960) reporting on two experiments to determine the effect of environmental temperature on feed consumption and weight gain of broilers between the age of 4 and 8 weeks, stated that increasing the temperature from 45°F. to 65°F. reduced feed consumption 9.4 percent and increased feed efficiency a corresponding 11.4 percent. These figures were significant at the 1 and 5 percent level of probability, respectively.

One worker discussing the report of Prince _et al._ (1961) was of the opinion that the increased feed efficiency of broilers grown in a completely insulated house could be expected to earn two cents more profit per broiler than those grown in a non-insulated house. Variability of broiler response and the small difference in feed conversion observed in this study fails to warrant the foregoing assumption, especially as the difference in the body weight of broilers at market time was in favor of those grown in the noninsulated houses.

Baxter and Shirley (1961) found that yearly average feed efficiency of chicks was approximately the same in three type houses, conventional, solar, and windowless. The relationships between insulation, and proper broiler house management, on both feed conversion and weight gains are confounded. Two factors directly involved are correct ventilation and the amount of heat available in the brooder houses and the efficient use of this heat. In this study, condemnations were not significantly related to outside temperature nor type of house, neither were broiler condemnations for the state of Tennessee, for the period August 1960 to July 1961. In contrast, relationships of average percentage of condemnations for the United States for the same period, to outside temperature and month of starting, was highly significant .765 1.0 < P.E. A higher correlation (.784) is shown between condemnations due to air sac infections and outside temperature (Figure 16). This finding agrees with Clarke _et al._ (1961) who found, in a study of respiratory diseases, that the combination of adverse environmental (management and weather) conditions with the presence of a disease, resulted in higher condemnations.

Ota and McNally (1960) pointed out the higher broiler condemnation rate during the winter months, compared with the remainder of the year, in some Southern broiler producing states. The authors pointed out that this was frequently related to inadequate insulation and ventilation of many broiler houses in the South during the winter months, which caused moisture condensation and wet litter situations conducive to outbreaks of disease. In the Cumberland Plateau study, total percent mortality (Appendix, Table II), and feed conversion (Appendix, Table VII) was in favor of the insulated houses which indicates that insulation may be an advantage, but, as the average weight of broilers (Appendix, Table IV) was in favor of the noninsulated houses, it is also indicated that management can offset some housing conditions usually considered desirable.

Broiler performance efficiency index, in contrast to weight and feed conversion, is significantly associated with outside temperature and month of starting chicks, in both types of houses. The correlation was .561 for the insulated houses and .678 in noninsulated houses, and were significant at the 10 and 5 percent level of probability, respectively. Relationships of both weight and feed conversion to outside temperature were not significant in insulated houses, but were significant in noninsulated houses. The explanation of this apparent reversal of form is not quite clear. However, it is generally accepted that faster growing chicks have a better feed conversion than do slower growing birds and that the greater variation in ambient temperature, associated with noninsulated houses, may contribute more to the general well-being of the chick than generally realized.

TABLE III

INFLUENCE OF TYPE OF HOUSE, NUMBER CHICKS PER HOVER, AND TEMPERATURE, ON PERCENT MORTALITY OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses					Non-insulated houses					Av. all broods
		All hovers	Number of chicks per hover: Under 600	600 to 699	700 to 799	800 and above	All hovers	Number of chicks per hover: Under 600	600 to 699	700 to 799	800 and above	
(Mo.)	(°F.)	Average mortality (percent)										
August	61	1.8	0.7	*	1.9	3.3	2.7	5.0	1.0	2.2	4.3	2.25
September	55	2.7	*	1.8	1.8	3.4	2.2	2.4	3.5	.1	4.8	2.45
October	45	0.8	*	*	*	0.8	2.2	1.7	2.8	2.3	2.0	1.50
November	31	3.5	2.7	4.2	5.6	2.8	3.6	*	4.0	4.1	0.6	3.50
December	19	3.5	2.3	4.6	6.6	0.0	2.4	2.4	2.4	1.3	6.0	2.95
January	19	3.9	9.4	4.2	3.0	2.0	5.3	*	6.6	4.7	3.9	4.65
February	33	3.1	2.6	3.0	5.9	1.6	2.9	3.1	4.5	2.0	3.9	3.00
March	39	1.8	1.5	2.1	2.2	0.8	2.7	0.0	1.4	4.1	4.1	2.75
April	39	2.4	2.5	*	1.8	2.7	4.6	*	4.4	5.0	*	3.50
May	47	3.4	1.4	8.0	2.1	0.9	3.0	3.4	3.2	3.0	1.6	3.20
June	55	3.0	2.0	3.3	5.9	2.0	3.3	*	2.3	6.9	1.3	3.15
July	59	3.0	1.8	1.3	9.0	3.5	3.0	7.7	3.3	2.3	*	3.00
Av.	42	2.75	2.6	3.6	3.5	3.2	3.16	3.1	3.4	3.0	3.1	2.97
No. of broods		95	28	16	27	24	99	11	30	45	13	194

*No broods reported.

