THE EFFECTS OF ANTIBIOTICS ON THE REPRODUCTIVE PERFORMANCE OF FEMALE TURKEYS

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CHAPTER I

INTRODUCTION

One of the most serious problems of the commercial turkey breeder is the high cost of the day-old turkey poult. The main factors involved in this high poult cost are the low fertility of the turkey eggs and the comparatively poor hatchability of the fertile eggs. With the development of the artificial insemination technique for turkeys some of these problems have been alleviated. At the same time, however, artificial insemination also created several new problems. One problem which seems to be typical with most turkey flocks is the loss in percentage fertility with time. As the breeding season progresses, the fertility shows an unexplained decline even in flocks in which the initial fertility was high. This loss in fertility causes a substantial financial burden upon the breeder and the industry. The low fertility may be caused by poor insemination techniques, or it may depend upon the reproductive physiology of the male or the female, or the interaction of these factors. Brown (1965) suggested that subclinical infections of Mycoplasma Gallisepticum, paracolon, or other specific pathogens might also cause low fertility. Indeed, these infections can be a definite deterrent to good fertility because these local infections can inhibit the activity or shorten the life span of spermatozoa. Very limited reports are available to show the value of routine prophylaxis through the use of antibiotics. Thus, any successful development of a technique to inhibit subclinical infections or at least to decrease the frequency of infections of the female reproductive tract during the breeding season could prevent a decline in the fertility.

The microbiological phase of this study will be presented in a separate report to be prepared by the Department of Pathology and Public Health in the Veterinary Medical College, Oklahoma State University.

The object of the experiments reported herein is to investigate the effect of the administration of antibiotics on the reproductive performance of mature turkey breeders.

CHAPTER II

LITERATURE REVIEW

A series of experiments was conducted by Carlson et al. (1952) involving seven hundred and twenty White Plymouth Rock pullets and New Hampshire pullets during two laying and hatching seasons. Pencillin and strepotomycin were added separately to the mash portion of practical type mash-grain diets in this study. An analysis of the data indicated that the egg production and hatchability were improved by both antibiotics. The streptomycin seemed to have a more favorable effect upon these traits than did the pencillin.

Sunde et al. (1952) reported that there was no evidence to indicate that a 0.25 percent antibiotic feed supplement (Lederle #5) improved egg production or hatchability in Single Comb White Leghorn pullets. Lederle #5 was stated to contain at least 1.8 gms. aureomycin per pound.

Peterson et al. (1952) reported that the inclusion of a vitamin B_{12}-antibiotic feed supplement in an all-plant protein ration fed to Single Comb White Leghorn pullets improved egg production and hatchability. This may have been due to either its vitamin B_{12} content, its aureomycin content, or to both. A similar experiment was conducted by Lillie and Sizemore (1954). High and low-producing New Hampshire pullets of a meat-type strain were used in this test. Egg production was improved in the low egg producers, but not in that of the high egg producers.

It was reported by Sizemore et al. (1953) that the hatchability of eggs produced by birds reared on antibiotic-supplemented diets was greater than the hatchability of eggs produced by birds reared without antibiotics when the breeder diet was deficient in vitamin B_{12}. Antibiotics in the growing diet had no such effect if a breeder diet containing ample B_{12} was fed. Crystalline aureomycin added to a vitamin B_{12} deficient breeder diet increased hatchability. The antibiotic supplement (0.5 percent) which was used in this study contained 1.8 mgs. vitamin B_{12} and 1.8 gms. aureomycin hydrochloride per pound.

Elam et al. (1953) reported that the prolonged feeding of antibiotics to New Hampshire pullets resulted in increased egg production and hatchability. Also, the parenteral administration of penicillin, penicillin-in-oil, inactivated penicillin, and inactivated pencillin-in-oil resulted in increased egg production and hatchability. The injection of antibiotics-in-water, however, failed to increase hatchability. Bacitracin was also studied in this trial at 33 mgs./kg. of diet and 1.2 mgs. injection intramuscularly per bird per week. A significant increase in egg production and hatchability were obtained only from the oral administration of bacitracin.

It was reported by Waikel et al. (1952) that the addition of penicillin to a practical breeder diet at the levels of 5 and 200 mgs./kg. of diet for Single Comb White Leghorn pullets resulted in no measurable effect on egg production or hatchability for an experimental period of ten months.

Peterson and Lampman (1952) observed that antibiotics did not improve egg production. Procaine penicillin, streptomycin, and tenamycin hydrochloride were used in this study. Each antibiotic was included separately in the ration of duplicate lots of sixty-five Single Comb White Leghorn pullets during the first year of egg production. Feed intake level of antibiotics was approximately 9 gms. of each antibiotic per ton of total feed.

Penicillin was added by Brown et al. (1953) to three practical-type breeder rations fed to Single Comb White Leghorn pullets. They reported that there was no effect on rate of production due to penicillin during a trial lasting for three hundred and thirty-six days. Fertility and hatchability of eggs produced were likewise not affected by the addition of pencillin to the ration. The antibiotic was added as Merck APF-8 supplement.

Sherwood and Milby (1953) reported that neigher 20 gms. nor 180 gms. of aureomycin per ton of mash had any effect on the reproductive characteristics. Both White Plymouth Rock and Single Comb White Leghorn pullets were used in this test.

In an extension of this experiment, Sherwood and Milby (1954) reported that no significant differences in egg production or hatchability were obtained by the administration of aureomycin (6 mgs./lb. diet), tenamycin (5 mgs./lg. diet), penicillin (2 mgs./lb. diet), or mixed antibiotics (100 mgs./lb. of pellet supplement). The average egg production of all birds on the control diet was 53.7 percent and 54.4 percent for all the birds receiving antibiotics. The hatchability of fertile eggs was 84.0 percent and 83.3 percent, respectively, for the control and treatment groups. Several breeds of chickens were used in this study.

White Plymouth Rock pullets receiving free choice mash and grain diets supplemented with procaine penicillin (2 gms./ton) or aureomycin hydrochloride (50-100 gms./ton) produced significantly more eggs than corresponding controls, according to Carlson and Kohlmeyer (1954). Hatchability was not consistently affected. Boone and Morgan (1955) reported that the administration of low levels of aureomycin, penicillin, terramycin, and bacitracin to birds from one day of age until they finished their first year of lay produced a significant increase in annual egg production.

A study presented by Jacobs et al. (1955) reported that egg production was increased 10 and 19 percent over a seven-month period by the feeding of penicillin and streptomycin, respectively, to Single Comb White Leghorn pullets at a high level (50 mgs./lb. of diet). No effect was observed on hatchability. A study of the fecal microflora revealed that there was an increase in the number of antibiotic-resistant bacteria when an antibiotic was added to the diet.

O'Neal and Savage (1959) reported that the increased egg production due to a continuous antibiotic supplement (200 gms./ton of feed) was significant at the five percent level of probability. Average egg production over the forty-week experimental period was 68.0 percent for the control group, and 70.5 percent for the continuous supplement group.

Hygromycin and tylosin base were used by Gard and Means (1959) to test the effect of these drugs on reproductive performance. Each treatment consisted of ten experimental units of eight 44-week old hens. Results (percent hen-day production) were: Control - 67.4 percent; tylosin base (20 gms./ton) - 69.7 percent; hygromycin B (4 million units/ton) - 68.3 percent; and hygromycin B (12 million units/ton) - 64.4 percent.

The effect of hygromycin B on reproductive performance was also tested by Llorico and Quisenberry (1965). They reported that hen-day egg production was significantly increased for all hygromycin-fed groups. Four treatments were used in this trial. They were: 8 gms/907 kgs. diet during the growing period only; 8 gms./907 kgs. diet during both growing and laying periods; 12 gms./907 kgs. diet during growing period only; and 12 gms/907 kgs. diet during both growing and laying periods.

Grimes and Moreng (1964) reported that the fertility of Single Comb White Leghorn pullets was depressed significantly when hygromycin B was added to the basal diet, but no depression of fertility resulted in the Delaware breed. Hatchability, however, was significantly depressed in the treated Delawares, while there was no depression for hatchability among the Leghorns. Individually caged Single Comb White Leghorn females, inseminated artificially, and Delaware females in floor pens under natural mating, were used in this test. In each breed, a control and a treated group were maintained.

In an experiment (associated with the 1955-56 Storrs Egg Laying Test) by Ryan et al. (1961) it was reported that females from several breeds were fed a diet containing 100 gms. of chlortetracycline per ton of feed in a high energy laying ration for a 48-week period, and showed highly significant egg production over the control birds. The average egg production for the treatment and control birds was 72.02 percent and 68.37 percent, respectively. In a similar experiment conducted by Ryan et al. (1957) in the same facilities during 1956-57, little or no egg production increase was obtained when 50 gms. of a combination of antibiotics (25 gms. terramycin, 18.75 gms. bacitracin, and 6.25 gms. procaine penicillin per ton) was fed.

Eoff et al. (1962) observed that the addition of tetracyclines (chlortetracycline and oxytetracycline) and terephthalic acid (0.4 percent), or oxytetracycline alone to a basal diet resulted in slight but non-significant improvements in egg production. Single Comb White Leghorn pullets received these diets for two hundred and fifty-two days. Both chlortetracycline and oxytetracycline were used at 50 gms./ton of feed in this study.

It was reported by Potter et al. (1963) that 10 gms. erythromycin thiocynate/ton of diet was tested over a 44-week laying period on the hens involved in the 1958-59 Storrs Egg Laying Test. During the first two 11-week periods, the production of the hens fed the diet containing erythromycin was significantly greater than that of hens fed the diet without the antibiotic. No significant difference, however, was noted during the final two 11-week periods.

Guenthner and Carlson (1964) reported that no significant difference was observed in egg production, fertility, or hatchability from the effect of antibiotics. Single Comb White Leghorn hens were used in this study. The antibiotics were added to a basal corn-soybean meal diet at the following rates per ton: 10 gms. erythromycin, 20 gms. tylosin, 2 gms. oleandonycin plus 8 gms. terramycin, and 10 gms. oleandomycin.

Oxytetracycline, erythromycin and arsanilic acid were administered to commercial egg production-type pullets at twenty-six weeks of age by Damson et al. (1966). No significant differences in egg production were observed when the basal diet was supplemented with any of the antibiotics tested. Each of the antibiotics used in this test were administered at the rate of 11 mgs./kg. and 22 mgs./kg. of diet.

Five treatment rations were formulated by Krueger et al. (1966) containing either 0.000, 0.008, 0.016, 0.024, or 0.032 percent sulfaquinoxaline. Chlortetracyline levels paralleling the sulfaquinoxaline levels were 0.000, 0.035, 0.070, 0.105, and 0.141 gms./kg. of feed. The treatment rations were fed to Single Comb White Leghorn pullets for a period of nine weeks. The results indicated that egg production, fertility, and percentage hatch of fertile eggs were not affected significantly by the addition of any of the antibiotic combinations.

Nivas et al. (1967) conducted three experiments to test the effect of erythromycin thiocyanate on reproductive performance of Single Comb White Leghorn pullets. Egg production was found to be improved due to the effect of antibiotic treatment. Hatchability seemed to be increased by the higher level of antibiotic supplementation, but the difference was not significant. The differences for body weight gains among the treatments, from the beginning of the experiment to the final observation, were proportional to the amount of antibiotic added to the basal diets.

It was reported by Zavala and Guerra (1967) that production type pullets receiving lincomycin at 25 gms./ton of ration seemed to perform better than the controls with regard to egg production. The birds receiving a combination of bacitracin and penicillin at a level of 5 gms. of each drug per ton of feed did not show any improvement in egg production. Antibiotics were fed to birds from 0 to 80 weeks of age.

Slinger et al. (1953) reported that penicillin decreased egg production, hatchability, and egg weight, when 2 gms./ton of crude procaine penicillin G was added to a practical all-amsh diet for Broad Breasted Bronze turkeys. The decreases in egg production, hatchability, and egg weight were not significant at the five percent level of probability. When the results showing lower egg production and smaller egg size are considered together, the conclusion seems warranted that the pencillin exerted a detrimental influence on egg production.

Aureomycin chlortetracycline levels varying from 50 to 200 gms./ton of feed were used by White-Stevens et al. (1955). Single Comb White Leghorn pullets, New Hampshire pullets, and Beltsville Small White turkey breeders were used in the two experiments. In general, it was found that the antibiotic significantly increased egg production and enhanced hatchability in the chicken females. In another experiment, the continuous feeding of 100 to 200 gms. aureomycin per ton of total diet to Beltsville Small White turkey breeders during the breeding season showed a significant increase in egg production and hatchability.

Greene et al. (1963) reported that the continuous use of 150 or 300 gms. chlortetracycline per ton in the breeder ration to a strain of commercial turkey breeders prevented the precipitous drop in fertility which was observed in the control group. In another experiment, the injection of 150 mgs. of oxytetracycline subcutaneously at bi-weekly intervals produced a significant favorable effect in maintaining the flock fertility.

Deacon and Patterson (1966) reported that the administration of 11, 55, and 110 mgs. of oxytetracycline per kilogram of diet resulted in improvements in egg production, but showed no effect on fertility and hatchability. During a period of definite heat stress, improvements in egg production were greater for birds receiving 110 mgs. of oxytetracycline per kilogram of feed. Broad Breasted Bronze turkeys were used in this study.

According to Balloun et al. (1968), a trend for improved egg production was observed from Large White turkeys receiving pencillin plus bacitracin, penicillin plus streptomycin, or penicillin, streptomycin, and bacitracin, but none of the treatments improved reproductive performance significantly. The best egg production and hatchability were obtained from hens fed antibiotics during both the growing and laying phases of the experiment.

Balloun et al. (1969) also observed that no significant improvements in reproductive performance were observed in Large White turkeys by the administration of penicillin-bacitracin mixture. The trial was started at thirty weeks of age, and lasted for a 14-week period. A 50 ppm penicillin-bacitracin mixture was used in this study.

The effect of neomycin-terramycin combination on the reproductive performance of turkeys was reported by Nestor and Touchburn (1970). The treatments conducted in this experiment were: (1) basal diet, (2) basal diet plus 440 mgs. of neomycin-terramycin per killogram of feed administered once each 28 days, (3) basal diet plus 110 mgs. of neomycin-terramycin per killogram of feed continuously. Large and Medium White turkeys were used in this study. The results indicated that egg production and hatchability of fertile eggs were not significantly affected by the administration of antibiotics. Continuous feeding of neomycin-terramycin supplement, however, significantly depressed fertility.

