EFFECTS OF RESERPINE AND TRIFLUOPERAZINE ON REPRODUCTIVE PERFORMANCE IN CHICKENS

By

ROBERT ELLIS WAGGONER

Bachelor of Science

University of Arkansas

Fayetteville, Arkansas

1958

Submitted to the faculty of the Graduate School
of the Oklahoma State University
in partial fulfillment of the
requirements for the
degree of
MASTER OF SCIENCE
August, 1960

EFFECTS OF RESERPINE AND TRIFLUOPERAZINE

ON REPRODUCTIVE PERFORMANCE IN CHICKENS

Thesis Approved:

J. C. Gilbreath
Thesis Adviser

John W. West
Head of the Department

Robert MacVicar
Dean of the Graduate School

ACKNOWLEDGMENTS

The author wishes to express his appreciation to Dr. J. C. Gilbreath, Associate Professor of Poultry Science, for his advice in the planning and conducting of this research and in the writing of this thesis.

He also wishes to acknowledge Dr. John W. West, Professor and Head of the Department of Poultry Science, for his suggestions and criticism in the writing of this manuscript.

Appreciation is also extended to Dr. Robert D. Morrison, Associate Professor of Mathematics, for his assistance in the statistical analyses.

The author also wishes to acknowledge the assistance of Quintin B. Welch, Instructor of Poultry Science, in the collection of these data.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

Since man domesticated the fowl, he has added many unnatural environmental stresses to the systems of the bird. The hen is now expected to lay approximately 300 eggs per year rather than a few in the spring for hatching. The broiler is expected to weigh four pounds in eight weeks on ten pounds of feed. The bird is given only a few square feet in which to live, whereas its ancestors had the run of the yard. The bird in confinement cannot go to a cooler place during the hot part of the day.

The results of these stresses often show up indirectly. Egg production may drop due to a disease which has been aggravated by tension. The disease may remain subclinical and not be recognized. The broiler may not have a full coat of feathers because of feather picking. Fighting among males on range accounts for a large percentage of the morbidity and mortality.

The relieving of these stresses is one of the greatest problems confronting the poultry industry. This may be accomplished in several ways. The birds may be given more floor, waterer and feeder space. An antibiotic may be administered continually. More elaborate houses and equipment may be used. Because of the narrow margin of profit, these practices rapidly become expensive.

When we are able to relieve most of the stresses, many of the problems will cease. The existence of these problems accounts for the research in tranquilizers in the field of poultry.

This thesis covers studies that were conducted to determine the influence of the tranquilizers, reserpine and trifluoperazine, on the following characteristics:

I. Egg Production

II. Egg Quality

III. Feed Consumption and Efficiency

IV. Mortality

V. Fertility and Hatchability

REVIEW OF LITERATURE

The ability of tranquilizers to calm or relieve the tension of the subject has become a very interesting field of study. This is true both in the human and in domestic animals. Researchers in this field do not always agree as to the effectiveness of the tranquilizers. A major reason for this lack of agreement appears to be in the conducting and reporting of research which did not follow the scientific research principles as outlined by Wilson (1952). Rather than experiment and then test the theory developed from this experimentation, too many reports are published from mere observations. The layman is thus misled.

Welsh (1958) listed these drugs in five categories as to their chemical origin:

I. The Phenothiazines
II. Rauwolfia-Alkaloids and Fractions
III. Substituted Propanediols
IV. Diphenylmethane Derivatives
V. Ureides and Amides

The response and dose level of each type of drug vary greatly. Meprobamate, a substituted propanediol, was used at doses from two 400-milligram tablets twice daily to 24, 400-milligram tablets daily (Pennington, 1957). This worker had 301 psychiatric patients whose ages ranged from 15 to 84 years. The patients were started on the lower dose level, with the level being increased until a favorable response was noted. Pennington found meprobamate to be effective in quieting the most violent, noisy patients. However, it had little effect on the hypoactive cases. There were no side effects observed except when an overdosage was taken. Chlorpromazine, a phenothiazine derivative, and reserpine, a rauwolfia alkaloid, can be used for hypomanic and manic states but are not of value in treating depressions (Ayrd, 1957).

Chlorpromazine has been shown to be very useful in veterinary medicine in several ways. Troughton et al. (1955) found it to be very effective in the sedation of both large and small animals. They used four milligrams per kilogram of body weight administered orally, or 2.5 milligrams per kilogram administered intramuscularly or intravenously for small animals. Large animals were given 1.5 milligrams per kilogram of body weight intramuscularly. These levels were successfully used as a pre-anaesthetic in more than 250 animals, making them much easier to handle. Troughton and co-workers (1955) gave dogs dosages as high as five milligrams per kilogram of body weight for 30 days without any toxicity.

In an attempt to apply this principle of relieving hypertension by the administration of a tranquilizer, Hewitt and Reynolds (1957) fed reserpine to ring-necked pheasants at the rate of seven milligrams per kilogram of diet. The drug appeared to stop the fighting of cocks and to improve egg production, but it resulted in a lowered fertility. The first trial had only one treatment pen and one control pen. Six females and two males were used in each pen. The second trial had 68 pens on the control treatment and 15 pens on reserpine treatment, at a rate of 2.5 milligrams of reserpine per pound of diet. Seven hens and one cock were used in each pen. The data indicated that the reserpine-treated birds had lower egg production, fertility, and hatchability than the control pens. There was no difference in feed consumption. The results indicated that reserpine may not be of value for pheasant breeding flocks. Hewitt and Reynolds (1957) conducted two trials using reserpine in an attempt to control feather picking and cannibalism in young growing pheasants. Reserpine was fed in both trials at a level of 2.5 milligrams per pound of diet. The first trial was a controlled experiment in which two pens were on one ration and two more pens were on a second ration. The treatment consisted of two more pens with the reserpine mixed in the feed. This trial was conducted for six weeks. The average gain for the reserpine treated birds was significantly less. However, reserpine treatment apparently reduced feather picking by approximately 15 percent. The second trial was an observation of birds raised by 4-H club members. A total of 3,150 pheasants was distributed to the members. Half of the chicks were used as controls and half were on treatment. Each member used either the control diet or the diet containing reserpine. The treated birds had approximately 19 percent less picking. Hewitt (1959), in another trial in which there was only one pen on each treatment, obtained results which indicated that a level as low as one milligram per kilogram of diet might reduce feather picking as much as the higher levels. An experiment was then conducted with 10 pens on reserpine treatment, at a rate of one milligram per kilogram of diet, and three control pens. There was considerable variation in the percentage of feather picking at three weeks of age. Picking in treatment pens ranged from 16 percent to 73 percent, and in the control pens from 30 percent to 62 percent, with the difference between the averages being only 2.5 percent. The control birds gained in body weight significantly more than those in the treatment pens.

It was thus indicated from these data that reserpine may not be of value in the rearing of pheasants. The great variation in the percentage of feather picking tends to indicate that this is a management problem requiring careful handling of the birds.

Hewitt (1959) obtained favorable results from the use of reserpine when given to pheasants just prior to shipping. There were 400 pheasants in this study, half on treatment and half on control. The drug was fed in a small quantity of feed the evening before shipment, after the birds had been without feed for 24 hours. It was estimated that all of the birds would consume 30 pounds of feed in a short time; therefore, 40 milligrams of reserpine per bird was mixed into this amount of feed and fed the evening before shipping. The men catching the pheasants, without knowing which was the treatment, indicated that the reserpine-fed birds were much easier to catch.