SUMMARY AND CONCLUSIONS

Data have been presented for percent mortality, average weight, feed conversion, performance efficiency index, and percent condemnations for broilers grown in two types of houses, insulated and noninsulated. Supplementary information is also included on type of brooders, length of houses, and number of chicks started per hover. The schedules of information, basic in the study, were completed by fieldmen of the Dixie Grain Company, Shelbyville, Tennessee. All broilers in this study were supervised by this company. The data covers 1,295,920 birds with 194 grow-outs. There were 95 grow-outs in insulated houses with 707,000 chicks started, and 99 grow-outs in insulated houses with 588,920 chicks started. There were 24 houses in each group and all houses were located on the Cumberland Plateau. The houses were located in Fentress and Grundy counties, where the elevation, above sea level, is between 1500 and 2000 feet. The climate is normally mild in summer, spring, and fall, with relatively cold winters.

A statistical analysis of broiler house mortality failed to associate percent mortality with either of the two types of houses, outside temperature or month of starting chicks.

Weight gains of broilers grown in insulated houses were not significantly associated with outside temperature. In the noninsulated houses, broiler weights were associated with outside temperature at the 5< P.E. The simple gross correlation coefficient for weight gains in noninsulated houses, to outside temperature was .677.

Analysis of feed conversion data indicated no correlation between feed conversion and outside temperature in insulated houses. There was a significant correlation between feed conversion and outside temperature in the noninsulated houses. The simple gross correlation of .554 was significant at 10 $<$ P.E. in the noninsulated houses.

Linear regression correlation of performance efficiency index to outside temperature, showed a significant relationship in both insulated and noninsulated houses. The coefficients were significant at the 10 and 5 $<$ P.E., respectively.

Condemnations in this study were not found to be associated to outside temperature, in either insulated nor noninsulated houses. Condemnations of all Tennessee broilers inspected from August 1960 to July 1961, the same period as this study, were not associated with outside temperature. A similar analysis of United States broiler condemnations showed a highly significant relationship of condemnations to outside temperature (.765).

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APPENDIX

TABLE I

INFLUENCE OF TYPE OF HOUSE, TYPE OF BROODER, AND TEMPERATURE, ON PERCENT MORTALITY OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All broods	Insulated houses: Type of brooder: Coal	Gas	Oil	Central	Non-insulated houses: All broods	Non-insulated houses: Type of brooder: Coal	Gas	Oil	Central	Av. all broods
(Mo.)	(°F.)	Average mortality (percent)										
August	61	1.8	3.0	0.3	0.8	3.1	2.7	2.8	3.2	*	1.7	2.25
September	55	2.7	2.4	*	*	2.8	2.2	1.4	*	*	*	2.45
October	45	0.8	*	.0	*	0.8	2.2	2.2	2.2	*	2.3	1.50
November	31	3.5	3.7	4.3	4.3	2.6	3.6	3.5	*	*	4.0	3.50
December	19	3.5	2.6	4.2	*	5.6	2.4	2.7	2.0	*	2.2	2.95
January	19	4.0	4.2	7/3	3.8	2.2	5.3	5.6	3.9	*	5.2	4.65
February	33	3.1	3.7	*	*	1.5	2.9	2.6	4.3	*	3.8	3.00
March	39	1.8	2.9	1.1	*	4.1	3.7	1.7	5.6	*	7.2	2.75
April	39	2.4	1.6	1.0	4.0	2.8	4.6	4.1	*	*	6.7	3.50
May	47	3.4	1.1	7.5	*	2.3	3.0	2.5	2.2	*	3.0	3.20
June	55	3.0	3.5	.4	2.0	3.9	3.3	1.9	2.0	*	6.9	3.15
July	59	3.0	1.5	5.0	*	3.7	3.0	2.8	2.6	*	3.8	3.00
Av.	42	2.75	2.7	4.0	3.0	2.8	3.16	3.0	3.1	*	4.0	2.97
No. of broods		95	31	20	5	39	99	66	13	*	20	194

*No broods reported.

TABLE II

INFLUENCE OF TYPE OF HOUSE, LENGTH OF HOUSE, AND TEMPERATURE, ON PERCENT MORTALITY OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses				Non-insulated houses				Av. all broods
		All lengths	Length of house (ft.) 100 to 149	150 to 199	200 and above	All lengths	Length of house (ft.) 100 to 149	200 to 199	200 and above	
(Mo.)	(°F.)	Average mortality (percent)								
August	61	1.8	0.5	3.0	3.3	2.7	2.9	2.7	1.7	2.25
September	55	2.7	*	2.3	3.1	2.2	3.6	0.3	0.0	2.45
October	45	.8	*	.4	*	2.2	2.2	*	2.2	1.55
November	31	3.5	4.0	3.3	3.0	3.6	3.1	4.2	4.0	3.50
December	19	3.5	2.8	6.1	2.7	2.4	2.7	0.0	3.1	2.95
January	19	4.0	5.6	1.8	3.7	5.3	5.9	4.2	5.2	4.65
February	33	3.1	2.0	5.5	2.1	2.9	4.0	1.4	2.5	3.00
March	39	1.8	1.7	1.8	*	3.7	2.4	1.9	3.9	2.75
April	39	2.4	2.2	1.7	2.7	4.6	4.4	3.4	6.7	3.50
May	47	3.4	0.3	2.2	1.9	3.0	2.4	1.3	4.4	3.20
June	55	3.0	1.9	5.2	2.5	3.3	2.6	*	7.4	3.15
July	59	3.0	0.7	4.7	2.8	3.0	3.7	1.2	3.3	3.00
Av.	42	2.75	3.0	3.1	2.7	3.16	3.3	2.1	4.0	2.97
No. of broods		95	36	32	27	99	58	18	23	194