The effect of erythromycin on the reproduction of Ring-Necked Pheasant breeders was tested by Smith et al. (1968). It was reported that the over-all average fertility and hatchability were not affected by the feeding of the antibiotic erythromycin at the level of 100 gms./ ton of feed for one week out of every 4-week period. Upon examining the fertility mean for individual hatches, however, it appeared that fertility was maintained in the latter phase of the hatching season.

CHAPTER III

EXPERIMENTAL PROCEDURE

This thesis reports the results of two separate experiments, involving two years, conducted at the Turkey Research Station, Perkins, Oklahoma. The experimental procedures were as nearly identical as possible for both experiments. The first-year experiment period was started in November, 1967, and ended in June, 1968. The second-year experimental period was initiated in November, 1968, and ended in June, 1969. The birds used in this investigation were Broad Breasted Bronze turkeys purchased from a commercial hatchery.

General Procedure

All male and female poults of the Broad Breasted Bronze variety were housed in individual brooder houses, each 12 ft. x 16 ft. in dimension, immediately after their arriving at the station farm. Feed and water were provided from three waterers of two and one-half gallon capacity each and three 36 in. trough-type feeders in each house.

The poults received a series of all-mash starter-grower rations fed ad libitum as recommended by the Oklahoma State University from one day old to twenty-four weeks of age. The compositions of these rations are shown in Table I and Table II.

At four days of age, all the male birds were desnooded. Both male and female birds were vaccinated against Newcastle disease at two weeks

TABLE I

ALL-MASH TURKEY STARTER AND GROWER RATIONS USED IN 1967

RATION NUMBER AGE FED	SMT671-4 1-4 Weeks	SMT672-4 5-6 Weeks	SMT673-4 7-8 Weeks	SMT674-4 9-11 Weeks	SMT675-4 13-16 Weeks	SMT676-4 17-20 Weeks	SMT677-4 21-24 Weeks
INGREDIENTS				PERCENT			
Ground yellow corn	28.70	31.35	42.00	52.05	56.47	70.00	37.18
Oat mill feed	4.92	4.85	2.35	1.94	1.75	1.15	0.95
Fat (tallow)	7.88	7.75	8.79	7.27	6.60	4.30	3.62
Corn gluton meal (60% protein)	3.45	3.40	2.44	2.04	1.84	1.24	1.05
Alfalfa meal (17% protein)	1.97	1.94	1.76	1.45	1.36	0.86	0.76
Fish meal (60% protein)	9.84	7.75	10.55	8.73	7.86	5.15	4.29
Blood meal (80% protein)	2.95	2.90	2.93	2.42	2.23	1.44	1.24
Meat and bone scrap (50% protein)	6.89	5.83	4.10	3.39	3.11	2.00	1.72
Soybean meal (50% protein)	23.63	22.04	15.63	11.64	10.20	5.74	4.29
Dried whey	1.97	1.94	1.76	1.45	1.36	0.86	0.76
Distillers solubles[1]	2.95	2.91	1.76	1.45	1.36	0.86	0.76
Dicalcium phospahte (20% Ca; 21% P)	1.36	2.77	2.15	2.13	2.43	2.95	2.86
Calcium carbonate	2.02	3.08	2.54	2.80	2.23	2.55	2.76
D-Methionine	0.10	0.10	0.10	0.10	0.09	0.06	0.05
VMC-60[2]	0.50	0.50	0.50	0.50	0.50	0.30	0.30
VC-60A[3]	0.25	0.25	-	-	-	-	-
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Histostat	0.05	0.04	0.04	0.04	0.04	0.04	0.04
TM-10	0.10	0.10	0.10	0.10	0.10	-	-

[1]Dried condensed fermented corn extractives--D.F.S. No. 3, Clinton Corn Processing Company, Clinton, Iowa.

[2]VMC-60-Vitamin-mineral concentrate adds the following per pound of finished ration: Vitamin A, 8,000 U.S.P. units; vitamin D_3, 1,200 I.C.M.; vitamin E, 6 I.M.; vitamin K, 3.0 milligrams; vitamin B_{12}, 0.008 milligrams; riboflavin, 4.0 milligrams; niacin, 32,0 milligrams; pathothenic acid, 8.0 milligrams; choline chloride, 500.0 milligrams; mangoose, 27.7 milligrams; iodine, 0.86 milligrams; cobalt, 0.59 milligrams; iron, 21.8 milligrams; copper, 1.65 milligrams; and zinc, 22.7 milligrams.

[3]VC-60A-vitamin concentrate adds the following per pound of finished ration: pyridoxine, 8.0 milligrams; biotin, 0.3 milligrams; thiamin, 12.0 milligrams; folic acid, 2.0 milligrams; inositol, 50.0 milligrams; para-amino-benjoic acid, 4.0 milligrams; and ascorbid acid, 10.0 milligrams.

TABLE II

ALL-MASH TURKEY STARTER AND GROWER RATIONS USED IN 1968

RATION NUMBER AGE FED	SMT681-5 1-4 Weeks	SMT682-5 5-6 Weeks	SMT683-5 7-8 Weeks	SMT684-5 9-11 Weeks	SMT685-5 13-16 Weeks	SMT686-5 17-20 Weeks	SMT687-5 21-24 Weeks
INGREDIENTS				PERCENT			
Ground yellow corn	29.15	32.30	43.05	53.65	58.16	73.19	39.00
Milo	-	-	-	-	-	-	-
Oat mill feed	5.00	5.00	2.40	2.00	1.80	1.20	1.00
Fat (tallow)	8.00	8.00	9.00	7.50	6.80	4.50	3.80
Corn gluten meal (60% protein)	3.50	3.50	2.50	2.10	1.90	1.30	1.10
Alfalfa meal (17% protein)	2.00	2.00	1.80	1.50	1.40	0.90	0.80
Fish meal (60% protein)	10.00	8.00	10.80	9.00	8.10	5.40	4.50
Blood meal (80% protein)	3.00	3.00	3.00	2.50	2.30	1.50	1.30
Meat and bone scrap (50% protein)	7.00	6.00	4.20	3.50	3.20	2.10	1.80
Soybean meal (50% protein)	24.00	22.70	16.00	12.00	10.50	6.00	4.50
Dried whey	2.00	2.00	1.80	1.50	1.40	0.90	0.80
Distillers solubles (CFS #3)[1]	3.00	3.00	1.80	1.50	1.40	0.90	0.80
Dicalcium phosphate	1.00	1.00	1.20	1.00	0.90	0.60	0.50
Calcium carbonate	1.00	2.00	1.20	1.00	0.90	0.60	0.50
D-Methionine	0.10	0.10	0.10	0.10	0.09	0.06	0.05
VMC-60[2]	0.50	0.50	0.50	0.50	0.50	0.06	0.30
VC-60A[3]	0.25	0.25	-	-	-	-	-
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Polystat	0.10	0.10	0.10	-	-	-	-
TM-10	0.10	0.10	0.10	0.10	0.10	-	-
Histostat	-	-	-	0.05	0.05	0.05	0.05

[1]Dried condensed fermented corn extractives--C.F.S. No. 3, Clinton Corn Processing Company, Clinton, Iowa.

[2]VMC-60-Vitamin-mineral concentrate adds the following per pound of finished ration: Vitamin A, 8,000 U.S.P. units; vitamin D_3, 1,200 I.C.M.; vitamin E, 6 I.M.; vitamin K, 3.0 milligrams; vitamin B_{12}, 0.008 milligrams; riboflavin, 4.0 milligrams; niacin, 32.0 milligrams; pathothenic acid, 8.0 milligrams; choline chloride, 500.0 milligrams; mangoose, 27.7 milligrams; iodine, 0.86 milligrams; cobalt, 0.59 milligrams; iron, 21.8 milligrams; copper, 1.65 milligrams; and zinc, 22.7 milligrams.

[3]VC-60-A-vitamin concentrate adds the following per pound of finished ration: pyridoxine, 8.0 milligrams; biotin, 0.3 milligrams; thiamin, 12.0 milligrams; folic acid, 2.0 milligrams; inositol, 50.0 milligrams; para-amino-benjoic acid, 4.0 milligrams; and ascorbic acid, 10.0 milligrams.

of age. The method used was intranasal with live-virus vaccine.

All of the poults were moved from the brooder house to a 48 ft. x 48 ft. pole shed at eight weeks of age and then allowed to run on a single 150 ft. x 250 ft. bermuda grass range adjacent to the pole shed during the period from ten to twenty-four weeks of age. Feed and water were supplied ad libitum from six 8 ft. bulk feeders and ten automatic waterers each 20 in. in diameter. Poults were vaccinated against fowl pox at nine weeks of age using the "thigh stick" method of vaccination.

At twenty-four weeks of age, one hundred and sixty female turkeys were selected from the flock and were assigned to sixteen breeding pens according to randomization. This provided ten female turkeys in each breeding pen. Each pen was 50 ft. x 100 ft. in dimension and contained a single house area (12 ft. x 16 ft. in dimension). Six nests and one roosting area were provided in each house. Feed and water were given ad libitum from one automatic waterer 12 in. in diameter and cylindrical-type feeder.

Forty-eight males were selected and randomly divided into four groups. Each group of twelve male turkeys was assigned to a 15 ft. x 30 ft. pen in the straw loft house. The equipment in each pen consisted of one roosting area, one three-gallon waterer, and one 6 ft. bulk feeder. Each pen of male turkeys was regarded as the semen pool and was randomly assigned to each treatment group before each artificial insemination. The purpose for randomizing the semen pool each time before artificial insemination was to provide an unbiased distribution of semen pool to female turkeys.

Since no block effect existed in the female pens (as shown by previous studies at this station), a completely randomized design was conducted.

An all-mash turkey breeder ration was provided from twenty-four weeks of age until the end of the experiment. The compositions of breeder rations are shown in Table III and Table IV.

Blood samples were collected from both male and female turkeys immediately after the beginning of egg production. This was for the purpose of the Pullorum-Typhoid Test. No infection was found in the flock.

Broody females were removed from the breeding pen to a hanging coop when they were first observed and were not returned to their pens until they had returned to egg production.

Fourteen hours of continuous light daily were provided by a 60-watt bulb in each house. It was started on December 23rd for the males, two weeks prior to the lighting of females. This was for the purpose of providing uniform sex maturity for both male and female turkeys. Fourteen hours of continuous light was maintained throughout the entire experimental period.

Treatment Group

Four different antibiotic combinations were established as treatment groups. The composition and dosage of the different treatment groups were as follows:

Treatment A (Control): 4 ml. deionized sodium chloride solution per bird, 2 ml. in each side of neck.

Treatment B (tylan in oil suspension): 4 ml. per bird, 2 ml. in each side of neck.

Treatment C (tylan plus terramycin): 10 gms. tylan soluable, plus

TABLE III

ALL-MASH TURKEY BREEDER RATION USED IN 1967

INGREDIENTS	% RATION	LBS. FEED
Fat (tallow)	9.40	47.00
Ground yellow corn	27.70	138.50
Ground yellow milo	20.00	100.00
Oat mill feed	6.50	32.50
Alfalfa meal (17% protein)	2.50	12.50
Wheat shorts	5.00	25.00
Soybean meal (50% protein)	7.50	37.50
Fish meal (60% protein)	6.50	32.50
Meat and bone scrap (50% protein)	4.00	20.00
Yeast culture	1.00	5.00
Distiller solubles[1]	1.50	7.50
Dicalcium phosphate (21% P; 20% Ca)	2.50	12.50
Calcium carbonate	4.00	20.00
Salt	0.50	2.50
Dried whey	1.00	5.00
D-Methionine	0.10	0.50
Octaferm	0.40	2.00
Lecithin	0.25	1.25
VMC-60[2]	0.50	2.50
Vitamin E (100,000 I.M./lb.)	17.00 gms./100 lbs.	85.00 gms.
NF-180	9.10 gms./100 lbs.	45.50 gms.
Histostat	22.70 gms./100 lbs.	113.50 gms.
	100.85%	504.79 lbs.

[1]Dried condensed fermented corn extractives--C.F.S. No. 3, Clinton Corn Processing, Company, Clinton, Iowa.

[2]VMC-60-Vitamin-mineral concentrate adds the following per pound of finished ration: Vitamin A, 8,000 U.S.P. units; vitamin D_3, 1,200 I.C.M. vitamin E, 5 I.M.; vitamin K, 3.0 milligrams; vitamin B_{12}, 0.008 milligrams; riboflavin, 4.0 milligrams; niacin, 32.0 milligrams; pathothenic acid, 8.0 milligrams; choline chloride, 500.0 milligrams; mangoose, 27.7 milligrams; iodine, 0.86 milligrams; cobalt, 0.59 milligrams; iron, 21.8 milligrams; copper, 1.65 milligrams; and zinc, 22.7 milligrams.

TABLE IV

ALL-MASH TURKEY BREEDER RATION USED IN 1968

INGREDIENTS	% RATION	LBS. FEED
Fat (tallow)	9.40	47.00
Ground yellow corn	27.70	138.50
Ground yellow milo	20.00	100.00
Oat mill feed	6.50	32.50
Alfalfa meal (17% protein)	2.50	12.50
Wheat shorts	5.00	25.00
Soybean meal (50% protein)	7.50	37.50
Fish meal (60% protein)	6.50	32.50
Meat and bone scrap (50% protein)	4.00	20.00
Yeast culture	1.00	5.00
Distiller solubles[1]	1.50	7.50
Dicalcium phosphate (21% P; 20% Ca)	2.92	14.60
Calcium carbonate	2.76	13.80
Salt	0.50	2.50
Dried whey	1.00	5.00
D-Methionine	0.10	0.50
Octaferm	0.40	2.00
Lecithin	0.25	1.25
VMC-60[2]	0.50	2.50
Vitamin E (100,000 I.M./lb.)	17.00 gms./100 lbs.	85.00 gms.
NF-180	9.10 gms./100 lbs.	45.50 gms.
Histostat	22.70 gms./100 lbs.	113.50 gms.
	100.03%	500.15 lbs.

[1]Dried condensed fermented corn extractives--C.F.S. No. 3, Clinton Corn Processing Company, Clinton, Iowa.

[2]VMC-60-Vitamin-mineral concentrate adds the following per pound of finished ration: Vitamin A, 8,000 U.S.P. units; vitamin D_3, 1,200 I.C.M.; vitamin E, 6 I.M.; vitamin K, 3.0 milligrams; vitamin B_{12}, 0.008 milligrams; riboflavin, 4.0 milligrams; niacin, 32.0 milligrams; pathothenic acid, 8.0 milligrams; choline chloride, 500.0 milligrams; mangoose, 27.7 milligrams; iodine, 0.86 milligrams; cobalt, 0.59 milligrams; iron, 21.8 milligrams; copper 1.65 milligrams; and zinc, 22.7 milligrams.