Carlson and Morgan (1958) found no difference in feather picking in twelve-week old pheasants fed reserpine from one day of age. The chicks were started in battery brooders with eight groups of 25 each. They were moved to four floor pens at three weeks of age and then to wire enclosures at eight weeks of age. Reserpine was fed at a level of 2.0 milligrams per pound of feed until three days prior to moving to wire enclosures, at which time the drug level was increased to 4.0 milligrams per pound of diet. Individual body weights were taken at three, eight, and twelve weeks of age.

Reserpine has been shown to be very effective in lowering the blood pressure of turkeys. This is believed to be the reason for its ability to reduce mortality in turkeys due to aortic rupture. Ringer (1959) fed reserpine orally to turkeys at levels varying from 0.1

milligram per kilogram of diet to 4.0 milligrams per kilogram of diet. He found a significant reduction in blood pressure at the 0.1, 0.2, 0.3, and 0.4 milligram levels. Birds receiving the 0.1 milligram level had greater body weight while those receiving the 1.0 and 4.0 milligram levels had lesser body weight. The 0.3 and 0.4 milligram levels indicated a trend toward suppressed growth. These studies were conducted with various ages, the ages ranging from 5 to 22 weeks.

Carlson (1956) observed a suppressed growth rate in turkeys fed reserpine levels as low as 0.5 milligram per kilogram of diet. The trial was conducted for an eight week period, starting with 18-week old turkeys. The turkeys were divided into three pens with nine toms and seven or eight hens each. Reserpine at the levels used appeared to reduce fighting among the toms.

Although meprobamate and promazine are effective in human medicine, they apparently have no effect on chickens. This was demonstrated by Garren and Hill (1957), who failed to calm young Single Comb White Leghorn males with these drugs. Both drugs were fed at the rate of 125 milligrams per pound of ration. Five groups were used with 20 birds per group. One group was on control and four groups were on treatment. The chicks were on treatment from day of hatch to four weeks of age. The drugs did not calm the birds but did cause a decreased growth rate. Babcock and Taylor (1957) attempted to determine if meprobamate produced muscle relaxation and taming in chickens as it did in mammals. They used ten groups of day-old Single Comb White Leghorn chicks with 20 chicks per group. The study was conducted for three weeks using eight levels of the drug and two pens of controls. They fed levels of 0.0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.4, 1.8, and 2.2 percent meprobamate. After three weeks of treatment there was less gain in body weight at the 0.6 level. Growth depression became more pronounced as the drug levels were increased. At three weeks of age the 0.8 level and one control group were discontinued. The heaviest and lightest birds were also taken out leaving 10 birds per treatment. There was significantly less gain at seven weeks of age at the 1.4 percent level and highly significantly less gain at the 1.8 and 2.2 percent levels. There was a progressive reduction in feed efficiency as the levels were increased.

Burger et al. (1959) ran several short-term studies on chlorpromazine and reserpine in attempting to set acute and chronic toxicity levels. Chlorpromazine was shown to increase growth rate of Single Comb White Leghorn chicks, when fed at levels varying from 10 through 100 milligrams per kilogram of diet. The drug depressed growth when fed at levels varying from 250 through 1600 milligrams per kilogram of diet, and at the higher level caused 100 percent mortality by the 24th day. The differences in growth rate were highly significant. These results were obtained with five separate experiments. The trials were conducted in multilevel battery brooders with three to four replicates per treatment and six to ten birds per replicate. In another study Burger et al. (1959) failed to get a stimulation of growth with New Hampshires when chlorpromazine was fed at levels of 2.5, 5.0, and 10.0 milligrams per kilogram of diet. Four trials were conducted using reserpine at levels varying from 0.5 to 500 milligrams per kilogram of diet fed to Single Comb White Leghorn chicks. The chicks were started on treatment at four days of age and continued to 16 or 24 days of age. Each treatment comprised three or four replicates with six to nine birds per replicate. These studies showed a highly significant increase in body weight, beginning at the 50.0 milligrams per kilogram level and continuing through the highest level. Mortality rate was 96 percent after 21 days of treatment at the 500.0 milligrams per kilogram level of reserpine. High mortality was not observed at any level of chlorpromazine.

Burger (1959) applied an artificial thermal stress to 121 Leghorn-New Hampshire crossbred hens that had been receiving reserpine for 14 days. A total of 40 birds was used as the control, 40 on 2.5 milligrams per kilogram of diet, and 41 on 5.0 milligrams per kilogram of diet. The hens were subjected to a temperature of 104 degrees Fahrenheit for three hours. The groups lost 25, 12, and 11 birds respectively. The percent egg production for the seven-day period prior to treatment was 72.5, 72.5, and 70.5; and for the seven days after treatment 44.6, 48.0, and 52.8 respectively.

A complete life cycle experiment was conducted by Anderson and Smyth (1959) with 525 Single Comb White Leghorn females. The birds were divided into three groups. One group received reserpine at the rate of 0.5 milligram per kilogram of diet starting at three weeks of age. A second group served as the control. The third group was put on the reserpine treatment at sexual maturity. At sexual maturity the birds were divided into floor and cage operations. After 14 weeks of production the temperature in the cage house was raised from 70 degrees Fahrenheit to 90 degrees Fahrenheit over a period of five days, and maintained at this temperature for two weeks. These workers found a significant increase in egg weight and a highly significant increase in albumen height for the treated birds. Both of these factors were reduced significantly by the thermal stress. No differences were noted in shell thickness, egg production or hatchability for the birds in the cages.

Weiss (1959) conducted seven trials using a total of 141 birds in attempting to find a level of reserpine which would be compatible with egg production. These levels were then used for studies of its protective effect against thermal stresses. There were 10 to 40 birds on each treatment and the trials were run for periods varying from four weeks to thirty-two weeks. In one trial reserpine was injected intramuscularly, using a dosage of 0.025 milligram per kilogram of body weight. In five trials it was given at the rate of 1.6 milligrams per kilogram of diet. There were no significant differences in body weight and egg production. At the end of the trials some of the birds were subjected to a temperature of 105 degrees Fahrenheit and a relative humidity of 70 percent. The survival time of the treated birds was 18 minutes, or 17 percent longer than the controls. In one of the trials the treated birds did not have a longer survival time. They were winter-acclimatized birds, whereas the birds in the other trials were summer-acclimatized.

Couch (1959) conducted an experiment using 128 Single Comb White Leghorn pullets on four treatments with four replications each. The treatments were 0.0, 0.25, 0.50, and 1.0 milligrams of reserpine per pound of diet. No differences in egg production, feed conversion or egg weight were observed. There was, however, a difference in the percentage of checked egg shells. The controls had 4.33 percent checks and the high level had 2.01 percent checks for the eight 28-day periods. The data were not analyzed statistically. However, it can be seen that this much difference could be important in a flock of several thousand birds.

Gilbreath *et al.* (1959), in an experiment designed to detect small differences, found that reserpine-treated birds laid significantly heavier eggs. The treated birds also had thicker shells; however, the control birds laid 1.4 percent more eggs. These differences fall in the .10-.05 percent probability range. The control birds ate slightly more feed per dozen eggs. The trial began February 1, and ran for seven, 28-day periods. There were 800 White Leghorn pullets in the experiment. They were divided into 16 pens. Eight pens were on control and eight pens were on treatment. These workers used 2.0 milligrams of reserpine per kilogram of diet in the treated pens.