*No broods reported.

TABLE IV

INFLUENCE OF TYPE OF HOUSE, TYPE OF BROODER, AND TEMPERATURE, ON WEIGHT OF BROILERS BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All broods	Insulated houses: Type of brooder: Coal	Gas	Oil	Central	Non-insulated houses: All broods	Non-insulated houses: Type of brooder: Coal	Gas	Oil	Central	Av. all broods
(Mo.)	(°F.)	Average live weight of broilers (lbs.)										
August	61	3.77	3.75	3.71	3.60	3.77	4.00	3.96	4.33	*	3.92	3.89
September	55	3.39	3.12	*	*	3.53	3.82	3.91	*	*	3.46	3.61
October	45	3.94	*	4.20	*	3.69	3.69	3.78	3.51	*	3.72	3.81
November	31	3.48	3.53	3/28	3.57	3.53	3.58	3.53	*	*	3.63	3.53
December	19	3.73	3.75	3.96	*	3.59	3.62	3.53	3.78	*	3.68	3.67
January	19	3.64	3.79	3.43	3.86	3.63	3.71	3.65	3.67	*	3.86	3.67
February	33	3.64	3.62	*	*	3.66	4.03	4.03	4.19	*	3.88	3.84
March	39	3.91	3.86	3.91	*	3.92	3.87	3.92	4.07	*	3.45	3.89
April	39	3.70	3.42	3.43	4.20	3.79	3.84	3.83	*	*	3.81	3.80
May	47	3.73	3.74	3.74	*	3.72	3.80	3.83	3.76	*	3.72	3.77
June	55	4.03	3.55	4.00	4.22	4.32	4.18	3.96	4.87	*	4.29	4.08
July	59	3.98	4.00	3.91	*	3.95	4.06	4.12	4.06	*	3.87	4.02
Av.	42	3.75	3.70	3.75	3.89	3.74	3.85	3.87	4.00	*	3.80	3.80
No. of broods		95	31	20	5	39	99	66	13	*	20	194

*No broods reported.

TABLE V

INFLUENCE OF TYPE OF HOUSE, LENGTH OF HOUSE, AND TEMPERATURE, ON WEIGHT OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses				Non-insulated houses				Av. all broods
		All lengths	Length of house (ft.) 100 to 149	150 to 200	200 and above	All lengths	Length of house (ft.) 100 to 149	150 to 200	200 and above	
(Mo.)	(°F.)	Average live weight of broilers (lbs.)								
August	61	3.77	3.67	3.64	4.01	4.00	4.00	3.84	3.92	3.89
September	55	3.39	*	3.26	3.53	3.82	3.76	4.35	3.46	3.61
October	45	3.94	*	3.94	*	3.69	3.69	*	3.71	3.81
November	31	3.48	3.37	3.59	3.66	3.58	3.46	3.61	3.57	3.53
December	19	3.73	3.80	4.07	3.42	3.62	3.74	3.53	3.42	3.67
January	19	3.64	3.49	3.69	3.75	3.71	3.82	3.72	3.86	3.67
February	33	3.64	3.85	3.46	3.67	4.03	4.09	4.05	3.92	3.84
March	39	3.91	3.87	3.98	*	3.87	3.99	3.69	3.65	3.89
April	39	3.79	3.97	3.53	3.78	3.84	3.86	3.82	3.81	3.80
May	47	3.73	3.73	3.73	3.73	3.80	3.44	3.93	3.76	3.77
June	55	4.03	3.95	4.33	3.96	4.18	4.14	*	4.43	4.08
July	59	3.98	3.88	4.06	3.87	4.06	4.15	4.08	3.89	4.02
Av.	42	3.75	3.61	3.85	3.66	3.85	3.96	3.83	3.48	3.80
No. of broods		95	31	32	27	99	58	18	23	194

*No broods reported.