60 ml. distilled water plus 40 ml. terramycin, 3 ml. per bird, 1 ml. in each side of neck.

Treatment D (penicillin plus combistrep): 16.67 ml. Pfizer procaine penicillin G and 83.33 ml. combistrep, 2 ml. per bird, 1 ml. in each side of neck. The antibiotics were administered by subcutaneous injection in the neck of female turkeys every three weeks, one day after artificial insemination. :ese four antibiotic combinations were assigned to sixteen female breeding pens with four replications in each group. Each individual breeding pen represented a replication.

Artificial Insemination

All females were inseminated at three week intervals throughout the experiment. Insemination was initiated on February 6, 1968, for the first experimental period, and on February 8, 1969, for the second experimental period, when egg production had reached 40 percent. Undiluted semen was used in this study. Pooled semen was collected by the abdominal massage method into small wax-lined glass vials. The semen then was drawn into a multiple-injection inseminating gun manufactured by Robert Tyler, Dallas, Wisconsin. Plastic inseminating tubes were filled with a constant volume of 0.025 mls. of whole semen. Each hen was inseminated by this plastic tube with a separate tube for each female.

Swabbing

One-half of the number of female turkeys in each breeding pen were vaginally swabbed one day before each artificial insemination and one week after each artificial insemination. These same five female turkeys in each pen were swabbed throughout the experiment. Vaginal swabbing was taken by inserting a sterile cotton swab one-half to three-quarters inches into the everted vagina. Then, at the laboratory, each swab was used to inoculate on the surface of a blood agar plate and a PPLO agar plate for the testing of micro-organisms. This part of the experiment was conducted by Dr. R. E. Corstvet and his research assistants in the Verterinary Medical College, Oklahoma State University, Stillwater, Oklahoma. The purpose of swabbing was to check the status and change of the micro-flora in the reproductive tracts of females before and after the artificial insemination and antibiotic injection. The semen pool which was used in each artificial insemination was also tested for the presence of micro-organisms.

Hatching

Eggs were collected and set in Jamesway 252 single stage incubators on a weekly basis. Immediately after the eggs were trucked in from the station farm, they were placed in an egg storage room in the Poultry Science building on the Oklahoma State University campus a6 55° F temperature and about 75 percent relative humidity.

Data Collection

Body weight was measured on the basis of total pen weight at the beginning of the experiment for both male and female turkeys, and was continued at 28-day intervals throughout the experiment. The weights were recorded as a pen average.

Egg production, percentage fertility, and percentage hatch of fertile eggs were recorded for fifteen one-week hatch periods throughout the experiment. Egg production was calculated on the hen-day basis.

Percentage fertility was determined by candling the eggs after twenty-four days of incubation. All of the eggs which were not identified as fertile by candling were broken out to determine fi the eggs were infertile or early dead germ. The percentage hatch of fertile eggs was determined by the actual number of poults hatched during the 28-day incubation period.

The analysis of variance was calculated on percentage egg production, percentage fertility, percentage hatch of fertile eggs, and percentage hatch of total eggs set by split-plot according to Snedecor and Cochran (1968). The error terms listed in the analysis of variance tables were described as follows: Error A is the pen within treatment sum of squares, and is used to test treatment. Error B is the period by pen within treatment sum of squares, and is used to test period and period by treatment. Error C is the hatch by pen within treatment and hatch by period by pen within treatment sum of squares, and is used to test hatch, hatch x treatment, hatch x period, and hatch x period x treatment. Error D is the swab by pen with treatment, swab by period by pen within treatment, swab by hatch by pen within treatment, and swab by period by hatch by hen within treatment sum of squares, and is used to test swab, swab x treatment, swab x period, swab x treatment x period, swab x hatch, swab x hatch x treatment, and swab x hatch x period x treatment.

CHAPTER IV

RESULTS AND DISCUSSION

The effect of antibiotic injections on Broad Breasted Bronze turkey females which were artificially inseminated with pooled semen is presented herewith. The results are divided into two parts according to the different data collected for the years 1967 and 1968, respectively. The reproductive phase of these experiments was started when the female turkeys reached 40 percent egg production, and was continued throughout a 15-week period. The variables analyzed were percentage egg production, percentage fertility, percentage hatch of fertile eggs, percentage hatch of total eggs set, and female body weight. Standard errors for treatment comparisons were calculated according to Cohcran and Cox (1968).

1967

A summary of percentage egg production with overall treatment mean is presented in Table V and Figure 1. Treatment A showed the smallest percentage for egg production while Treatment D exhibited the highest egg production. The data for Treatments B and C were similar and intermediate between Treatments A and D. The result of the analysis of variance indicated that the difference between treatments was not large enough to be significant at the five percent level of probability. The analysis of variance is presented in Table VI.

The highest egg production occurred from the second week to the

TABLE V

AVERAGE PERCENTAGE EGG PRODUCTION PER TREATMENT BY HATCH BY PERIOD IN 1967

TREATMENT	PERIOD 1			PERIOD 2			PERIOD 3			PERIOD 4			PERIOD 5			OVERALL TREATMENT MEAN
	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	
A	30.72	34.64	38.57	37.50	35.71	37.14	30.72	33.93	34.29	40.72	31.79	21.79	18.57	22.62	21.97	31.38
B	45.36	47.87	51.43	46.79	41.07	26.07	27.14	35.00	30.00	26.79	34.64	28.22	24.29	23.57	18.21	33.76
C	36.43	38.22	45.36	38.93	31.43	25.18	23.39	33.13	33.84	32.42	39.37	33.75	20.54	27.66	29.10	32.58
D	42.50	46.79	42.50	46.43	33.57	27.50	31.79	37.18	34.11	35.18	26.87	23.13	23.04	33.57	24.29	33.90

Standard error for treatment comparison:
1. Between two treatment means: ±4.13
2. Between two treatment means during the same hatch: ±7.16
3. Between two treatment means during the same hatch and period: ±16.01

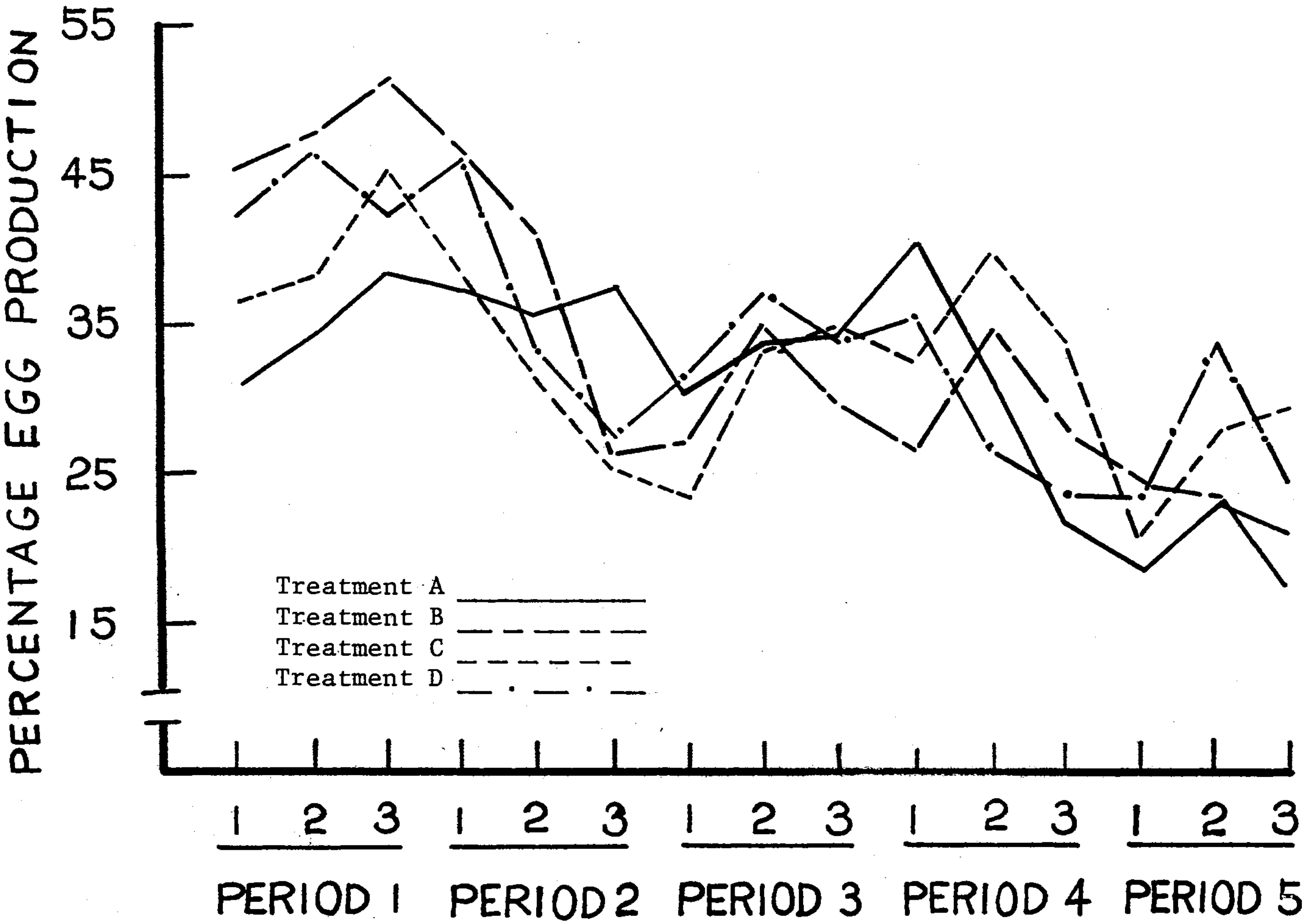

Figure 1. The Influence of Antibiotics on Percentage Egg Production in 1967. Measured Weekly.

TABLE VI

ANALYSIS OF VARIANCE FOR PERCENTAGE EGG PRODUCTION

SOURCE OF VARIANCE	D.F.	S.S.	M.S.	F.
Treatment	3	498.4571	166.1524	0.1621
Error A	12	12297.9679	1024.8307	
Period	4	16162.5234	4040.6308	12.8354**
Period x Treatment	12	3893.6429	324.4702	1.0307
Error B	48	15110.6108	314.8044	
Hatch	2	774.0602	387.0301	5.3739**
Hatch x Treatment	6	973.5763	162.2627	2.2530*
Hatch x Period	8	4810.8705	601.3588	8.3497**
Hatch x Period x Treatment	24	3028.7008	126.1959	1.7522*
Error C	120	8642.4953	72.0208	
Swab	1	2303.9680	2303.9680	12.5431**
Swab x Treatment	3	95.5260	31.8420	
Swab x Period	4	3775.9281	943.9820	5.1391**
Swab x Period x Treatment	12	2470.3107	205.8592	
Swab x Hatch	2	125.7374	62.8687	
Swab x Hatch x Treatment	6	242.5145	40.4191	
Swab x Hatch x Period	8	1569.5217	196.1902	
Swab x Hatch x Period x Treatment	24	2098.9424	87.4559	
Error D	180	33063.2279	183.6846	

**$P < 0.01$

*$P < 0.05$

fourth week of hatch and gradually decreased until the last hatch. These normal changes due to the effects of seasonal variables such as temperature caused the difference in egg production between periods to be significant at the one percent level of probability. The difference for period-by-treatment interaction was not significant at the five percent level of probability. It was noticed that Treatments B, C, and D showed higher egg production than Treatment A during the first four weeks and the last four weeks of the experiment. These differences were not significant at the five percent level of probability.

The analysis of variance also showed a hatch period difference and a hatch-by-treatment interaction, significant at the five percent and one percent level of probability, respectively. The interaction is shown in Figure 2. It appears that, generally, the treated birds had higher egg production than did the control birds at the beginning of each insemination period, excepting Treatment C, but this higher egg production could not be maintained by the treated birds toward the end of each period. The higher percentage egg production presented by Treatment C during the third hatch was not significant at the five percent level of probability.

It is to be noted that the birds receiving vaginal swabbing laid more eggs than did the unswabbed birds. The total mean egg production for the swabbed birds was 35.10 percent, and 30.71 percent for the unswabbed birds. The difference was highly significant at the one percent level of probability. The reasons for this difference are not at all clear.

These results indicate that egg production was not significantly affected by the administration of antibiotics, although the control

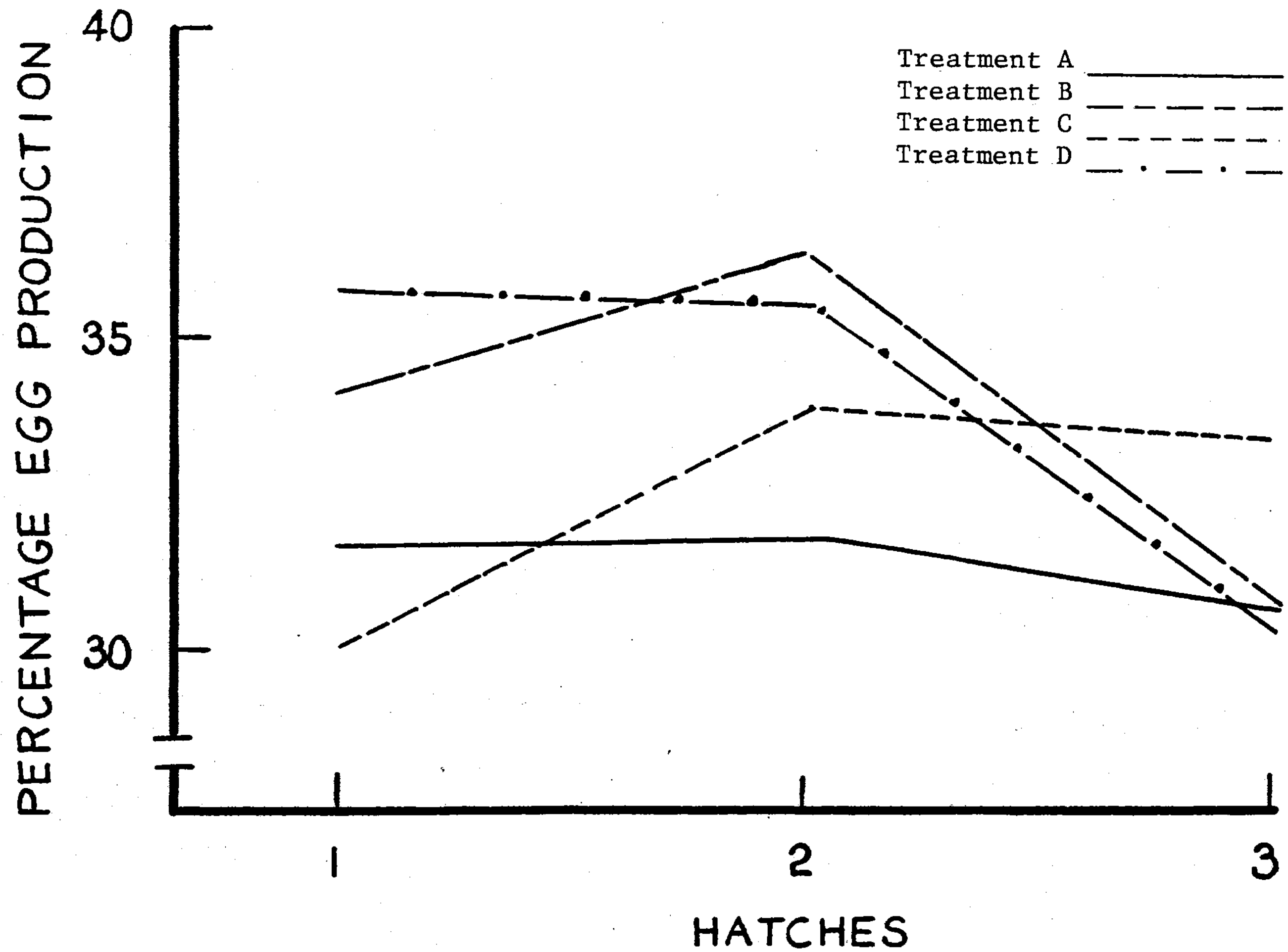

Figure 2. The Influence of Antiobiotics on Percentage Egg Production by Hatch in 1967.

birds had the lowest egg production among the four experimental groups. Egg production could not be maintained at a high level by antibiotics during the complete breeding season, nor for the third hatch within each artificial insemination period. The decreasing egg production after the fourth week of the experiment was probably due, in part, to the starting of the broodiness phase which was experienced in each female pen.