EXPERIMENTAL PROCEDURE

The results of three experiments are reported in this thesis. A total of 985 birds was used in the three trials.

Trial I

Trial I was started July 3, 1957, and was concluded August 24, 1958. A commercial strain-cross Single Comb White Leghorn, purchased as day-old chicks, was used.

The chicks were vaccinated intranasally against Newcastle disease and infectious bronchitis at one day of age. At 11 weeks they were vaccinated against fowl pox and Newcastle disease. They were also sexed, dubbed, and placed on range at this time. The birds were housed and vaccinated against infectious bronchitis at 16 weeks of age. The birds were treated for worm infestation prior to housing.

The experimental design for this trial was a randomized complete block. The blocks were located in each corner of a 60-pen house. The long axis of the house runs northwest to southeast. There were six treatments, thus each block contained six pens. Twenty females and two males were placed in each pen. The males remained in the pens throughout the study. They were rotated within tranquilizer levels on December 30, 1957.

The pens' dimensions were seven feet by twelve feet. The birds were fed and watered *ad libitum* throughout the growing period and the experiment. Oyster shell and grit were kept before the hens at all times. Cane bagasse was used for litter. The hens were trapnested throughout the experiment. There were six nests in each pen. One (5-foot) feeder was used in each pen. Watering cups, which maintained a continuous flow, were used. Fourteen hours of light were maintained by using an automatic time switch.

Reserpine was mixed in a basal ration recommended by Oklahoma State University (Table I). Drug levels used were 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0 milligram per kilogram of diet.

Individual body weight was obtained by using a hanging type scale graduated to 0.1 pound. Body weights were recorded every 28 days. Feed consumption was measured every 22 days. Two tests were made for fertility and hatchability. Eggs were saved for four days for each hatch. Interior egg quality was determined three times. Three days' collection of eggs was used for each determination. The temperature range of the house was recorded daily throughout the study. Sexual maturity was measured as age, in days, when the first egg was laid.

Trial II

Trial II was conducted in an attempt to bracket the optimum response level of trifluoperazine. Scheidy (1959) reported that 30 to 50 milligrams per kilogram when given orally, produced notable tranquilizing effects in young birds.

The experiment was started November 5, 1958 and was concluded November 28, 1958; it was divided into two phases. The first phase was concluded November 14, 1958, and the second phase at the end of the study. The only difference in the two phases was the method of mixing the trifluoperazine into the ration. For the first phase a premix was made by mixing one gram of the drug into 100 grams of corn starch. For

TABLE I

COMPOSITION OF BASAL USED IN TRIAL I

Ingredients	Percent
Feed grade fat	4.95
Ground yellow corn	21.61
Finely ground kafir	21.61
Pulverized oats	9.82
Wheat shorts	4.95
Alfalfa meal (17% protein)	2.51
Fish meal (60% protein)	4.95
Soybean oil meal (44% protein)	14.77
Yeast culture	1.02
Pex (liquid whey)	1.02
Dried fish solubles	1.96
Distiller solubles	1.96
Calcium carbonate	1.96
Di-calcium phosphate (18% phosphorus)	3.93
Trace mineral mix[1]	0.05
Salt	0.48
Vitamin concentrate (VC-55)[2]	0.48
Coliver[3]	1.96
Feed grade dl-methionine	0.01
Folic acid concentrate	19 grams
Vitamin E concentrate	19 grams
	100.00

[1]Trace mineral adds per pound of ration: manganese, 27.5 milligrams; iodine, 0.88 milligrams; cobalt, 0.59 milligrams; iron, 8.3 milligrams; copper, 1.65 milligrams; and zinc, 1.52 milligrams.

[2]VC-55---Vitamin concentrate adds the following per pound of finished ration: vitamin A, 4,000 I.U.; vitamin D_3, 2,000 I.C.U.; riboflavin, 3.0 milligrams; pantothenic acid, 4 milligrams; niacin, 20 milligrams; choline chloride, 300 milligrams; vitamin B_{12}, 3.0 micrograms; procaine penicillin, 2 milligrams; and menadione, 3.0 milligrams.

[3]Coliver---A cold process cod liver extract manufactured by the Silmo Chemical Company, Vineland, New Jersey.

the second phase, a premix of the drug with the basal ration was used instead of using corn starch.

The treatment levels used in this study were 153.37, 306.74, 613.48, and 1226.96 milligrams of trifluoperazine per kilogram of diet. The basal diet was a breeder mash recommended by Oklahoma State University (Table II).

Twenty-five Single Comb White Leghorn pullets were randomly assigned into 25 individual cages. The pullets were placed into every other cage, thus reducing the possible effects of social order as much as possible. Each bird was provided an individual feeder and waterer. Feed and water were provided *ad libitum*. Individual body weights were taken with a hanging scale graduated in ounces. Individual body weight, body temperature, and feed consumption were recorded every Monday, Wednesday, and Friday. The individual body temperature was taken by suspending the bird by its feet and inserting a veterinary thermometer approximately three inches into the vent. The temperature range of the house was recorded daily.

The experimental birds used in both Trial II and Trial III were from the same breeder. They were Single Comb White Leghorn strain-cross pullets purchased as day-old chicks from a commercial hatchery. These birds had the same vaccination program as the birds in Trial I. They were hatched July 1, 1958, and placed on range at 11 weeks of age.

Trial III

Trial III was initiated November 5, 1958 and was concluded August 12, 1959. It was divided into ten, 28-day periods. Reserpine was fed at three levels; 1.5, 2.0, and 2.5 milligrams per kilogram of diet.

TRIAL II

COMPOSITION OF BASAL USED IN TRIALS II AND III

Ingredients	Percent
Ground yellow corn	14.91
Ground milo	19.89
Wheat shorts	19.89
Alfalfa meal (17% protein)	4.97
Fish meal (60% protein)	4.97
Soybean oil meal (44% protein)	12.43
Meat and bone scrap (50% protein)	4.97
Yeast culture	1.99
Pex (liquid whey)	3.98
Dried distiller solubles	2.98
Calcium carbonate	2.98
Di-calcium carbonate	2.98
Salt	0.50
Fat (feed grade)	1.99
Trace mineral mix[1]	0.05
Vitamin concentrate (VC-55)[2]	0.50
NF-180[3]	0.02
	100.00

[1]Trace mineral adds per pound of ration: manganese, 27.5 milligrams; iodine, 0.88 milligrams; cobalt, 0.59 milligrams; iron, 8.3 milligrams; copper, 1.65 milligrams; and zinc, 1.52 milligrams.

[2]VC-55---Vitamin concentrate adds the following per pound of finished ration: vitamin A, 4,000 I.U.; vitamin D_3, 2,000 I.C.U.; riboflavin, 3 milligrams; pantothenic acid, 4 milligrams; niacin, 20 milligrams; choline chloride, 300 milligrams; vitamin B_{12}, 3 micrograms; procaine penicillin, 2 milligrams; and menadione, 3 milligrams.

[3]NF-180---Furazolidone (N-(5 nitro-2-furfurylidene)-3-amino-2-oxazolidone). Dr. Hess and Clark, Incorporated, Ashland, Ohio.

Trial II was in progress at the beginning of this study; therefore, the trifluoperazine part of Trial III did not begin until the second 28-day period. Until that time these pullets received the basal ration (Table II). Two levels of trifluoperazine, 153.37 and 306.74 milligrams per kilogram of diet, were started on December 3, 1958. Only the nine periods in which all treatments were in effect are reported.