TABLE VI

INFLUENCE OF TYPE OF HOUSE, NUMBER OF CHICKS PER-HOVER, AND TEMPERATURE, ON WEIGHT OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All hovers	Insulated houses, Number of chicks per hover: Under 600	600 to 699	700 to 799	800 and above	Non-insulated houses: All hovers	Non-insulated houses, Number of chicks per hover: Under 600	600 to 699	700 to 799	800 and above	Av. all broods
(Mo.)	(°F.)	Average live weight of broilers (lbs.)										
August	61	3.77	3.71	*	3.63	4.00	4.00	4.14	3.79	3.88	4.27	3.89
September	55	3.39	*	3.15	3.60	3.35	3.82	3.98	3.75	3.90	3.56	3.61
October	45	3.94	*	*	4.20	3.69	3.69	3.55	4.01	3.65	3.67	3.81
November	31	3.48	3.57	3.36	3.41	3.53	3.58	*	3.37	3.67	3.85	3.53
December	19	3.73	3.75	3.66	3.96	3.20	3.62	3.42	3.78	3.66	3.72	3.67
January	19	3.64	3.86	3.79	3.55	3.62	3.71	*	3.28	3.79	3.67	3.67
February	33	3.64	3.82	3.37	3.84	3.91	4.03	3.98	4.12	4.09	3.91	3.84
March	39	3.91	4.00	3.72	4.06	3.77	3.87	4.15	3.92	3.62	4.35	3.89
April	39	3.79	3.92	*	3.63	3.75	3.84	*	3.86	3.81	*	3.80
May	47	3.73	3.81	3.79	3.60	3.77	3.80	3.81	3.73	3.77	3.82	3.77
June	55	4.06	3.89	3.63	4.46	4.19	4.18	*	3.93	4.04	4.48	4.08
July	59	3.98	4.11	3.81	4.01	3.92	4.06	3.71	4.02	4.15	*	4.02
Av.	42	3.75	3.70	3.56	3.77	3.71	3.85	3.82	3.77	3.84	4.00	3.80
No. of broods		95	28	16	27	24	99	11	30	45	13	194

*No broods reported.

TABLE VII

INFLUENCE OF TYPE OF HOUSE, TYPE OF BROODER, AND TEMPERATURE, ON FEED CONVERSION OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All broods	Insulated: Type of brooder: Coal	Gas	Oil	Central	Non-insulated houses: All broods	Non-insulated: Type of brooder: Coal	Gas	Oil	Central	Av. all broods
(Mo.)	(°F.)	Average feed conversion (lbs. feed÷wt.)										
August	61	2.42	2.41	2.45	2.32	2.46	2.44	2.39	2.52	*	2.57	2.43
September	55	2.63	2.85	*	*	2.50	2.47	2.45	*	*	2.57	2.55
October	45	2.66	*	2.63	*	2.69	2.64	2.48	2.99	*	2.58	2.65
November	31	2.59	2.57	2.55	2.59	2.63	2.61	2.60	*	*	2.75	2.60
December	19	2.62	2.57	2.56	*	2.73	2.71	2.76	2.65	*	2.60	2.68
January	19	2.47	2.49	2.53	2.37	2.47	2.52	2.46	2.61	*	2.61	2.50
February	33	2.45	2.44	*	*	2.45	2.44	2.46	2.26	*	2.44	2.45
March	39	2.44	2.60	2.44	*	2.79	2.47	2.44	2.49	*	2.53	2.45
April	39	2.32	2.25	2.38	2.35	2.35	2.52	2.49	*	*	2.64	2.42
May	47	2.43	2.38	2.43	*	2.58	2.41	2.39	2.36	*	2.45	2.42
June	55	2.38	2.24	2.39	2.39	2.50	2.38	2.35	2.38	*	2.45	2.38
July	59	2.46	2.34	2.56	*	2.46	2.42	2.43	2.42	*	2.37	2.44
Av.	42	2.48	2.47	2.49	2.40	2.48	2.50	2.49	2.54	*	2.52	2.50
No. of broods		95	31	20	5	39	99	66	13	*	20	194

*No broods reported.

TABLE VIII

INFLUENCE OF TYPE OF HOUSE, LENGTH OF HOUSE, AND TEMPERATURE, ON FEED CONVERSION OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All lengths	Insulated houses: Length of house (ft.) 100 to 149	Insulated houses: Length of house (ft.) 150 to 199	Insulated houses: Length of house (ft.) 200 and above	Non-insulated houses: All lengths	Non-insulated houses: Length of house (ft.) 100 to 149	Non-insulated houses: Length of house (ft.) 150 to 199	Non-insulated houses: Length of house (ft.) 200 and above	Av. all broods
(Mo.)	(°F.)	Average feed conversion (lbs. feed÷wt.)								
August	61	2.42	2.45	2.40	2.52	2.44	2.40	2.48	2.57	2.43
September	55	2.63	*	2.74	2.51	2.47	2.43	2.51	2.57	2.55
October	45	2.66	*	2.66	*	2.64	2.64	*	2.64	2.65
November	31	2.59	2.54	2.67	2.49	2.61	2.54	2.69	2.75	2.60
December	19	2.62	2.53	2.66	2.64	2.71	2.66	3.00	2.66	2.68
January	19	2.47	2.46	2.48	2.53	2.52	2.52	2.42	2.61	2.50
February	33	2.45	2.43	2.45	2.46	2.44	2.44	2.44	2.51	2.45
March	39	2.44	2.45	2.42	*	2.47	2.47	2.56	2.45	2.45
April	39	2.32	2.37	2.31	2.30	2.53	2.52	2.46	2.64	2.42
May	47	2.43	2.44	2.38	2.42	2.41	2.34	2.39	2.52	2.42
June	55	2.38	2.34	2.50	2.32	2.38	2.37	*	2.48	2.38
July	59	2.46	2.37	2.53	2.41	2.42	2.41	2.46	2.39	2.44
Av.	42	2.48	2.43	2.51	2.45	2.50	2.46	2.51	2.54	2.50
No. of broods		95	36	32	27	99	58	18	23	194