The summary of the data on percentage fertility is presented in Table VII. On the basis of the overall treatment mean, Treatment B exhibited the lowest fertility among the four experimental groups. The difference between treatments was not significant at the five percent level of probability. This is shown in Table VIII.

The difference for fertility between insemination periods was significant at the five percent level of probability, but the difference for period-by-treatment interaction was not significant at the five percent level of probability. As shown in Figure 3, it was evident that in all of the treatments, except Treatment B and Treatment D, the highest fertility was reached during the second insemination period and the downward trend from that point resulted in the lowest fertility during the last period, excepting for Treatment C. The increased percentage fertility for Treatment C during the last period was not significantly different from the percentage fertility of Treatment A. It was also indicated that the fertility was not successfully maintained among the treated birds during the late breeding season.

The difference in fertility between hatches within artificial insemination period was significant at the one percent level of probability, and in all the treatments except B, highest fertility was reached during the second hatch as shown in Figure 4. It was also shown that no

TABLE VII

AVERAGE PERCENTAGE FERTILITY PER TREATMENT BY HATCH BY PERIOD IN 1967

TREATMENT	PERIOD 1 Hatch 1	1 Hatch 2	1 Hatch 3	PERIOD 2 Hatch 1	2 Hatch 2	2 Hatch 3	PERIOD 3 Hatch 1	3 Hatch 2	3 Hatch 3	PERIOD 4 Hatch 1	4 Hatch 2	4 Hatch 3	PERIOD 5 Hatch 1	5 Hatch 2	5 Hatch 3	OVERALL TREATMENT MEAN
A	66.69	86.93	79.14	86.64	89.33	87.11	87.29	78.82	65.27	91.41	84.75	72.81	69.49	75.89	75.36	79.80
B	72.84	85.46	84.20	93.06	86.21	78.52	86.89	92.30	83.08	85.01	77.96	66.10	74.96	60.20	47.43	78.01
C	65.48	86.69	85.32	92.94	88.31	77.07	79.86	79.02	76.27	74.95	88.66	66.08	76.67	75.73	86.41	79.97
D	76.44	88.42	84.97	85.78	87.16	77.91	85.83	90.75	79.28	80.01	73.59	64.11	64.25	78.56	71.98	79.27

Standard error for treatment comparison:
1. Between two treatment means: ±3.56
2. Between two treatment means during the same period: ±7.95
3. Between two treatment means during the same hatch: ±6.16

TABLE VIII

ANALYSIS OF VARIANCE FOR PERCENTAGE FERTILITY IN 1967

SOURCE OF VARIANCE	D.F.	S.S.	M.S.	F.
Treatment	3	280.4222	93.4741	0.1232
Error A	12	9110.8009	758.4001	
Period	4	11296.6198	2824.1550	2.6054*
Period x Treatment	12	7931.9523	660.9960	
Error B	48	52029.5788	1083.9496	
Hatch	2	4595.1951	2297.5975	6.6913**
Hatch x Treatment	6	1610.1930	268.3655	
Hatch x Period	8	8232.8531	1029.1066	2.9970**
Hatch x Period x Treatment	24	6578.1864	274.0911	
Error C	120	41204.1538	343.3679	
Swab	1	95.5150	97.5150	
Swab x Treatment	3	1728.4958	576.1653	1.6651
Swab x Period	4	8737.6048	2184.4012	6.3129**
Swab x Period x Treatment	12	5453.3920	454.4493	1.3133
Swab x Hatch	2	773.1585	386.5793	1.1172
Swab x Hatch x Treatment	6	1602.0374	267.0062	
Swab x Hatch x Period	8	1689.8276	211.2285	
Swab x Hatch x Period x Treatment	24	11498.6029	479.1085	
Error D	180	62283.6507	346.0203	

**P < 0.01

*P < 0.05

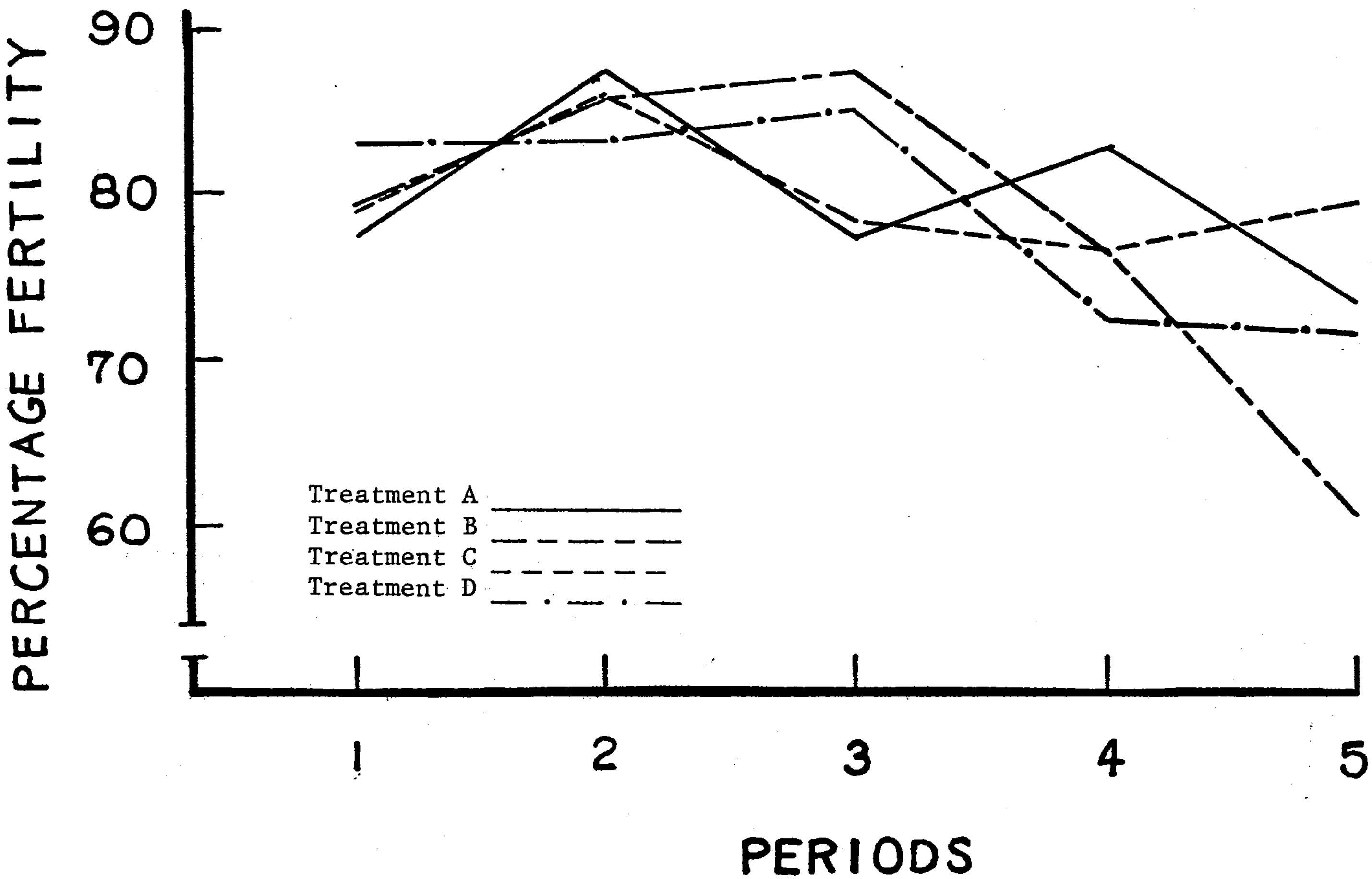

Figure 3. The Influence of Antibiotics on Percentage Fertility by Period in 1967.

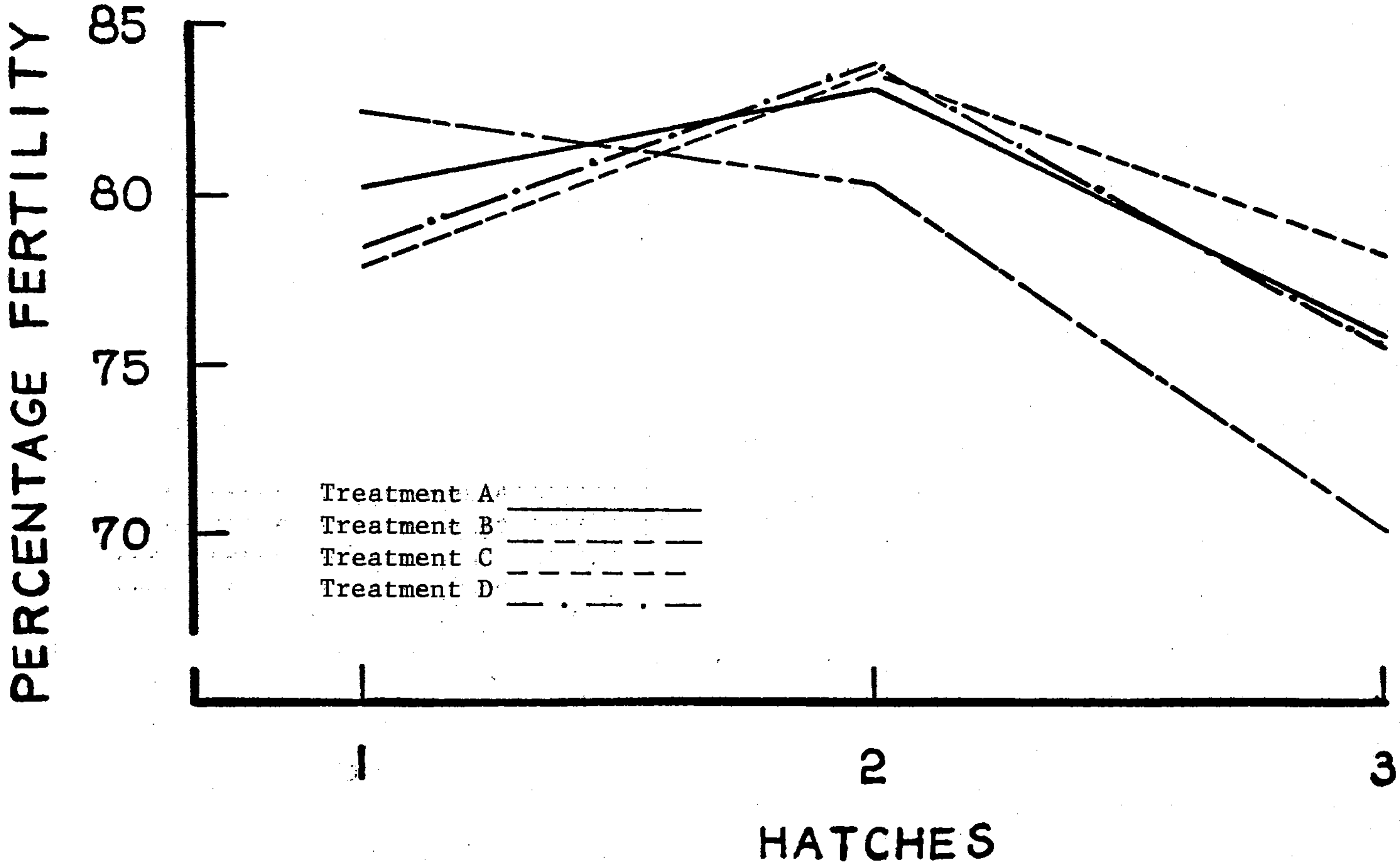

Figure 4. The Influence of Antibiotics on Percentage Fertility by Hatch in 1967.

treatment effect was observed to keep the fertility from dropping during the third hatch.

The difference for percentage fertility between the swabbed and the unswabbed birds and the effect of swab-by-treatment interaction were not significant at the five percent level of probability.

These results indicate that no significant difference in percentage fertility was observed between treated and control birds. The highest fertility was usually observed during the second hatch within the insemination period, and during the second insemination period within the breeding season. These results reflect that the variation for fertility is affected more by factors involved in the artificial insemination technique than by the treatment effect.

A summary of percentage hatch of fertile eggs is presented in Table IX. The analysis of variance for all of the data indicated a non-significant difference for treatment at the five percent level of probability, as shown in Table X. It was noticed, however, that Treatment D exhibited a higher percentage hatch of fertile eggs than any of the other treatments. Treatment C showed the lowest percentage hatch of fertile eggs. The difference between Treatment D and Treatment C was not significant at the five percent level of probability.