Trial III was conducted in the same 60-pen house in which Trial I was conducted. A randomized complete block design was used, with the blocks in each corner of the house. The six treatments were randomized within each block. At the initiation of the study the pullets were randomly distributed throughout the house. In the process of housing the birds were cooped according to the range shelter from which they came. Then an equal ratio of birds from each shelter was placed in each experimental pen. This procedure minimized any differences that might exist among birds among treatments. The same equipment and lighting procedure used in Trial I were used in Trial III.

Each pen contained 20 pullets, which were trapnested throughout the study. One male was placed into each pen approximately two weeks before the eggs were saved for hatching. Three hatches of four days' egg production were made. Egg quality data were taken six times, at four-week intervals. Four days' egg production was used. Each day's egg production was broken out the following day. A Lufkin micrometer graduated to .001 inch was used for measuring the egg shell thickness. An Ames dial micrometer gauge graduated to 0.1 millimeter was used for measuring the albumen height. The same person took the same measurement for each collection of eggs to minimize human error.

RESULTS AND DISCUSSION

The summary and analysis of Trial I are presented in Table III. No statistically significant differences were obtained for any of the measurements. Consistent relationships between drug level and measurements did not exist. A good example is in the percentage egg production, where there was no consistent trend. More variation was noted within treatments than among treatments. The 1.0 milligram level of reserpine had the highest feed consumption and the 0.4 level had the lowest feed consumption. Birds receiving the 0.6 milligram level laid the heaviest eggs, while those receiving the 0.8 level laid the lightest eggs; however, hens in pen 28, the 0.2 level, had the heaviest eggs for a single pen. The thickest shells were produced by the 0.4 milligram level and the thinnest by the 0.0 and 0.8 levels. The 0.0 and 1.0 milligram levels had the highest Haugh unit reading, and the 0.6 and 0.8 levels had the lowest Haugh unit reading.

The largest percentage of fertile eggs was obtained with the 0.4 milligram level, and the lowest by the 0.0 level. Hens receiving the 0.8 milligram level had the highest percentage hatch of fertile eggs, and the 0.4 level the lowest. Sexual maturity was latest with the 0.4 milligram and 1.0 levels and earliest with the 0.0 and 0.8 levels. Hens receiving the 0.8 milligram level had the heaviest body weight, the 0.6 level the lowest body weight.

The negative results found here tend to agree with other workers' results, in that the optimum level of reserpine was approximately 2.0

TABLE III

EFFECTS OF RESERPINE ON EGG PRODUCTION, EGG WEIGHT, SHELL THICKNESS, INTERIOR EGG QUALITY, BODY WEIGHT AND CERTAIN REPRODUCTIVE TRAITS

Treat.[1]	Pen no.	Percent egg prod.	Adj. feed cons. (lbs.)	Ave. egg wt. (gm.)	Ave. shell thick.	Ave. Haugh units	Percent fert.	Percent[2] hatch fert.	Days to first egg	Ave. body wt. (lbs.)
0.0	6	57.7	2287	61.1	.0118	79.4	92.0	73.1	170	4.22
	29	63.5	2187	60.3	.0110	77.5	98.4	88.6	168	4.20
	33	54.7	2274	61.4	.0115	78.8	67.0	78.0	172	4.33
	55	57.4	2243	60.2	.0117	78.0	93.7	84.6	166	4.07
	Ave.	58.5	2248	60.7	.0115	78.4	89.2	81.8	169	4.20
0.2	1	48.7	2220	61.3	.0116	79.8	94.7	80.0	178	4.16
	28	52.9	2146	64.8	.0118	79.7	89.7	74.3	179	4.18
	32	64.0	2304	60.7	.0112	73.6	100.0	80.7	165	4.18
	56	59.4	2252	59.2	.0118	76.4	96.0	85.6	174	4.09
	Ave.	56.1	2230	61.2	.0116	77.0	95.0	80.0	174	4.15
0.4	3	48.0	2139	62.2	.0128	77.0	100.0	73.4	180	4.18
	25	56.3	2252	58.7	.0116	78.9	97.0	77.6	169	4.19
	35	55.0	2370	62.4	.0112	80.1	96.8	81.1	177	4.21
	57	57.6	2148	61.3	.0117	77.4	96.4	82.1	184	4.07
	Ave.	54.3	2227	60.9	.0119	78.3	97.5	78.6	178	4.16

0.6	5	56.0	2239	59.0	.0117	75.0	97.3	87.2	174	4.06
	27	53.8	2248	63.3	.0118	75.0	94.6	78.1	175	4.14
	31	49.6	2266	62.1	.0114	78.3	100.0	70.9	171	4.19
	60	60.8	2234	61.6	.0114	77.2	90.5	79.0	173	4.12
	Ave.	55.3	2247	61.6	.0116	76.3	95.0	78.9	174	4.13
0.8	4	61.0	2312	60.0	.0115	76.1	99.1	80.0	168	4.16
	26	57.0	2253	60.1	.0115	75.4	99.0	87.7	170	4.25
	34	60.0	2246	60.0	.0116	76.4	84.2	87.1	168	4.47
	59	52.7	2195	57.5	.0114	77.5	97.8	80.7	171	4.14
	Ave.	57.7	2252	59.4	.0115	76.3	94.8	83.6	169	4.26
1.0	2	56.1	2276	60.4	.0119	77.6	95.7	86.4	189	4.25
	30	55.6	2339	62.1	.0117	79.3	91.9	74.6	180	4.52
	36	60.5	2178	60.2	.0115	77.5	82.2	81.4	164	4.00
	58	55.6	2270	60.3	.0117	79.3	95.6	84.9	177	4.18
	Ave.	57.0	2266	60.7	.0117	78.4	90.7	82.0	178	4.24
					Calculated F					
Treatment		.445	.176	1.02	.625	1.26	1.01	1.35	1.89	.764
Block		.441	.583	1.08	2.37	.018	1.59	.369	1.70	1.69
					Relative Efficiency					
		92.72	94.56	82.95	117.81	83.77	108.01	91.77	109.08	108.96

[1] Milligrams of reserpine per kilogram of diet.

[2] Percentage hatch of fertile eggs.

milligrams per kilogram of diet.

There are several factors the researcher should consider before the trial is started, and after it is analyzed. These factors will generally fall into two categories; (1) the experimental unit used, and (2) the physical facilities employed.

The experimental unit should be a random sample of the population. If it is not a random sample the results may not be applicable to other conditions and other samples of the population. This is the reason for using a commercial strain of birds. If a closed flock had been used, it might not have been a true sample of birds now used for commercial purposes.

The experimental design to be used is a question that must be answered very carefully. This will be determined by the variation in the house among different locations. It was believed that a location gradient existed in this house; therefore, the randomized complete block design was used. Unless a uniformity trial is run, the researcher will not know definitely where the gradient is until sufficient experiments have been conducted.

The relative efficiency analysis will give an indication as to which design is the most efficient. If the relative efficiency reaches 120 or above, the randomized complete block design would be applicable (Cochran and Cox, 1957). Therefore, from Table III it can be seen that, under the conditions of this experiment, very little efficiency was gained by using the randomized complete block design.