*No broods reported.

TABLE IX

INFLUENCE OF TYPE OF HOUSE, NUMBER OF CHICKS PER HOVER, AND TEMPERATURE, ON FEED CONVERSION OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All hovers	Insulated: Number of chicks per hover: Under 600	Insulated: 600 to 699	Insulated: 700 to 799	Insulated: 800 and above	Non-insulated houses: All hovers	Non-insulated: Number of chicks per hover: Under 600	Non-insulated: 600 to 699	Non-insulated: 700 to 799	Non-insulated: 800 and above	Av. all broods
(Mo.)	(°F.)	Average feed conversion (lbs. feed÷wt.)										
August	61	2.47	2.35	*	2.43	2.52	2.44	2.35	2.36	2.52	2.47	2.43
September	55	2.63	*	2.86	2.54	2.48	2.47	2.39	2.47	2.54	2.44	2.55
October	45	2.66	*	*	2.63	2.69	2.64	2.51	2.45	2.63	2.99	2.65
November	31	2.59	2.52	2.51	2.70	2.67	2.61	*	2.52	2.71	2.59	2.60
December	19	2.62	2.54	2.63	2.67	2.71	2.71	2.59	2.60	2.77	2.88	2.68
January	19	2.47	2.38	2.42	2.57	2.42	2.52	*	2.49	2.51	2.61	2.50
February	33	2.45	2.44	2.51	2.45	2.38	2.44	2.52	2.37	2.44	2.38	2.45
March	39	2.44	2.44	2.49	2.44	2.38	2.47	2.39	2.44	2.51	2.44	2.45
April	39	2.32	2.29	*	2.28	2.38	2.52	*	2.51	2.55	*	2.42
May	47	2.43	2.36	2.52	2.40	2.22	2.41	2.47	2.35	2.44	2.38	2.42
June	55	2.38	2.27	2.34	2.50	2.49	2.38	*	2.35	2.45	2.37	2.38
July	59	2.46	2.33	2.42	2.65	2.46	2.42	2.50	2.45	2.44	*	2.44
Av.	42	2.48	2.40	2.54	2.50	2.48	2.50	2.48	2.43	2.52	2.53	2.50
No. of broods		95	28	16	27	24	99	11	30	45	13	194

*No broods reported

TABLE X

INFLUENCE OF TYPE OF HOUSE, NUMBER OF CHICKS PER HOVER, AND TEMPERATURE, ON PERFORMANCE EFFICIENCY INDEX OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses					Non-insulated houses					Av. all broods
		All broods	Type of brooder: Coal	Gas	Oil	Central	All broods	Type of brooder: Coal	Gas	Oil	Central	
(Mo.)	(°F.)	Average performance efficiency index (wt.÷feed conv.)										
August	61	152	155	151	151	153	164	164	172	*	152	158
September	55	142	145	*	*	142	154	159	*	*	135	148
October	45	152	*	167	*	137	140	152	125	*	144	146
November	31	135	136	133	138	135	136	137	*	*	130	135
December	19	143	146	158	*	131	133	127	142	*	141	138
January	19	143	156	131	162	146	147	149	141	*	149	145
February	33	148	147	*	*	151	165	164	185	*	160	157
March	39	160	150	160	*	164	158	163	165	*	138	159
April	39	163	166	149	178	162	151	152	*	*	144	158
May	47	156	155	153	*	158	156	157	158	*	146	156
June	55	170	154	174	176	175	172	171	204	*	166	170
July	59	163	169	154	*	159	167	168	168	*	163	165
Av.	42	152	152	151	161	151	154	160	158	*	145	153
No. of broods		95	31	20	5	39	99	66	13	*	20	194

*No broods reported.