The difference between insemination periods for hatch of fertile eggs was highly significant at the one percent level of probability. In the Treatments A and B, the highest percentage hatch of fertile eggs was attained during the second period, as shown in Figure 5. The overall mean for hatch of fertile eggs was 44.68 percent for the second insemination period and then decreased to 30.17 percent for the fifth period. The difference in period-by-treatment interaction was not

TABLE IX

AVERAGE PERCENTAGE HATCH OF FERTILE EGGS PER TREATMENT BY HATCH BY PERIOD IN 1967

TREATMENT	PERIOD															OVERALL TREATMENT MEAN
	1			2			3			4			5			
	Hatch			Hatch			Hatch			Hatch			Hatch			
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
A	61.38	53.68	37.47	56.34	40.23	56.19	45.67	39.06	47.59	33.54	39.66	45.50	30.22	34.44	56.46	45.16
B	49.44	54.20	52.37	62.54	49.98	46.95	53.09	42.60	48.79	48.03	30.71	39.64	30.56	47.54	25.59	45.47
C	42.48	42.29	42.31	57.25	53.01	43.68	60.02	43.23	63.62	48.10	37.24	40.47	36.76	34.18	28.74	44.89
D	65.72	56.38	40.78	55.68	58.02	46.25	50.38	46.05	43.85	44.33	25.83	34.37	30.08	54.91	59.03	53.72

Standard error for treatment comparison:

1. Between two treatment means: ±5.98
2. Between two treatment means during the same period: ±13.38
3. Between two treatment means during the same hatch: ±10.36

TABLE X

ANALYSIS OF VARIANCE FOR PERCENTAGE HATCH OF FERTILE EGGS IN 1967

SOURCE OF VARIANCE	D.F.	S.S.	M.S.	F.
Treatment	3	0.0483	0.0161	0.0749
Error A	12	2.5782	0.2148	
Period	4	1.5168	0.3792	6.3305**
Period x Treatment	12	0.7232	0.0603	
Error B	48	2.8746	0.0599	
Hatch	2	0.1366	0.0683	1.5110
Hatch x Treatment	6	0.1890	0.0315	
Hatch x Period	8	0.8436	0.1054	2.3318*
Hatch x Period x Treatment	24	1.3148	0.0548	
Error C	120	5.4251	0.0452	
Swab	1	0.0069	0.0069	
Swab x Treatment	3	0.1925	0.0642	1.2969
Swab x Period	4	0.1018	0.0255	
Swab x Period x Treatment	12	0.8851	0.0738	1.4909
Swab x Hatch	2	0.0364	0.0182	
Swab x Hatch x Treatment	6	0.3572	0.0595	
Swab x Hatch x Period	8	0.3980	0.0498	
Swab x Hatch x Period x Treatment	24	0.8505	0.0354	
Error D	180	8.9101	0.0495	

**$P < 0.01$

*$P < 0.05$

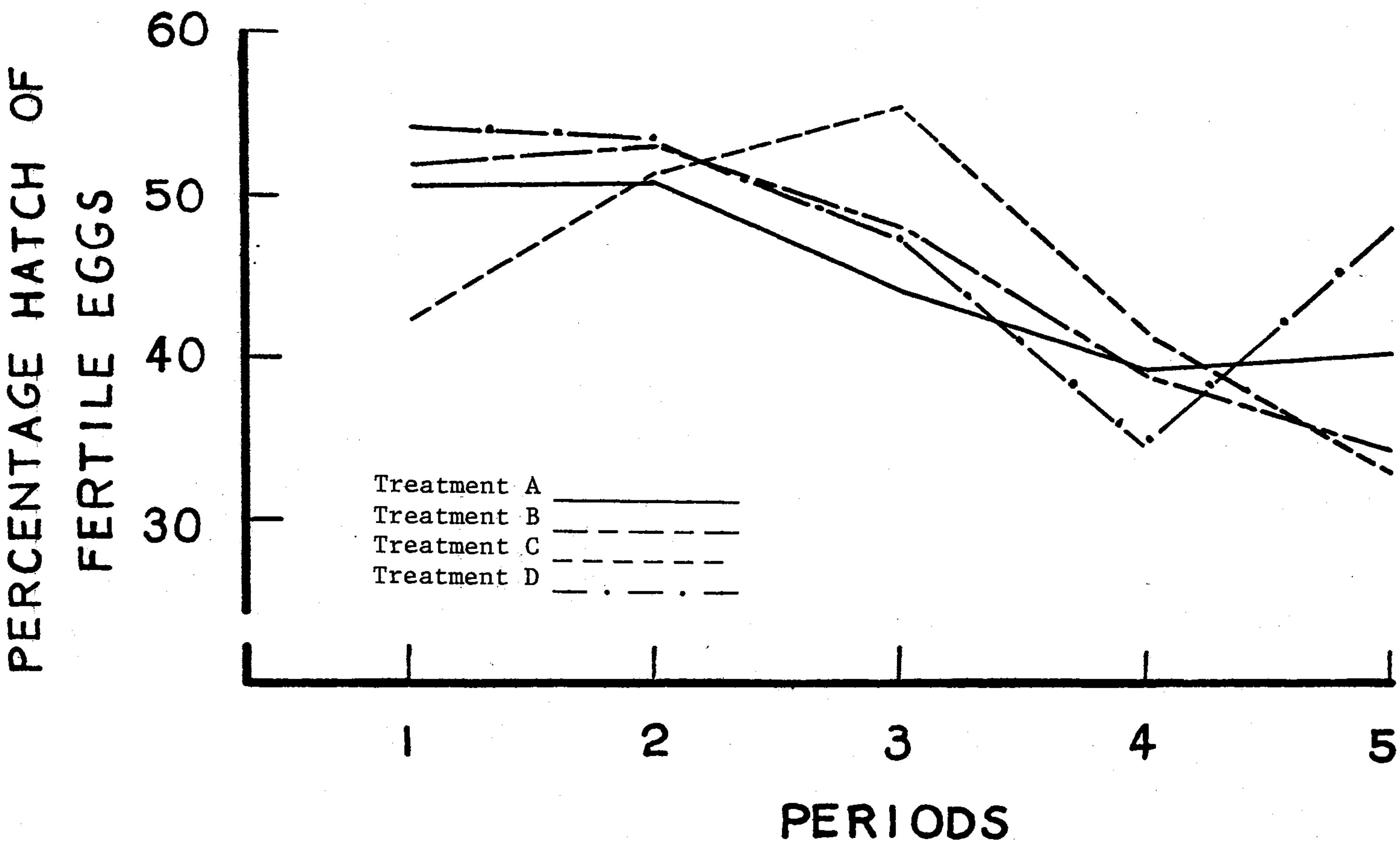

Figure 5. The Influence of Antibiotics on Hatch of Fertile Eggs by Period in 1967.

significant at the five percent level of probability. It appears that no treatment could maintain the initial level of performance toward the late breeding season, with the exception of Treatment D. The difference between Treatments A and D during this final insemination period was not significant at the five percent level of probability.

Comparing the differences in hatch of fertile eggs between hatches and the effect of hatch-by-treatment interaction revealed that they were not significant at the five percent level of probability. All of the treatments, with the exception of Treatment A, exhibited the highest hatch of fertile eggs during the first hatch within insemination period. This is presented in Figure 6.

These results indicate that the difference for hatch of fertile eggs between control and treated birds was not significant. The birds receiving antibiotics, however, with the exception of Treatment C, did show higher hatch of fertile eggs than did the birds in the control group. The administration of antibiotics also failed to maintain a high level of hatch of fertile eggs during the latter part of the breeding season.

A summary of the data for the percentage hatch of total eggs set is presented in Table XI. The analysis of variance for this data revealed that the treatment effect was not significant at the five percent level of probability. This is shown in Table XII. Considering overall treatment means, Treatment D exhibited the highest percentage hatch of total eggs set, while Treatment A showed the lowest level of performance for this trait. The difference between Treatments A and D was still not significant.

The difference between insemination periods for hatch of total eggs set was significant at the one percent level of probability. In all of

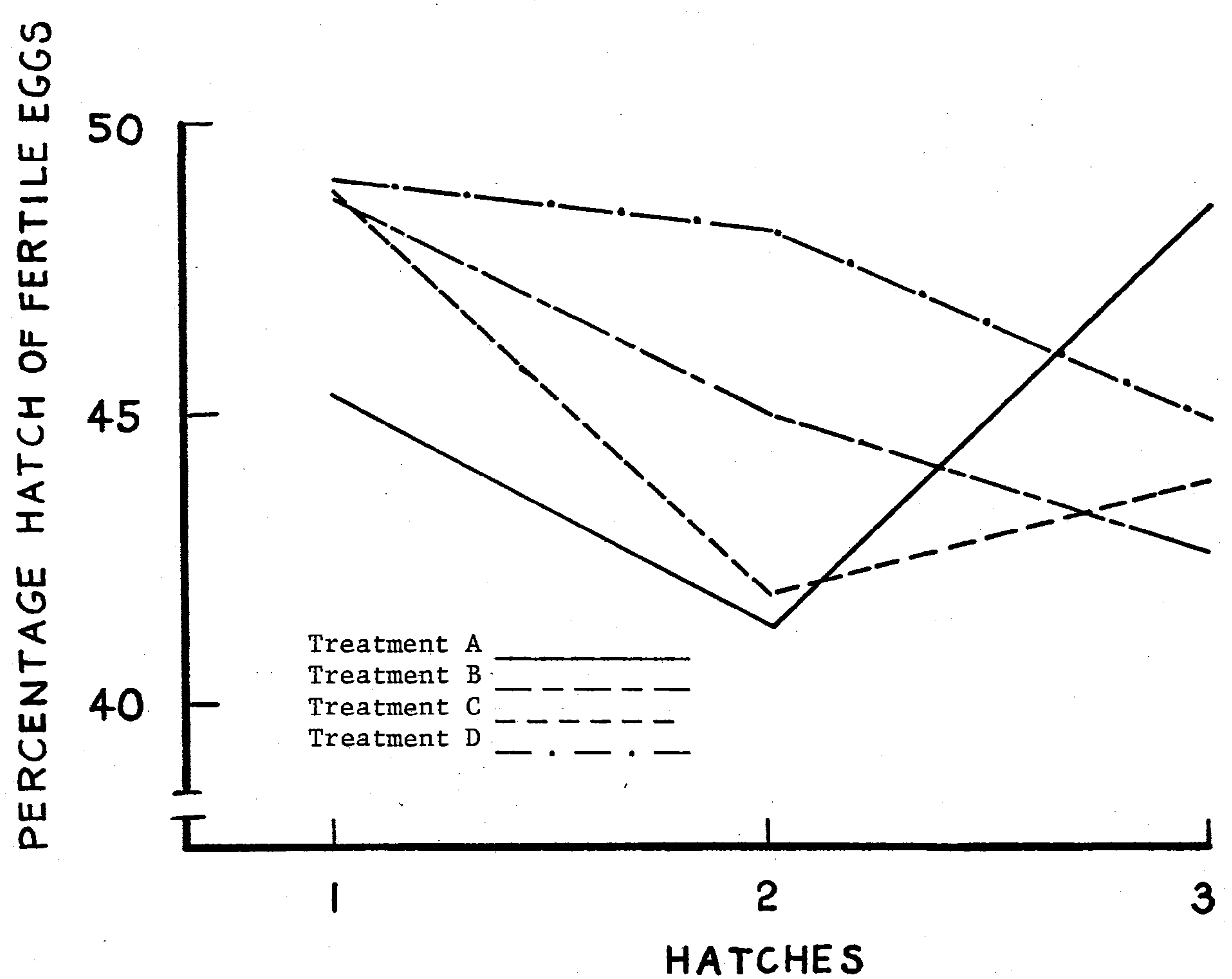

Figure 6. The Influence of Antibiotics on Hatch of Fertile Eggs by Hatch in 1967.

TABLE XI

AVERAGE PERCENTAGE HATCH OF TOTAL EGGS SET PER TREATMENT BY HATCH BY PERIOD IN 1967

TREATMENT	PERIOD 1			PERIOD 2			PERIOD 3			PERIOD 4			PERIOD 5			OVERALL TREATMENT MEAN
	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	
A	39.17	45.89	27.11	46.88	35.25	49.00	40.25	28.88	34.97	30.17	33.24	29.76	22.44	28.38	38.53	35.38
B	36.74	47.01	42.40	58.47	42.90	35.16	46.10	39.44	35.59	42.58	23.77	28.77	25.38	28.69	20.82	37.19
C	29.88	36.85	37.25	52.78	47.22	33.72	47.08	33.22	49.59	39.79	33.30	32.16	31.77	30.32	24.35	37.29
D	50.51	48.57	32.72	47.71	27.25	39.88	44.41	42.92	31.95	36.58	24.11	28.93	22.81	42.35	46.15	39.12

Standard error for treatment comparison:
1. Between two treatment means: ±4.68
2. Between two treatment means during the same period: ±10.47
3. Between two treatment means during the same hatch: ±8.11

TABLE XII

ANALYSIS OF VARIANCE FOR PERCENTAGE HATCH OF TOTAL EGGS SET IN 1967

SOURCE OF VARIANCE	D.F.	S.S.	M.S.	F.
Treatment	3	0.0843	0.0281	0.2135
Error A	12	1.5795	0.1316	
Period	4	1.4016	0.3504	6.6870^{**}
Period x Treatment	12	0.3689	0.0307	
Error B	48	2.5169	0.0524	
Hatch	2	0.1615	0.0808	2.5569
Hatch x Treatment	6	0.1103	0.0184	
Hatch x Period	8	0.5873	0.0734	2.3227^{*}
Hatch x Period x Treatment	24	0.9360	0.0390	1.2341
Error C	120	3.7893	0.0316	
Swab	1	0.0019	0.0019	
Swab x Treatment	3	0.1657	0.0552	1.4878
Swab x Period	4	0.0712	0.0178	
Swab x Period x Treatment	12	0.4676	0.0390	1.0512
Swab x Hatch	2	0.0790	0.0395	1.0646
Swab x Hatch x Treatment	6	0.2316	0.0386	
Swab x Hatch x Period	8	0.1292	0.0162	
Swab x Hatch x Period x Treatment	24	0.5709	0.0238	
Error D	180	0.6704	0.0371	

$^{**}P < 0.01$

$^{*}P < 0.05$

the treatments, the highest percentage hatch of total eggs set was attained during the second insemination period. The decreasing trend toward the fifth insemination period was observed in all of the treatments with the exception of Treatment D, as shown in Figure 7. Again, this difference for Treatment D was not considered important because of the large variation within period and treatment. The effect of period-by-treatment interaction was not significant at the five percent level of probability.