When the data in an analysis are in either high or low percentages (above 70 or below 30), a transformation may be needed (Bartlett, 1947). He gives the transformation as the arcsin $\sqrt{\text{percentage}}$. This transformation makes a more normal distribution from the binomial distribution of the percentages. This is done by decreasing the value of the large numbers and increasing the value of the small numbers. Such a transformation was made on the percentage of fertile eggs and the percentage hatch of fertile eggs. The calculated F value for the percentage and transformation of these two measurements is shown in Table IV. As can be seen from this table, there was a difference in the value obtained. However, the null hypothesis was not rejected in either case. This tends to indicate the ability of the F test to give a valid answer although all of the assumptions of the F test are not met.

TABLE IV

CALCULATED F FOR PERCENTAGE AND ARCSIN $\sqrt{\text{PERCENTAGE}}$

	Treatment	Block
Hatch of fertile eggs		
Percent	1.35	0.37
Transformation	0.50	0.32
Fertile eggs		
Percent	1.01	1.59
Transformation	0.91	0.54

The summary and analysis of Trial II are presented in Table V. Shown are the means by treatment for the following observations: initial weight, weight gain, feed consumption, initial body temperature, and final body temperature. The calculated F values are listed at the bottom of the table. From Table V it can be seen that only three of the traits show treatment effects. The F value indicated a real difference existing due to treatment (at the 95 percent level of probability) for weight gain, and a difference due to treatment (at the 99.9 percent level) for feed consumption. The probability level for effect of treatment on final body temperature was about 75 percent.

TABLE V

MEANS BY TREATMENT FOR TRIAL II

Treatment[1]	Initial wt. lbs.	Weight gain lbs.	Feed cons. Kgm.	Initial body temp.[2]	Final body temp.[2]
0	2.626	.540	2.067	108.2	107.6
153.37	2.852	.428	2.007	108.2	107.2
206.74	2.752	.540	2.003	108.2	107.1
613.48	2.790	.428	1.803	108.0	106.8
1226.96	2.776	.316	1.531	108.2	107.3
MS Error	.0463	.01343	.03884	.14	.171
F	.7914	3.269*	6.246***	.25	2.191

[1]Milligrams of trifluoperazine per kilogram of diet.

[2]Degrees Fahrenheit.

*P = < 0.05

***P = < 0.001

It then becomes of interest to determine which of the treatments differ. To assist in doing this, Duncan's Multiple Range Test is used (Duncan, 1955). In this technique the treatment means are ranked in order of magnitude, and a line is drawn underscoring those means which are not significantly different. The results are shown in Table VI.

TABLE VI

DUNCAN'S MULTIPLE RANGE TEST APPLIED TO FEED CONSUMPTION AND BODY WEIGHT GAIN DATA OBTAINED IN TRIAL II

	Feed consumption (99% level)				
Treatment[1]	1226.96	613.48	306.74	153.37	0
Mean[2]	1.531	1.803	2.003	2.007	2.067

	Weight gain (95% level)				
Treatment[1]	1226.96	613.48	153.37	306.74	0
Mean[3]	0.316	0.428	0.428	0.540	0.540

[1]Milligrams of trifluoperazine per kilogram of diet.
[2]Expressed as kilograms
[3]Expressed as pounds

In the case of feed consumption, it can be seen that the 1226.96 level of trifluoperazine did not differ from the 613.48 level, but did differ from the other levels. In the weight gain the only difference was between the high level and all other levels. The 153.37 and 306.75 levels appeared to show an effect on the feed consumption, but are the only levels which did not show a significant or marked effect. Because they maintained their growth while possibly consuming less feed than the controls, they were selected as the two levels to be used in Trial III.

The summary and analysis of Trial III are presented in the following tables: percentage egg production by periods on hen-day basis, Table VII; adjusted feed consumption in pounds by periods on hen-day basis, Table VIII; factor representing ratio of percent egg production to pounds of feed consumed on hen-day basis, Table IX; mean body weight by periods based on pen weights, Table X; treatment means of egg quality factors, Table XI; and treatment means of hatchability, Table XII.

Five mutually orthogonal comparisons were made on treatments and three on blocks (Snedecor, 1956). These comparisons are given in Table XIII. In the table of comparisons, the first one compares the control with all other treatments. The second compares the reserpine treatments with the trifluoperazine treatments. The third compares the two levels of trifluoperazine. The fourth compares the middle level of reserpine with the low and high levels of reserpine. The fifth compares the low and high levels of reserpine. In the comparisons of blocks, the first compares the two sides of the house. The second compares the two ends of the house. The third compares the house diagonally. The importance of these comparisons will be discussed further as they become of consequence. Comparison one for treatments has little importance in this study since it compares the control with all other treatments. Since the treatments are made up of two drugs, any interpretation would involve comparing the category drugs with control.

In Table VII the percentage egg production is given as treatment means for each period. The significance of comparison one, period one, is probably due to chance. Comparison two is significant in a majority of the periods. It will be noted that the cause of this significance reverses during the sixth period. The trifluoperazine treatments were

TABLE VII

PERCENTAGE EGG PRODUCTION BY PERIODS ON HEN-DAY BASIS

Treatment	Periods 1	2	3	4	5	6	7	8	9
0.0	45.6	76.2	79.1	82.0	79.5	77.0	77.8	71.9	70.1
1.5 Res.	32.9	71.6	78.6	80.6	80.3	78.4	76.5	69.4	65.5
2.0 Res.	32.8	73.0	79.1	80.1	79.2	76.7	77.3	74.4	71.0
2.5 Res.	35.6	76.9	83.1	82.5	80.0	72.8	72.9	63.1	61.1
153.4 Tri.	41.5	75.7	82.7	84.2	83.3	71.4	67.2	60.5	62.3
306.7 Tri.	36.8	80.7	87.8	88.3	84.8	75.0	67.6	59.0	57.1
Period mean	37.5	75.7	81.7	83.0	81.2	75.2	73.2	66.4	64.5

Comparison	Sum of squares for treatments								
1	310.1*	1.5	31.8	5.2	33.6	15.6	99.9	145.0*	145.6**
2	139.3	95.5	122.8	131.2*	86.7*	38.1	318.5**	393.1**	154.4**
3	44.6	50.0	51.0	33.2	4.8	25.9	0.4	2.6	36.6
4	6.0	4.2	7.8	5.2	1.8	3.4	18.7	181.5*	157.1**
5	13.5	55.1	37.4	8.0	0.1	63.3	25.2	75.6	36.1

	Sum of squares for replicates								
1	1.6	104.2	52.2	26.2	32.0*	95.2*	172.3*	2.2	20.2
2	102.1	10.4	36.0	29.3	7.6	0.0	1.4	42.4	127.0**
3	2.9	10.1	0.4	15.8	13.6	31.3	67.7	225.1**	200.7***
Error M.S.	40.2	36.4	27.8	18.9	10.3	26.0	31.3	25.6	11.9