TABLE XI

INFLUENCE OF TYPE OF HOUSE, LENGTH OF HOUSE, AND TEMPERATURE, ON PERFORMANCE EFFICIENCY INDEX OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All lengths	Insulated houses: Length of house (ft.) 100 to 149	150 to 199	200 and above	Non-insulated houses: All lengths	Non-insulated houses: Length of house (ft.) 100 to 149	150 to 199	200 and above	Av. all broods
(Mo.)	(°F.)	Average performance efficiency index (wt.÷feed conv.)								
August	61	152	156	151	159	164	142	154	152	158
September	55	142	*	143	140	154	154	173	135	148
October	45	152	*	152	*	140	140	*	140	143
November	31	135	132	132	143	136	138	134	130	135
December	19	143	150	151	128	133	138	117	128	138
January	19	143	139	147	146	147	145	153	149	145
February	33	148	157	142	154	165	169	165	156	157
March	39	160	159	164	*	158	164	150	149	159
April	39	163	168	152	162	152	153	155	144	158
May	47	155	158	156	151	157	161	155	152	156
June	55	170	175	173	170	171	179	*	157	170
July	59	163	165	162	160	168	171	163	156	165
Av.	42	152	153	153	151	154	155	154	149	153
No. of broods		95	36	32	27	99	58	18	23	194

*No broods reported.

TABLE XII

INFLUENCE OF TYPE OF HOUSE, TYPE OF BROODER, AND TEMPERATURE, ON PERFORMANCE EFFICIENCY INDEX OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses					Non-insulated houses					Av. all broods
		All hovers	Number of chicks per hover: Under 600	600 to 699	700 to 799	800 and above	All hovers	Number of chicks per hover: Under 600	600 to 699	700 to 799	800 and above	
(Mo.)	(°F.)	Average performance efficiency index (wt.÷feed conv.)										
August	61	152	154	*	149	159	164	176	160	153	172	158
September	55	142	*	149	141	135	154	166	151	154	145	148
October	45	152	*	*	167	137	140	141	163	138	122	143
November	31	135	141	131	125	134	136	*	134	133	150	135
December	19	143	149	138	150	112	133	130	145	133	129	138
January	19	143	150	156	134	148	147	*	144	151	141	145
February	33	148	145	134	156	162	165	173	174	165	166	157
March	39	160	163	149	167	158	158	157	160	145	175	159
April	39	163	173	*	161	158	152	*	153	149	*	158
May	47	156	161	150	149	168	157	155	158	155	160	156
June	55	170	167	155	178	168	171	*	166	166	187	170
July	59	163	175	154	151	168	167	176	169	164	*	165
Av.	42	152	157	145	145	150	154	157	157	153	160	153
No. of broods		95	28	16	27	24	99	11	30	45	13	194

*No broods reported.

TABLE XIII

INFLUENCE OF TYPE OF HOUSE, LENGTH OF HOUSE, AND TEMPERATURE, ON PERCENT CONDEMNATIONS OF BROILERS BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All broods	Insulated houses: Type of brooder: Coal	Gas	Oil	Central	Non-insulated houses: All broods	Non-insulated houses: Type of brooder: Coal	Gas	Oil	Central	Av. all broods
(Mo.)	(°F)	Average condemnations (percent)										
August	61	0.8	1.1	0.7	1.1	0.7	0.7	0.7	0.6	*	0.4	0.75
September	55	0.7	1.0	*	*	0.5	0.9	1.0	*	*	0.2	0.80
October	45	0.7	*	1.1	*	0.4	0.9	0.6	1.6	*	0.4	0.80
November	31	1.3	1.2	1.6	*	1.2	1.5	1.6	*	*	0.9	1.40
December	19	1.4	0.9	1.3	3.0	2.5	1.2	1.8	0.2	*	*	1.30
January	19	0.6	0.3	0.7	0.7	0.7	0.6	0.6	0.8	*	0.4	0.60
February	33	1.5	1.6	*	*	1.5	0.7	0.6	0.8	*	*	1.10
March	39	0.7	2.7	0.5	*	0.5	0.8	0.5	0.8	*	1.0	0.75
April	39	0.7	0.8	.6	0.5	0.7	1.2	1.5	*	*	0.5	0.95
May	47	1.1	0.6	2.3	*	0.6	1.0	0.8	1.2	*	0.7	1.05
June	55	0.8	1.3	0.3	0.8	0.8	1.0	1.0	1.5	*	0.8	0.90
July	59	1.2	0.6	2.7	*	1.1	1.0	1.1	0.7	*	1.1	1.10
Av.	42	.95	1.0	1.1	1.0	.9	.96	1.0	.9	*	.7	.96
No. of broods		95	31	20	5	39	99	66	13	*	20	194

*No broods reported.