The difference between hatches for hatch of total eggs set and the effect of hatch-by-treatment interaction were not significant at the five percent level of probability. All of the treated birds yielded higher percentage hatch of total eggs set than did the birds under control during the first two hatches within the insemination period. This trend was not maintained, however, during the last hatch within period. This is shown in Figure 8.

These results indicate that the treated birds exhibited higher hatch of total eggs set than did the control birds. This difference, however, was not significant. Also, there was no evidence of a favorable treatment effect on the hatch of total eggs set toward the latter part of the breeding season.

Female body weights were recorded at 28-day intervals throughout the experimental period. This data is presented in Table XIII. The analysis of variance for female body weight change over all periods did not show any effect of treatment. These results indicate that the female body weight was not changed by the administration of antibiotics throughout the breeding season.

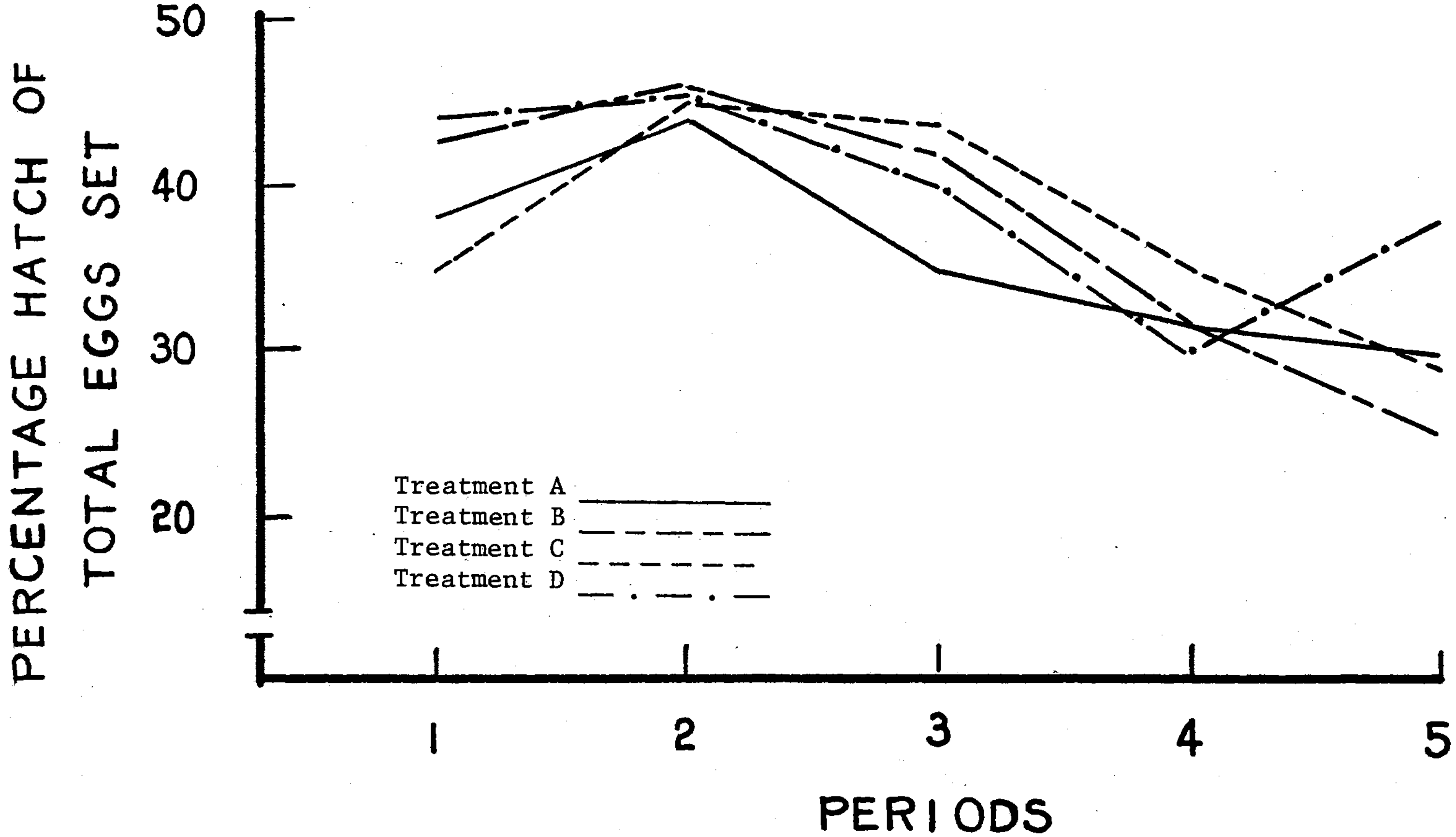

Figure 7. The Influence of Antibiotics on Percentage Hatch of Total Eggs Set by Period in 1967.

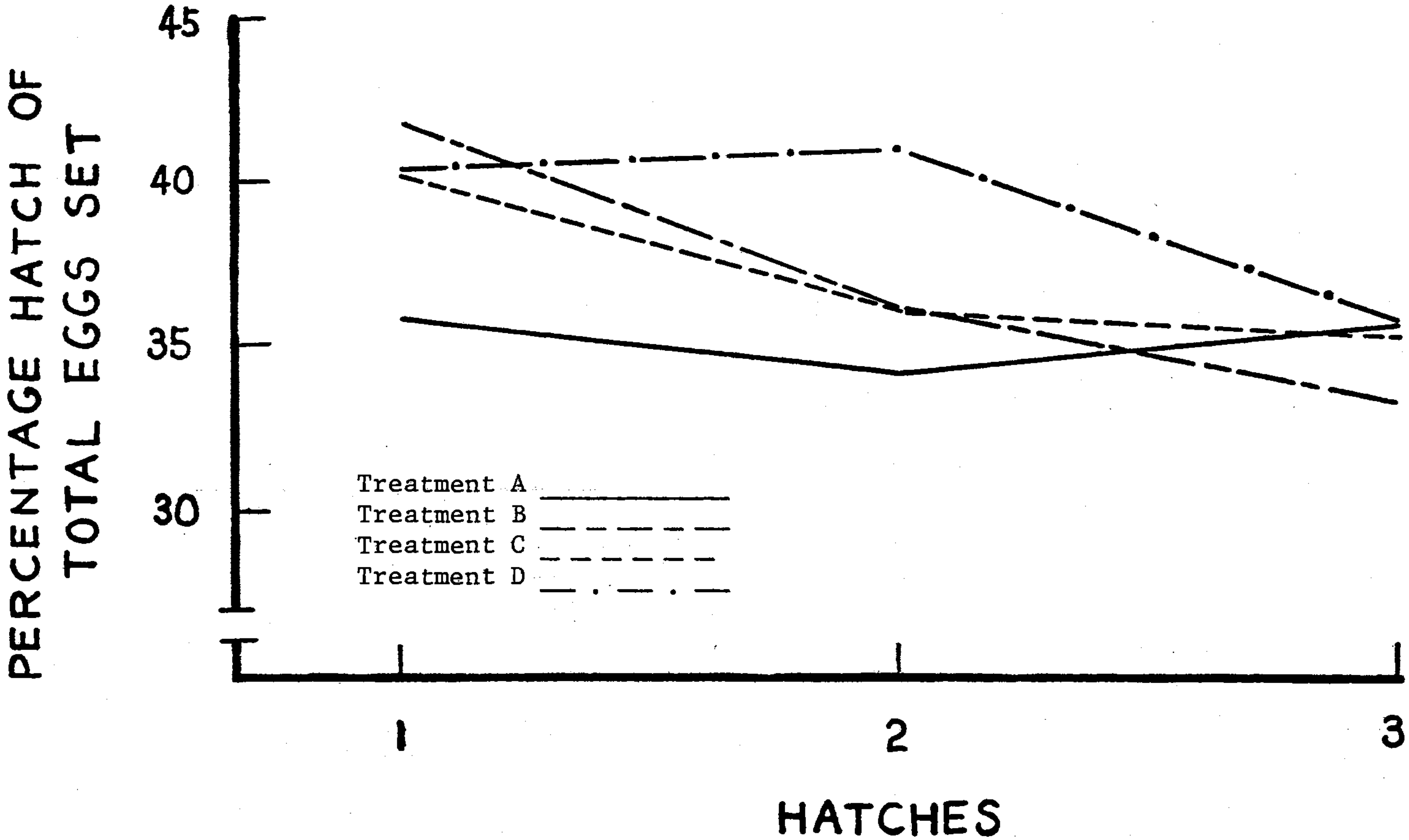

Figure 8. The Influence of Antibiotics on Percentage Hatch of Total Eggs Set by Hatch in 1967.

TABLE XIII

AVERAGE FEMALE BODY WEIGHT PER TREATMENT BY 28-DAY INTERVALS IN 1967

Treatment	Period				
	1	2	3	4	5
A	22.30	21.90	21.10	20.55	19.55
B	21.71	21.08	20.15	19.73	19.35
C	21.95	21.43	20.38	20.23	19.63
D	22.06	21.50	20.43	20.05	19.28

1968

The summarized data for percentage egg production is presented in Table XIV and Figure 9. The analysis of this data is presented in Table XV. Considering the treatment averages for all of the hatches, Treatment A showed a smaller percentage egg production than did Treatments B, C, or D. Treatment D exhibited the highest egg production among all of the groups. The differences between treatments were not significant at the five percent level of probability. These data for 1968 agreed with the results obtained in 1967 which indicated that higher egg production was observed for the females under Treatments B, C, and D, than for the control females.

The analysis of variance indicated that the difference for egg production by insemination period was significant at the one percent level of probability, and in general, the highest egg production was obtained from the third to the fifth week of hatch. Compared to the results for 1967, this might indicate that the seasonal effects such as

TABLE XIV

AVERAGE EGG PRODUCTION PER TREATMENT BY HATCH BY PERIOD IN 1968

TREATMENT	PERIOD 1			PERIOD 2			PERIOD 3			PERIOD 4			PERIOD 5			OVERALL TREATMENT MEAN
	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	
A	27.86	43.22	45.72	45.71	46.79	37.50	35.00	32.14	34.64	37.50	37.86	32.14	34.64	37.50	37.86	37.74
B	31.42	46.07	49.29	40.36	40.72	29.28	32.50	37.14	44.29	35.00	39.64	37.07	44.28	35.00	39.64	38.78
C	21.43	33.21	47.14	49.29	56.79	49.64	36.79	37.82	39.47	37.05	37.23	37.82	39.47	37.05	37.23	39.83
D	35.36	41.07	52.86	53.21	51.07	35.71	33.21	35.00	47.86	46.07	46.79	35.00	47.86	46.07	46.79	43.60

Standard error for treatment comparison:
1. Between two treatment means: ±3.68
2. Between two treatment means during the same hatch: ±6.37
3. Between two treatment means during the same hatch and period: ±14.25

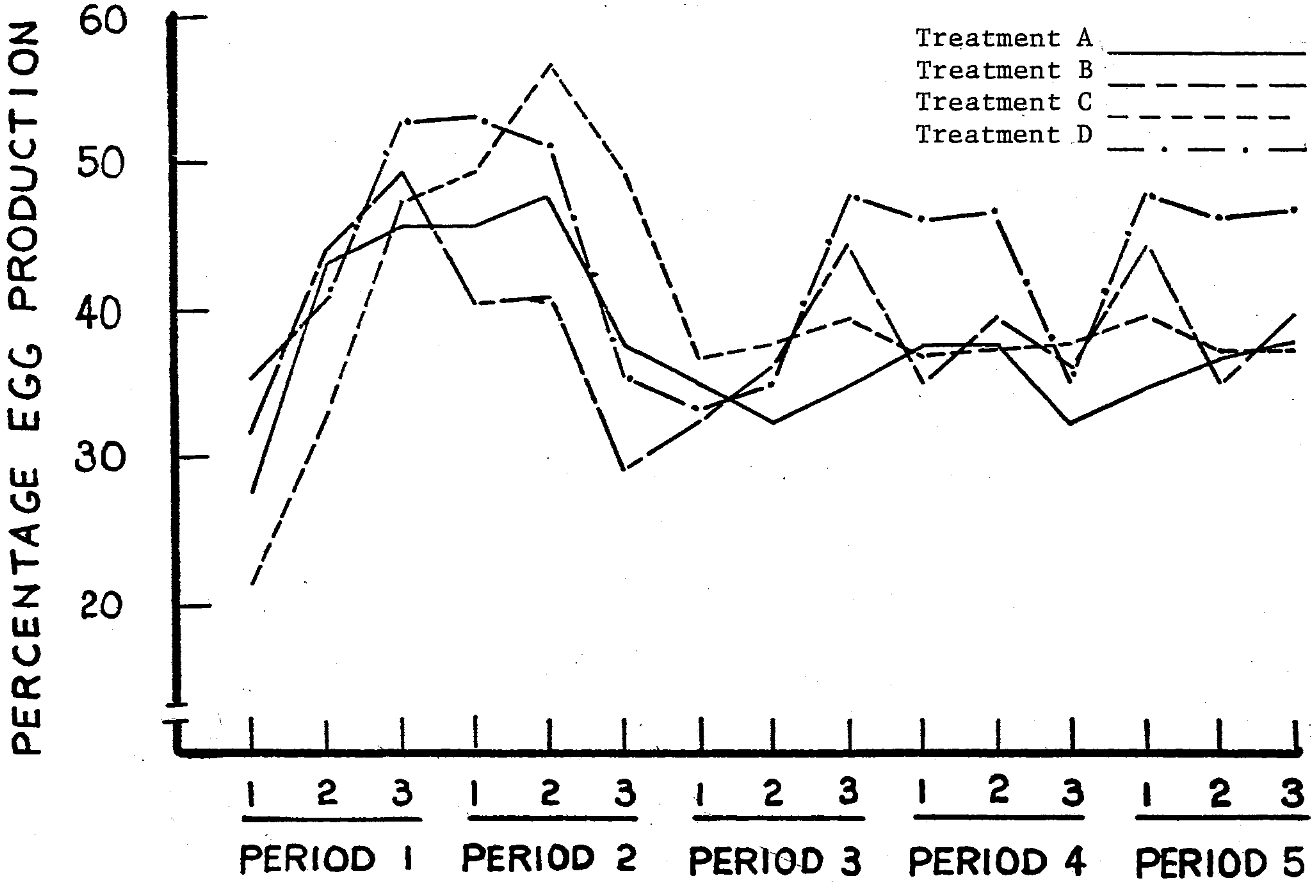

Figure 9. The Influence of Antibiotics on Percentage Egg Production in 1968. Measured Weekly.