*P = < 0.05   **P = < 0.01   ***P = < 0.001

TABLE VIII

ADJUSTED FEED CONSUMPTION IN POUNDS BY PERIODS ON HEN-DAY BASIS

Treatment	Periods 1	2	3	4	5	6	7	8	9
0.0	606.6	653.2	697.4	667.6	694.2	630.2	609.3	574.2	572.5
1.5 Res.	609.1	662.4	702.4	676.4	693.8	604.4	593.0	556.5	555.2
2.0 Res.	611.3	665.4	705.6	681.3	691.7	598.2	606.0	565.4	574.2
2.5 Res.	617.6	663.9	715.4	679.1	682.3	578.5	601.7	492.7	526.0
153.4 Tri.	611.9	644.2	682.1	660.2	623.7	522.9	513.6	491.7	540.2
306.7 Tri.	608.3	622.6	656.4	641.3	633.6	508.6	501.0	494.8	505.6
Period mean	610.8	652.0	693.2	667.7	669.9	573.8	570.8	529.2	545.6
Comparison	**Sum of squares for treatments**								
1	5.3	0.4	5.2	0.0	177.0***	924.2***	445.4*	607.0	216.8*
2	2.0	279.8**	445.8***	238.3***	1102.3***	1904.8***	2591.0***	606.2	250.6*
3	1.6	58.3	82.6	44.6	12.2	25.6	19.8	1.2	149.6
4	0.7	0.3	1.8	2.1	2.2	2.9	12.5	277.4	188.2*
5	9.0	0.2	21.1	0.9	16.0	121.0*	9.5	508.8	106.6
	Sum of squares for replicates								
1	16.7	10.5	21.8	0.1	9.2	2.3	2.8	38.2	1.8
2	16.0	555.8***	39.3	3.8	46.8	7.0	46.5	744.8*	448.1**
3	0.9	0.4	0.6	0.0	1.1	97.6*	0.0	359.6	132.1
Error M.S.	17.0	19.3	21.7	14.2	12.3	18.5	65.0	144.0	36.8

*P = < 0.05 **P = < 0.01 ***P = < 0.001

TABLE IX

FACTOR REPRESENTING RATIO OF PERCENT EGG PRODUCTION TO POUNDS OF FEED CONSUMED ON HEN-DAY BASIS[1] GIVEN AS TREATMENT MEANS BY PERIODS

Treatment	Periods 1	2	3	4	5	6	7	8	9
0.0	30.0	46.8	45.4	49.1	45.2	48.9	51.1	50.1	49.0
1.5 Res.	21.7	43.3	44.8	47.7	46.2	51.9	51.6	49.8	47.1
2.0 Res.	21.4	44.0	44.8	47.0	45.8	51.3	51.0	52.6	49.4
2.5 Res.	23.0	46.4	46.4	48.6	46.9	50.3	49.0	51.2	46.5
153.4 Tri.	27.1	47.0	48.5	51.0	53.4	54.6	52.3	49.2	46.1
306.7 Tri.	26.9	51.8	53.5	55.2	53.8	58.8	54.0	47.9	45.9
Period mean	25.0	46.6	47.2	49.8	48.6	52.6	51.5	50.1	47.3

Comparison	Sum of squares for treatments								
1	120.4*	0.2	16.0	2.3	54.4**	67.5**	0.7	0.4	13.8
2	118.8*	111.6*	155.0***	136.5**	253.5***	145.2***	31.7	52.5	13.1
3	0.2	46.6	51.0*	33.6	0.2	36.1*	5.0	2.6	0.2
4	2.3	1.9	1.6	3.3	1.4	0.1	1.6	4.8	17.8
5	3.2	19.2	5.1	1.7	0.8	5.0	13.8	17.7	1.2

	Sum of squares for replicates								
1	5.0	30.2	30.8	10.3	16.0	43.7*	80.7*	8.0	12.8
2	24.8	73.2*	2.5	5.3	0.2	1.5	1.1	44.0	0.8
3	9.4	3.0	0.0	5.3	3.1	0.1	25.6	61.6	40.8
Error M.S.	16.9	11.3	7.8	8.9	4.9	7.5	17.8	24.5	8.6

[1]Coded 10-2 *P = < 0.05 **P = < 0.01 ***P = < 0.001

TABLE X

MEAN BODY WEIGHT BY PERIODS BASED ON PEN WEIGHTS

Treatment	Periods 1	2	3	4	5	6	7	8	9
0.0	4.02	4.05	4.15	4.21	4.27	4.29	4.30	4.34	4.32
1.5 Res.	4.06	4.09	4.14	4.26	4.31	4.24	4.24	4.25	4.26
2.0 Res.	4.07	4.09	4.12	4.24	4.28	4.24	4.26	4.26	4.24
2.5 Res.	4.00	4.04	4.16	4.26	4.24	4.18	4.19	4.16	4.16
153.4 Tri.	4.04	4.14	4.20	4.29	4.11	4.07	4.17	4.09	4.21
306.7 Tri.	4.06	4.14	4.19	4.27	4.08	3.97	3.93	4.03	4.00
Period mean	4.04	4.09	4.16	4.26	4.22	4.17	4.18	4.19	4.20
Comparison	**Sum of squares for treatments**								
1	0.002	0.007	0.0	0.009	0.006	0.076**	0.064	0.110**	0.070*
2	0.0	0.024	0.012	0.005	0.148***	0.197***	0.155**	0.117**	0.603*
3	0.001	0.0	0.001	0.0	0.002	0.022	0.113*	0.005	0.074*
4	0.005	0.001	0.003	0.002	0.0	0.002	0.005	0.009	0.002
5	0.010	0.004	0.0	0.0	0.012	0.007	0.007	0.190	0.200
	Sum of squares for replicates								
1	0.007	0.001	0.018	0.005	0.0	0.0	0.001	0.001	0.004
2	0.0	0.026	0.040	0.010	0.040	0.029	0.025	0.001	0.062*
3	0.0	0.002	0.003	0.002	0.0	0.014	0.042	0.032	0.018
Error M.S.	0.008	0.012	0.015	0.009	0.133	0.089	0.0143	0.0123	0.012

*P = < 0.05   **P = < 0.01   ***P = < 0.001

TABLE XI

TREATMENT MEANS OF EGG QUALITY FACTORS FOR SIX PERIODS

	March			April			May		
Treatment	Egg weight	Shell thick.[1]	Haugh units	Egg weight	Shell thick.[1]	Haugh units	Egg weight	Shell thick.[1]	Haugh units
0.0	54.6	1.35	82.0	55.4	1.34	84.2	56.1	1.25	80.7
1.5 Res.	55.4	1.33	83.2	55.4	1.32	83.4	56.5	1.23	80.3
2.0 Res.	55.2	1.34	85.9	56.0	1.34	85.4	56.8	1.23	83.1
2.5 Res.	54.8	1.34	82.9	54.9	1.32	83.9	55.9	1.24	80.9
153.4 Tri.	54.3	1.30	83.1	54.5	1.31	83.9	55.7	1.23	80.7
306.7 Tri.	54.6	1.26	83.6	54.2	1.30	84.4	55.0	1.22	81.5
Mean	54.8	1.32	83.5	55.1	1.32	84.2	56.0	1.23	81.2
Comparison	Sum of squares for treatments								
1	0.21	58.80*	9.24	0.42	18.41	0.02	0.04	14.01	1.16
2	1.88	114.08***	1.22	5.55*	26.13	0.01	6.12***	6.53	0.55
3	0.08	28.12	0.45	0.12	4.50	0.45	0.91	4.50	1.36
4	0.06	1.50	23.60***	1.98	12.04	9.38	0.67	0.17	17.85
5	0.84	2.00	0.32	0.66	1.12	0.32	0.72	4.50	1.36
	Sum of squares for replicates								
1	0.08	2.67	0.57	0.07	12.04	0.92	0.11	2.04	2.80
2	1.04	2.67	0.09	0.05	0.04	3.45	0.00	22.04	2.04
3	0.67	16.67	0.01	0.18	0.38	2.60	1.13	22.04	1.31
Error M.S.	1.77	9.70	2.14	0.68	7.00	4.354	0.33	7.60	4.70