TABLE XIV

INFLUENCE OF TYPE OF HOUSE, LENGTH OF HOUSE, AND TEMPERATURE, ON PERCENT CONDEMNATIONS OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All lengths	Insulated houses: Length of house (ft.) 100 to 149	Insulated: 150 to 199	Insulated: 200 and above	Non-insulated houses: All lengths	Non-insulated houses: Length of house (ft.) 100 to 149	Non-insulated: 150 to 199	Non-insulated: 200 and above	Av. all broods
(Mo.)	(°F.)	Average condemnations (percent)								
August	61	0.8	0.8	1.0	0.4	0.7	0.7	0.6	0.4	0.75
September	55	0.7	*	0.8	0.6	0.9	1.2	0.6	0.2	0.80
October	45	0.7	*	0.4	*	0.9	0.9	*	0.7	0.80
November	31	1.3	1.1	0.9	1.2	1.5	0.7	3.5	1.0	1.40
December	19	1.4	1.1	1.1	2.1	1.7	1.1	1.1	0.9	1.30
January	19	0.6	0.7	0.6	0.6	0.6	0.8	0.2	0.4	0.60
February	33	1.5	1.3	1.9	1.4	0.7	0.6	0.9	0.5	1.10
March	39	0.7	0.8	0.4	*	0.8	0.8	0.4	0.7	0.75
April	39	0.7	0.7	0.7	0.7	1.2	2.0	0.1	0.6	0.95
May	47	1.1	1.7	0.6	0.6	1.0	0.9	0.5	1.4	1.05
June	55	0.8	0.8	0.9	0.7	1.0	1.1	*	0.7	0.90
July	59	1.2	0.8	1.7	1.0	1.0	1.3	0.7	0.9	1.10
Av.	42	.95	1.0	1.0	.9	.96	1.0	0.9	1.0	.96
No. of broods		95	36	32	27	99	58	18	23	194

*No broods reported.

TABLE XV

INFLUENCE OF TYPE OF HOUSE, NUMBER OF CHICKS PER HOVER, AND TEMPERATURE, ON PERCENT CONDEMNATIONS OF BROILERS, BY MONTH OF STARTING 194 BROODS, CUMBERLAND PLATEAU, TENNESSEE, AUGUST 1960-JULY 1961

Date of starting chicks	Outside av. min. temp.	Insulated houses: All hovers	Insulated houses: Number of chicks per hover: Under 600	Insulated houses: Number of chicks per hover: 600 to 699	Insulated houses: Number of chicks per hover: 700 to 799	Insulated houses: Number of chicks per hover: 800 and above	Non-insulated houses: All hovers	Non-insulated houses: Number of chicks per hover: Under 600	Non-insulated houses: Number of chicks per hover: 600 to 699	Non-insulated houses: Number of chicks per hover: 700 to 799	Non-insulated houses: Number of chicks per hover: 800 and above	Av. all broods
(Mo.)	(°F.)	Average condemnations (percent)										
August	61	0.8	0.7	*	1.0	0.4	0.7	0.6	0.8	0.5	0.7	0.75
September	55	6.7	*	0.9	0.3	0.7	0.9	1.0	2.0	0.4	0.6	0.80
October	45	0.7	*	*	1.1	0.4	0.9	0.5	0.7	0.6	2.1	0.80
November	31	1.3	1.0	0.8	2.8	0.9	1.15	*	1.0	2.7	0.6	1.40
December	19	1.4	1.0	1.7	1.2	2.7	1.2	1.1	0.3	0.7	3.7	1.30
January	19	0.6	0.8	0.3	0.8	0.4	0.6	*	0.7	0.4	0.8	0.60
February	33	1.5	1.2	2.5	2.3	0.4	0.7	0.4	1.0	0.6	0.4	1.10
March	39	0.7	0.6	1.6	0.4	0.5	0.8	0.2	0.9	0.8	0.9	0.75
April	39	0.7	0.8	*	0.5	0.8	1.2	*	2.0	0.3	*	0.95
May	47	1.1	0.9	2.0	0.5	0.6	1.0	1.8	1.4	0.6	.5	1.05
June	55	0.8	0.6	1.6	1.0	0.2	1.0	*	1.2	0.8	1.00	0.90
July	59	1.2	0.6	0.9	4.4	1.0	1.0	0.8	1.4	0.9	*	1.10
Av.	42	.95	0.8	1.4	1.1	0.7	.96	0.9	1.2	0.6	1.0	.96
No. of broods		95	28	16	27	24	99	11	30	45	13	194

*No broods reported.

TABLE XVI

SCHEDULE I

General Information — All Information Confidential

Grower__________ Address__________

Date chicks started______ No. started______ House No.______

Source of chicks (hatchery)__________ Strain______

Field Supervisor__________ Feed Co. (brand)______

HOUSE

Length______ Width______ Direction long Axis (ridge)______

Wall covering______ Foundation contruction______ If poles indicate__________

ROOF

Type, Steel____ Aluminum____ Tar paper____ Homasote____ Metal and Wood____ Metal & Tar paper under____ other, Explain____

VENTILATORS

Type____ None____ Can ventilators be closed Yes____ No____

Continuous, Depth of opening______ Opening both sides of ridge: Yes___ No___ If commercial type: Number___ Size___ Fans: Number____ Size______ Location__________