TABLE XV

ANALYSIS OF VARIANCE FOR PERCENTAGE EGG PRODUCTION IN 1968

SOURCE OF VARIANCE	D.F.	S.S.	M.S.	F.
Treatment	3	2347.1154	782.3718	0.9624
Error A	12	9749.7529	812.4794	
Period	4	3188.4662	797.1165	4.1022**
Period x Treatment	12	4278.4864	356.5405	1.8348
Error B	48	9326.9744	194.3120	
Hatch	2	764.7332	382.3666	3.3348*
Hatch x Treatment	6	350.8485	58.4748	
Hatch x Period	8	9179.0850	1147.3856	10.0071**
Hatch x Period x Treatment	24	2451.2177	102.1341	
Error C	120	13758.7673	114.6564	
Swab	1	1317.9783	1317.9783	9.3787**
Swab x Treatment	3	5351.4542	1783.8175	12.6937**
Swab x Period	4	3159.8826	789.9707	5.6214**
Swab x Period x Treatment	12	5072.3327	422.6944	3.0079**
Swab x Hatch	2	85.8294	42.9147	
Swab x Hatch x Treatment	6	282.4411	47.0735	
Swab x Hatch x Period	8	451.4329	56.4291	
Swab x Hatch x Period x Treatment	24	2848.7419	118.6976	
Error D	180	25294.9443	140.5275	

**$P < 0.01$

*$P < 0.05$

temperature, differed for the two years. The effect of period-by-treatment interaction was not significant at the five percent level of probability.

The difference in egg production by hatch within insemination period was significant at the five percent level of probability. The highest mean egg production was reached during the second hatch within the insemination period. In all of the hatches, Treatments B, C, and D exhibited higher egg production than did Treatment A, as shown in Figure 10. These differences were not significant at the five percent level of probability.

The difference between the swabbed and unswabbed females for egg production was significant at the one percent level of probability, as was the situation in 1967. The mean egg production for the swabbed females was 41.64 percent, and for the unswabbed females was 38.33 percent. As in the 1967 situation, there is no clear explanation for these results. This does appear to be a very unusual result and coincident, since there is no apparent reason for the swabbed females having superior egg production.

These results indicate that all of the birds receiving antibiotic injections produced higher egg production than did the birds in the control group; however, the difference was not significant. The egg production for the females receiving antibiotics was superior to that of the controls during the latter part of the breeding season. This difference, however, was not statistically significant.

A summary of the data for percentage fertility is presented in Table XVI. Treatment A exhibited the lowest fertility and Treatment D showed the highest fertility among the four experimental groups. The

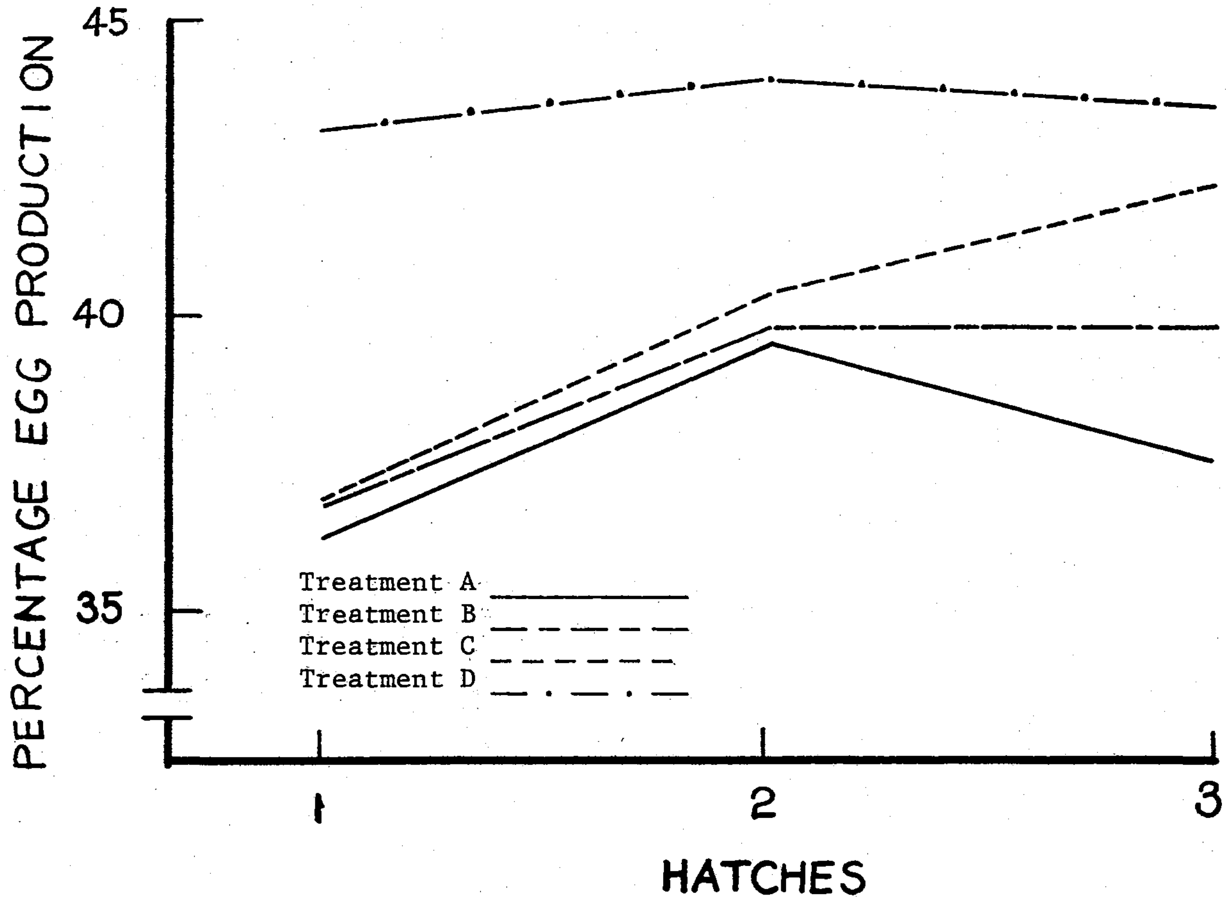

Figure 10. The Influence of Antibiotics on Percentage Egg Production by Hatch in 1968.

TABLE XVI

AVERAGE PERCENTAGE FERTILITY PER TREATMENT BY HATCH BY PERIOD IN 1968

TREATMENT	PERIOD 1			PERIOD 2			PERIOD 3			PERIOD 4			PERIOD 5			OVERALL TREATMENT MEAN
	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	
A	64.71	85.67	83.64	87.83	84.22	75.54	79.79	78.14	76.18	84.71	72.01	65.05	65.05	61.40	52.08	74.40
B	64.05	77.83	75.69	91.86	84.45	80.24	86.28	90.13	69.24	78.72	62.90	59.18	63.26	73.68	71.07	75.24
C	60.11	77.15	76.29	80.67	90.93	81.29	85.44	73.35	69.18	78.20	74.48	72.87	72.99	72.82	67.58	75.56
D	80.52	89.59	87.39	91.63	88.04	78.98	91.54	85.27	66.50	83.21	78.13	69.24	75.96	77.75	67.59	80.76

Standard error for treatment comparison:
1. Between two treatment means: ±4.81
2. Between two treatment means during the same period: ±10.76
3. Between two treatment means during the same hatch: ±8.33

difference between treatments was not significant at the five percent level of probability. The analysis of variance for percentage fertility is shown in Table XVII.

The difference for percentage fertility between insemination periods was significant at the one percent level of probability; however, the period-by-treatment interaction was not significant. This is presented in Figure 11. It is noticed that in all of the treatments, the highest fertility was attained during the second insemination period and then decreased to the lowest point during the final period. During this final period, Treatments B, C, and D all exhibited higher fertility than did Treatment A. It was also noted that Treatment D exhibited higher fertility than any of the other treatments throughout the experiment within the exception during the third period, but these differences were not significant at the five percent level of probability.

There was a significant difference between hatches within insemination period at the one percent level of probability. In all of the treatments, the lowest percentage fertility was observed for the third hatch of the insemination period. Considering the means for the three hatches for the five insemination periods, Treatment A showed less fertility than did the other treatments, with the exception of the first hatch. This is shown in Figure 12. The hatch-by-treatment interaction was not significant at the five percent level of probability.

The difference for fertility between the swabbed and unswabbed groups and the effect of swabbing-treatment interaction was significant at the five percent level of probability. The reason for these differences is not clear.

These results indicate that a favorable but non-significant differ-

TABLE XVII

ANALYSIS OF VARIANCE FOR PERCENTAGE FERTILITY IN 1968

SOURCE OF VARIANCE	D.F.	S.S.	M.S.	F.
Treatment	3	2999.3588	999.7863	0.7201
Error A	12	16660.4016	1388.3668	
Period	4	14371.6430	3592.9107	6.9397**
Period x Treatment	12	5074.3424	422.8619	
Error B	48	24850.9986	517.7291	
Hatch	2	4356.1942	2178.0971	9.3570**
Hatch x Treatment	6	784.9617	130.8269	
Hatch x Period	8	10028.1018	1253.5127	5.3850**
Hatch x Period x Treatment	24	4013.2181	167.2174	
Error C	120	27933.0999	232.1710	
Swab	1	2093.3459	2093.3459	6.4179*
Swab x Treatment	3	2798.6247	932.8749	2.8600*
Swab x Period	4	5588.4707	1397.1177	4.2833**
Swab x Period x Treatment	12	5231.3805	435.9484	1.3365
Swab x Hatch	2	805.2985	402.6493	1.2344
Swab x Hatch x Treatment	6	953.5504	158.9251	
Swab x Hatch x Period	8	3504.3973	438.0497	1.3430
Swab x Hatch x Period x Treatment	24	6367.9208	265.3300	
Error D	180	58710.7856	326.1710	

**P < 0.01

*P < 0.05

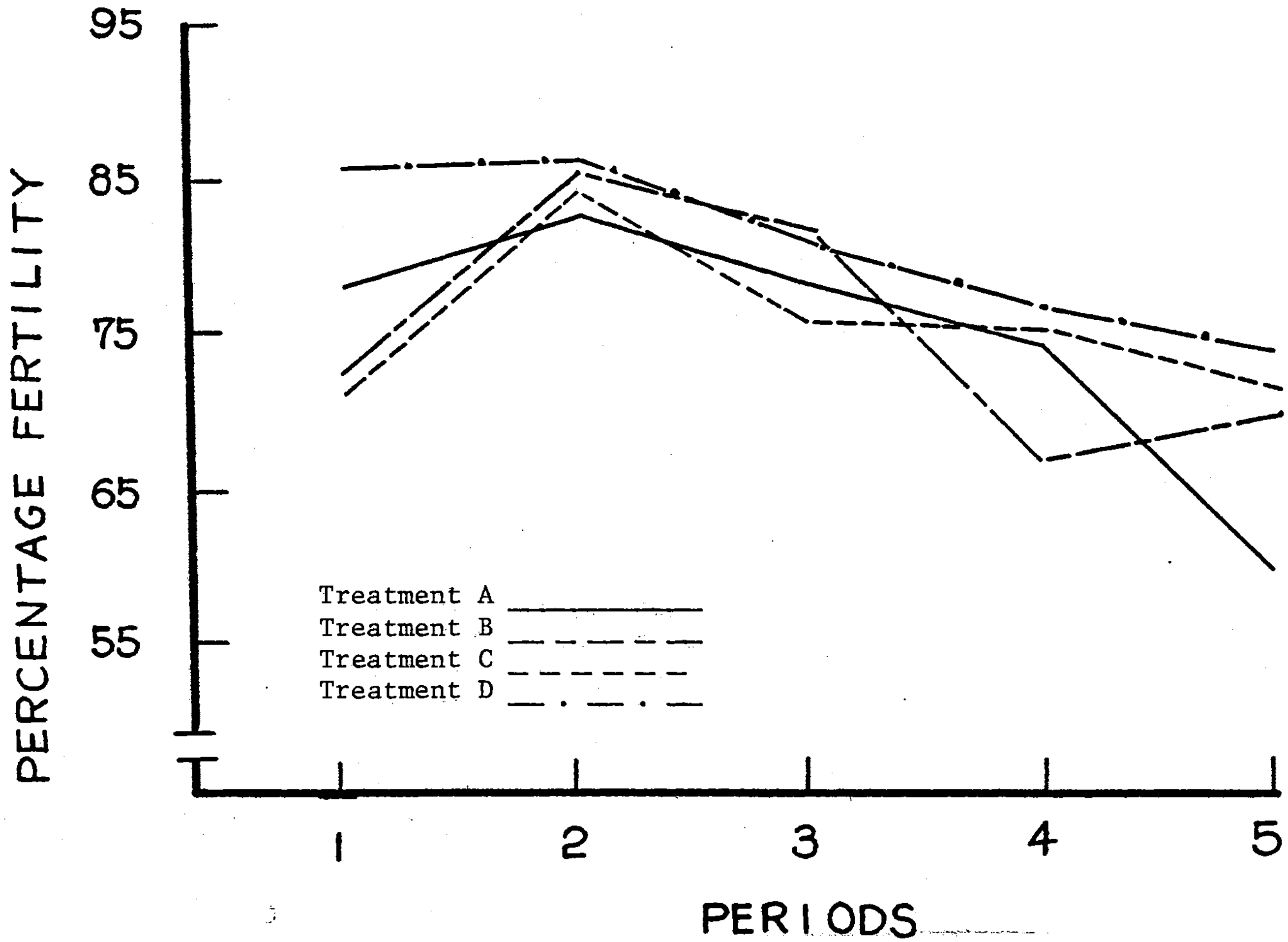

Figure 11. The Influence of Antibiotics on Percentage Fertility by Period in 1968.