	June			July			August		
Treatment	Egg weight	Shell thick.[1]	Haugh units	Egg weight	Shell thick.[1]	Haugh units	Egg weight	Shell thick.[1]	Haugh units
0.0	56.5	1.23	80.5	56.9	1.26	79.4	57.4	1.27	77.6
1.5 Res.	57.0	1.20	80.1	57.3	1.26	78.5	57.3	1.24	78.2
2.0 Res.	57.2	1.21	81.9	56.5	1.24	81.8	57.4	1.25	79.7
2.5 Res.	56.7	1.23	80.2	56.3	1.27	78.9	56.8	1.28	77.9
153.4 Tri.	56.0	1.22	80.1	56.1	1.26	78.8	56.9	1.26	78.0
306.7 Tri.	55.1	1.19	81.1	55.5	1.22	79.9	55.8	1.22	79.0
Mean	56.4	1.21	80.7	56.4	1.25	79.6	56.9	1.25	78.4
Comparison				Sum of squares for treatments					
1	0.02	12.03	0.08	1.01	12.68	0.08	0.82	18.41	2.58
2	9.35*	5.00	0.14	3.82	6.08	0.66	2.05	17.63	0.01
3	1.53	18.00	2.10	0.60	28.12	2.53	2.10	32.00	2.20
4	0.35	1.50	7.71	0.35	18.38	25.01*	0.40	2.67	0.55
5	0.21	8.00	0.04	2.10	1.12	0.36	0.28	32.00	0.28
				Sum of squares for replicates					
1	0.40	0.67	4.95	0.01	0.04	0.81	1.35	5.04	0.20
2	0.22	42.67*	0.77	1.76	7.04	0.02	2.34	22.04	15.36*
3	1.98	8.17	1.35	2.34	3.38	0.08	1.00	18.38	0.48
Error M.S.	0.60	8.60	3.87	1.05	11.00	5.32	1.27	11.00	2.51

[1]Coded 10-2 *P = < 0.05 **P = < 0.01 ***P = < 0.001

TABLE XII

TREATMENT MEANS OF HATCHABILITY[1]

Treatment	1st Hatch Fertility	1st Hatch Hatch of fertile eggs	2nd Hatch Fertility	2nd Hatch Hatch of fertile eggs	3rd Hatch Fertility	3rd Hatch Hatch of fertile eggs
0.0	85.92	76.26	87.87	68.28	75.94	71.76
1.5 Res.	84.45	69.64	79.86	67.94	80.54	67.78
2.0 Res.	82.83	76.17	80.19	68.53	81.87	68.36
2.5 Res.	81.85	75.19	84.56	70.18	78.32	64.67
153.4 Tri.	83.86	74.19	80.90	68.70	80.72	69.73
306.7 Tri.	76.26	78.70	79.37	73.05	76.56	67.21

[1]Arcsin $\sqrt{\text{percentage}}$ transformation

Comparison	Sum of squares for treatments					
1	55.07	7.30	66.53	4.97	53.77	23.85
2	43.04	37.11*	18.72	15.96	22.28	26.60
3	115.60	40.64*	33.54	36.04	51.76	96.88
4	0.24	37.55*	23.52	1.00	5.12	0.64
5	13.52	61.60**	16.19	14.66	4.70	0.08

	Sum of squares for blocks					
1	58.94	8.59	53.07	2.60	14.74	40.98
2	20.89	2.21	0.06	0.26	73.54	307.16*
3	4.39	3.89	28.84	3.02	3.19	578.99**
E.M.S.	48.25	6.83	42.36	28.91	75.91	48.71

*P = $<$ 0.05 **P = $<$ 0.01

TABLE XIII

ORTHOGONAL COMPARISONS ON TREATMENTS AND ON BLOCKS

Comparison	Treatments[1]					
	0.0	1.5	2.0	2.5	153	306
1 Control vs. other treatments	-5	+1	+1	+1	+1	+1
2 Reserpine vs. trifluoperazine		-2	-2	-2	+3	+3
3 High vs. low trifluoperazine					-1	+1
4 Quadratic with reserpine		-1	+2	-1		
5 Linear with reserpine		+1		-1		

Comparison	Blocks[2]			
	1	2	3	4
1 Sides S.W. & S.E. vs. N.W. & N.E.	+1	+1	-1	-1
2 Ends S.W. & N.W. vs. S.E. & N.E.	-1	+1	+1	-1
3 Diagonal S.W. & N.E. vs. S.E. & N.W.	-1	+1	-1	+1

[1]Tranquilizer levels expressed as milligrams per kilogram of diet.
[2]Physical location of the laying pens.

higher during the first part of the study but lower during the last part. Comparison four indicates a quadratic effect of reserpine on egg production during the last two periods, which were the periods of high temperature.

Due to the many variables which might be present, it is impossible to explain the erratic differences among blocks. These variables could include a consistent wind direction, topographical gradient, differences in amount of direct sunlight, and because of the above, a Treatment X Block interaction. If interaction were present the main effects would, technically speaking, have no meaning. This interaction, if present, could be removed in further studies by replicating treatments within blocks.

Comparison two, Table VIII, indicated the ability of trifluoperazine to decrease feed consumption. This decrease was significant for all periods except periods one and eight. As stated previously the significant difference in comparison one was expected. The two significant differences found in comparisons four and five may be only chance since there were 16 other such constants which were not significant. Although not significant, it is of interest to note, as was expected, the hens receiving the high level of trifluoperazine in the majority of the periods consumed less feed than those receiving the low level.

The importance of using the randomized block can be illustrated again in the second comparison for the sum of squares of blocks (Table XIII). This indicated a significant difference between ends of the house for periods two, eight, and nine.

It has been pointed out in previous tables that trifluoperazine increased egg production and decreased feed consumption. The question now arises as to whether treatment altered the ratio of egg production to volume of feed consumed. From comparison two, Table IX, it can be seen that the trifluoperazine treatments resulted in a higher percentage of egg production per volume of feed consumed than did the other treatments. This difference was significant from the second period through the sixth. The importance of computing this ratio can be seen when this comparison is considered with the same comparisons for egg production and feed consumption. The differences in egg production did not reach significance until the fourth period and in feed consumption not until the second period. However, differences in egg production were significant for the last three periods and differences in feed consumption were significant, or approached significance, for the same periods. Thus there may be no difference for these two measurements when calculated separately; however, when calculated combined as a ratio, significant differences were detectable.

Although hens receiving the trifluoperazine treatments consumed less feed, they maintained body weight proportional to the other experimental units through the fourth period (see comparison two, Table X). From the fifth period until the end of the study they had significantly less weight. Again, the hens receiving the high level of trifluoperazine, after the first two periods, weighed less than those receiving the low level. In the block sum of squares, although it was significant for only one period, comparison two contained the majority of the sum of squares in seven of the nine periods.

Egg quality data are presented in Table XI. As can be seen in comparison two, trifluoperazine appeared to decrease egg weight and shell thickness but did not affect Haugh units. This comparison for egg weight was significant for three collection periods. Although the difference in shell thickness for this comparison was significant only once, and approached significance a second time, it will be noted that the high level of trifluoperazine produced the thinnest shells in all periods. The above results could be expected when the past discussion on egg production and feed consumption is considered.