HOUSE LOCATION

Level____ Hilltop____ Side of hill____ Hollow____

Which side of slope, South____ East____ South____ North____

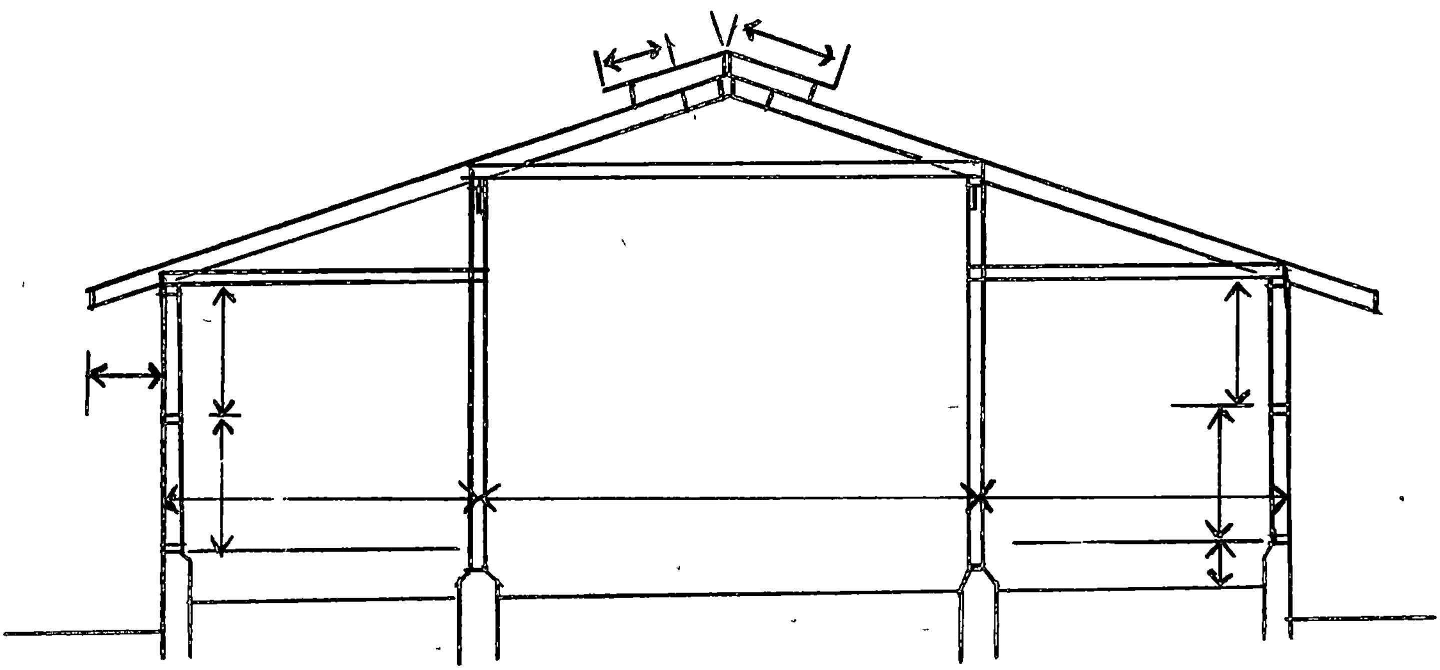
Water drainage around house: Good___ Fair___ Poor___ Bad____

Air drainage around house: Good___ Fair___ Bad___ If bad why___

METHOD OF BROODING:

Number of hovers in house____ Size of hovers__________

Listed capacity_______Number of chicks per hover____if central:
Hot air___Hot water___Other_________Listed capacity of Central
system___________BTU per 1,000 chicks______Type of supplemental
heaters________Size____________________Number______________________



INSULATION	TYPE	THICKNESS	LOCATION
Roof	________	________	________
Ceiling	________	________	________
Walls	________	________	________
North (w)	________	________	________
South (e)	________	________	________
PLASTIC:	TYPE	THICKNESS	LOCATION
North (w) wall	________	Double__Single__	________
South (e) wall	________	Double__Single__	________

TABLE XVI (Cont.)

North (w) windows	____________	Double__Single__	____________
South (e) windows	____________	Double__Single__	____________
How used	Stationary	Adjustable	
North (w) windows	____________________	____________________	
South (e) windows	____________________	____________________	

TABLE XVII

SCHEDULE II

Grower________________Number started_______Date started_________

Source of chicks (hatchery)_______________Strain_______________

Name of processing plant_______Date processed________Shift______

No. of birds arriving at plant___________Age sold_______________

No. pounds arriving at plant____________Average weight__________

Percent birds sold________________Total pounds feed_____________

Percent Mortality_________________Feed conversion_______________

No. birds condemned_________Performance efficiency index________

No. pounds condemned____________(Bird wt.÷feed conversion)

No. birds passed________If Federal graded: No. A_______________

No. pounds passed________________________ No. B_______________

Percent condemned________________________ No. C_______________

BROODING COSTS PER POUND:

Chick______________________Cost each chick_____________

Feed_______________________

Fuel_______________________

Medication_________________

Other______________________

Other______________________

Total______________________Cost per pound______________

Comments on the total operation by the fieldman (or person taking questionnaire) that may be pertinent to a complete analysis of the operation.

____