Another point of interest in Table XI is comparison four for Haugh units. Although differences represented in this comparison were significant only twice, in all but one of the collection periods it contained the majority of the treatment sum of squares.

It appears from these data that there was no difference in block sum of squares with regard to egg quality factors.

Under the conditions of this experiment there appeared to be no effect of treatment on hatchability, Table XII. The significant difference obtained in the hatch of fertile eggs in the first hatch may have been due to chance. The error mean square for these comparisons was considerably lower than the other error mean squares.

Since there appeared to be no explanation for the significance found in the block sum of squares for the third hatch, this may have been due to chance. If a trend had been evident in the other hatches for these comparisons, a statement could possible be made.

SUMMARY AND CONCLUSIONS

In three trials a total of 985 Single Comb White Leghorn pullets were fed two tranquilizers, reserpine and trifluoperazine, in an attempt to determine the effects of these tranquilizers on mature laying hens. Reserpine treatment levels were 0.2, 0.4, 0.6, 0.8, 1.0, 1.5, 2.0, and 2.5 milligrams per kilogram of diet. The trifluoperazine treatment levels were 153.37, 306.74, 613.48, and 1226.96 milligrams per kilogram of diet.

No treatment effects were detected in Trial I, where the maximum level of reserpine was 1.0 milligram per kilogram of diet.

A significant difference due to treatment was obtained in Trial II. Because the trifluoperazine levels of 153.37 and 306.74 maintained body weight on less feed, they were used in Trial III.

In Trial III, reserpine fed at the 2.0 level appeared to maintain egg production during mid-summer weather and possibly improved the interior quality of the egg as measured by Haugh units.

Trifluoperazine levels of 153.37 and 306.74 increased the ratio of egg production to the volume of feed consumed. This ratio remained significant throughout the major portion of the trial. The egg production for the trifluoperazine treatments, however, was below the average egg production for all treatments in the later periods. There was some indication that these levels decreased egg weight. The birds on these treatments also had significantly lower body weights than did those on the other treatments. With these results in mind, it would be of interest in further studies to increase the feed nutrient intake per volume of feed consumed. If this were done, the egg production, weight, and shell thickness of these treatments might possibly be maintained.

The results of Trials I and III illustrate the necessity of using the randomized complete block design when using this building. Since one block may not affect all treatments the same as the other blocks, thus getting a Treatment X Block interaction, it might be of value in further studies to replicate treatments within blocks. Thus, if Treatment X Block interaction were present it could be measured.

SELECTED BIBLIOGRAPHY

Anderson, D. L. and J. R. Smyth, Jr., 1959. Effect of serpasil on caged layers-thyroid and cholesterol relationships. Conference on the use of the tranquilizing and antihypertensive agent serpasil in animal and poultry production. CIBA Pharmaceutical Products Inc.; Summit, New Jersey. 44-50.

Ayrd, Frank J., Jr., 1957. A critique of chlorpromazine and reserpine therapy. Tranquilizing Drugs, A.A.A.S., Washington, D. C. pp. 173-181.

Babcock, J. J. and N. W. Taylor, 1957. Effect of meprobamate on growth and feed efficiency of chickens. Poultry Sci. 36:485-487.

Bartlett, M. S., 1947. The use of transformations. Biometrics 3:39-52.

Burger, R. E., 1959. Protective action of serpasil in broilers exposed to thermal stress. Conference on the use of the tranquilizing and antihypertensive agent serpasil in animal and poultry production. CIBA Pharmaceutical Products Inc.; Summit, New Jersey. 58-66.

_______, N. S. Van Matre and F. W. Lorenz, 1959. Growth and mortality of chicks and poults fed tranquilizing drugs. Poultry Sci. 38:508-512.

Carlson, C. W. and W. C. Morgan, 1958. Some effects of reserpine on pheasants. Proc. South Dakota Acad. of Sci. 37:48-52.

_______, 1956. An effect of reserpine on growing turkeys. Proc. South Dakota Acad. of Sci. 35:186-188.

Cochran, William G. and G. M. Cox, 1957. Experimental Designs. John Wiley and Sons, Inc.; New York.

Couch, J. R., 1959. Reserpine in poultry nutrition. Conference on the use of the tranquilizing and antihypertensive agent serpasil in animal and poultry production. CIBA Pharmaceutical Products Inc.; Summit, New Jersey. 36-39.

Duncan, D. B., 1955. Multiple range and multiple F. Test. Biometrics 11:1.

Garren, Henry W. and C. H. Hill, 1957. The effects of continually feeding tranquilizing agents to young White Leghorns. Poultry Sci. 36:1386-1387.

Gilbreath, J. C., L. F. Garvin and Q. B. Welch, 1959. Effect of orally administered reserpine on egg production and quality. Poultry Sci. 38:535-538.

Hewitt, Oliver H. and R. E. Reynolds, 1957. Tranquilizers in rearing game birds. Proc. Cornell Nutr. Conf. 53-60.

________, 1959. The use of serpasil in the rearing and handling of pheasants. Conference on the use of the tranquilizing and anti-hypertensive agent serpasil in animal and poultry production. CIBA Pharmaceutical Products Inc.; Summit, New Jersey. 40-43.

Pennington, Veronica M., 1957. Meprobamate, a tranquilizing drug with muscle relaxant properties in psychotic cases. Tranquilizing Drugs, A.A.A.S., Washington, D. C. pp. 125-131.

Ringer, Robert K., 1959. Influence of reserpine on early growth, blood pressure and dissecting aneurysms in turkeys. Conference on the use of the tranquilizing and antihypertensive agent serpasil in animal and poultry production. CIBA Pharmaceutical Products Inc.; Summit, New Jersey. 21-28.

Scheidy, S. F., 1959. Personal communication.

Snedecor, G. W., 1956. Statistical Methods. Iowa State College Press; Ames, Iowa.

Troughton, Sibyl E., G. N. Gould and J. A. Anderson, 1955. A report on the use of chlorpromazine hydrochloride in domestic animals. The Veterinary Record 67:903-906.

Weiss, Harold S., 1959. Protective effect of serpasil in laying birds against high lethal temperatures. Conference on the use of the tranquilizing and antihypertensive agent serpasil in animal and poultry production. CIBA Pharmaceutical Products Inc.; Summit, New Jersey. 51-57.

Welsh, Aston L., 1958. Psychotherapeutic Drugs. Charles C. Thomas; Springfield, Illinois.

Wilson, E. Bright, 1952. An Introduction to Scientific Research. McGraw-Hill Book Co., Inc.; New York.

VITA

Robert Ellis Waggoner

Candidate for the Degree of

Master of Science

Thesis: EFFECTS OF RESERPINE AND TRIFLUOPERAZINE ON REPRODUCTIVE PERFORMANCE IN CHICKENS

Major Field: Poultry Management

Biographical:

Personal data: Born near Amity, Arkansas, June 2, 1933, son of Arlington and Mary Alma Waggoner.

Education: Undergraduate study: Bachelor of Science in Agriculture with a major in Poultry Science from University of Arkansas, May, 1958.

Experiences: United States Marine Corps, August, 1951 to August, 1954. Part-time and full-time employee of Department of Animal Industry and Veterinary Medicine while an undergraduate. Research assistant, Poultry Science Department, Oklahoma State University, September, 1958 to August, 1960.

Organizations: Alpha Zeta and Poultry Science Association.

Date of Final Examination: July, 1960.