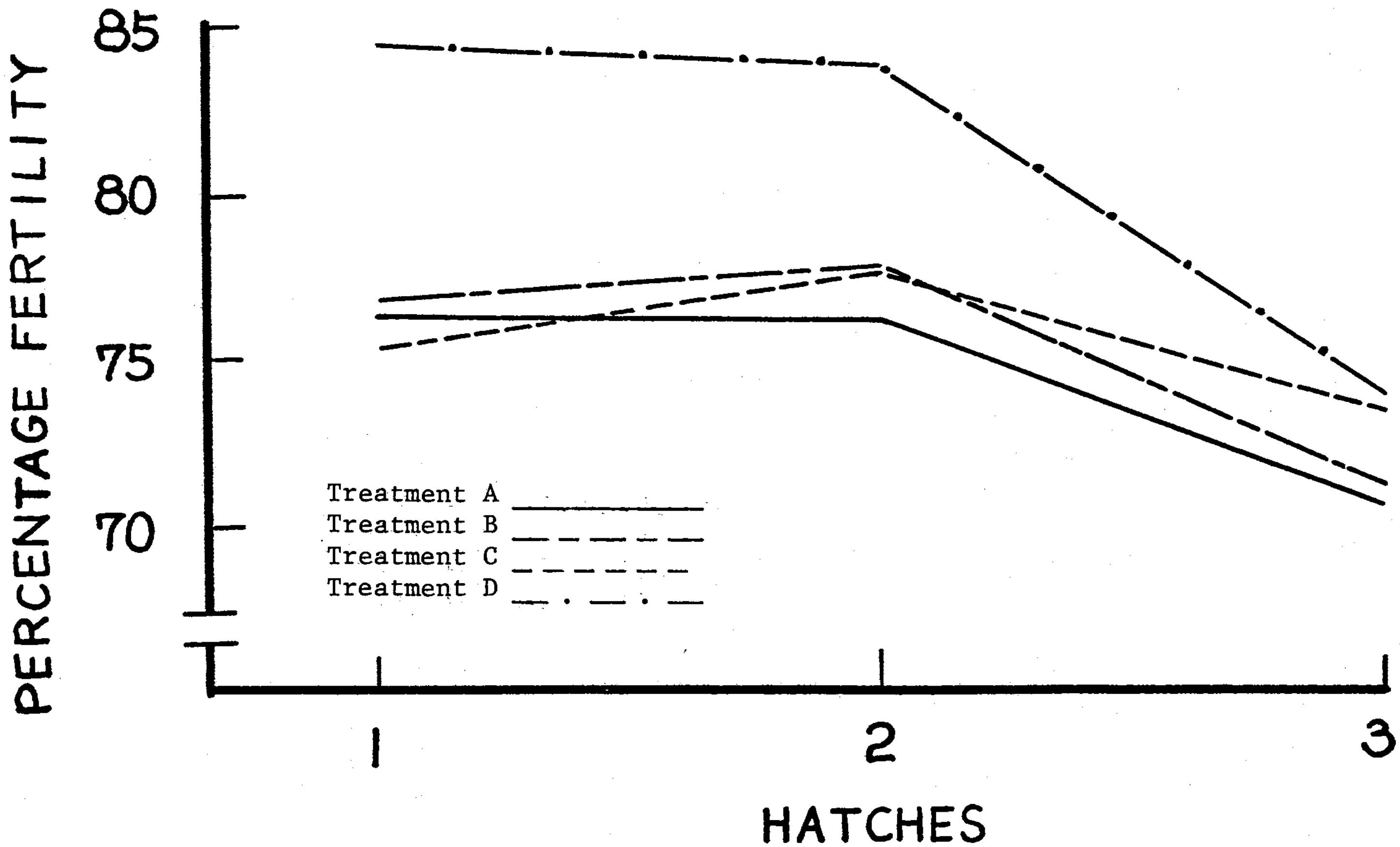

Figure 12. The Influence of Antibiotics on Percentage Fertility by Hatch in 1968.

ence for percentage fertility was observed for the birds receiving antibiotics. All of the treated birds, especially in Treatment D, tended to maintain fertility at a comparatively high level during the late breeding season. All of the treated birds, with the exception of Treatment C, also showed higher fertility during each hatch within insemination period than did the control birds. This trend was difficult to maintain during the last hatch within period.

The summary of the data for the percentage hatch of fertile eggs is presented in Table XVIII. The analysis of variance revealed that there was no significant difference between treatments at the five percent level of probability, as presented in Table XIX. Treatment A exhibited a higher percentage hatch of fertile eggs than any other group, while Treatment B showed the lowest percentage hatch of fertile eggs.

The difference for hatch of fertile eggs between insemination periods was significant at the one percent level of probability. This is shown in Figure 13. The lowest percentage hatch of fertile eggs was observed during the third insemination period. Both Treatments B and C showed a higher but non-significant hatch of fertile eggs than that exhibited by Treatment A during the final period. The effect of period-by-treatment interaction was not significant at the five percent level of probability.

Neither the difference between hatches within insemination period nor hatch-by-treatment interaction was significant at the five percent level of probability. In all of the hatches, except Treatment D in hatch three, Treatments B, C, and D showed a lower hatch of fertile eggs than did Treatment A. This is shown in Figure 14.

These results indicate that the control birds yield a higher per-

TABLE XVIII

AVERAGE PERCENTAGE HATCH OF FERTILE EGGS PER TREATMENT BY HATCH BY PERIOD IN 1968

TREATMENT	PERIOD 1			PERIOD 2			PERIOD 3			PERIOD 4			PERIOD 5			OVERALL TREATMENT MEAN
	Hatch 1	2	3	Hatch 1	2	3	Hatch 1	2	3	Hatch 1	2	3	Hatch 1	2	3	
A	40.94	54.19	50.24	64.49	42.01	49.13	35.80	45.40	44.19	43.70	39.75	51.96	57.67	33.68	33.71	45.79
B	44.30	41.34	39.38	39.80	36.74	44.74	25.29	28.97	10.96	36.92	22.93	43.03	57.92	28.30	45.57	39.17
C	32.94	42.47	39.82	52.21	32.29	43.46	29.92	30.74	25.87	43.67	38.80	56.52	43.67	48.03	52.67	40.87
D	37.58	43.07	63.53	46.95	40.16	40.42	30.17	38.09	35.88	37.59	48.86	59.91	36.56	40.23	43.15	42.14

Standard error for treatment comparison
1. Between two treatment means: ±6.40
2. Between two treatment means during the same period: ±14.32
3. Between two treatment means during the same hatch: ±11.09

TABLE XIX

ANALYSIS OF VARIANCE FOR PERCENTAGE HATCH OF FERTILE EGGS IN 1968

SOURCE OF VARIANCE	D.F.	S.S.	M.S.	F.
Treatment	3	0.2841	0.0944	0.3851
Error A	12	2.9510	0.2459	
Period	4	1.5265	0.3816	4.3611**
Period x Treatment	12	1.3369	0.1114	1.2731
Error B	48	4.1991	0.0875	
Hatch	2	0.3276	0.1638	1.7278
Hatch x Treatment	6	0.6931	0.1155	
Hatch x Period	8	1.3421	0.1678	1.7700
Hatch x Period x Treatment	24	1.8201	0.0758	
Error C	120	11.3729	0.0948	
Swab	1	0.0003	0.0003	
Swab x Treatment	3	0.6921	0.2307	2.4594
Swab x Period	4	0.3299	0.0825	
Swab x Period x Treatment	12	0.9988	0.0833	
Swab x Hatch	2	0.0800	0.0400	
Swab x Hatch x Treatment	6	0.1211	0.0202	
Swab x Hatch x Period	8	1.0966	0.1371	1.4616
Swab x Hatch x Period x Treatment	24	2.2663	0.0944	
Error D	180	16.8899	0.0938	

**$P < 0.01$

*$P < 0.05$

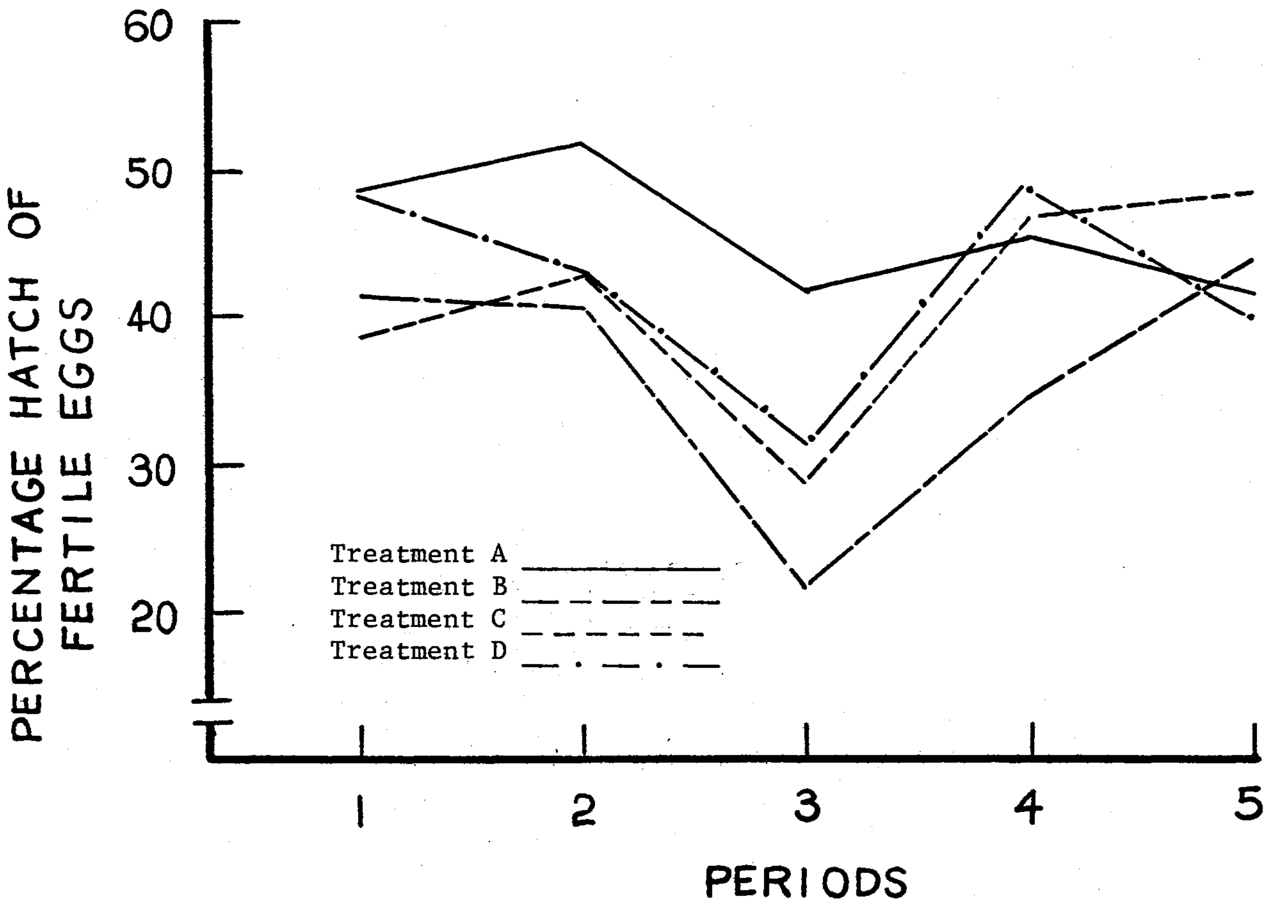

Figure 13. The Influence of Antibiotics on Percentage Hatch of Fertile Eggs by Period in 1968.

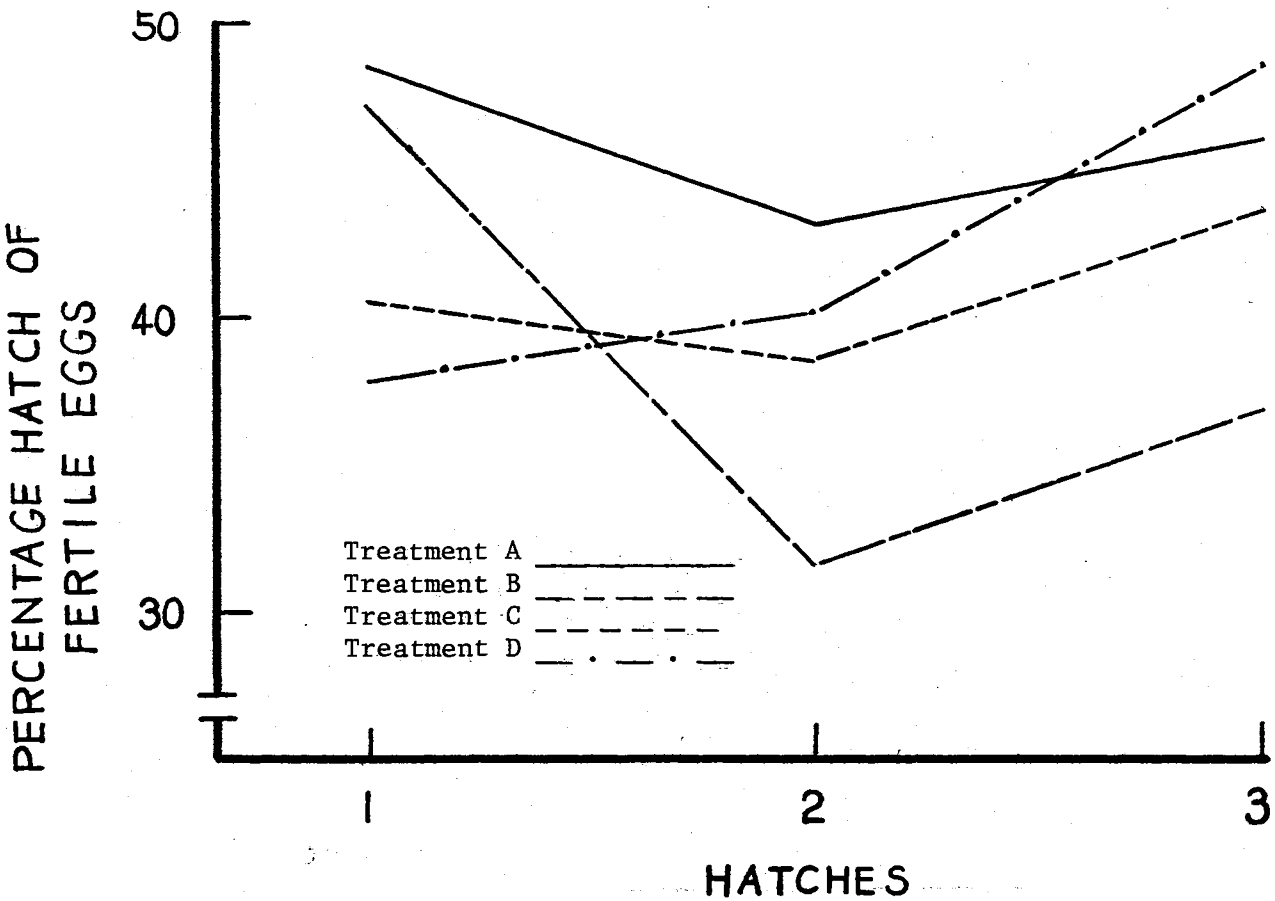

Figure 14. The Influence of Antibiotics on Percentage Hatch of Fertile Eggs by Hatch in 1968.

centage hatch of fertile eggs than did the birds receiving antibiotic injections. The difference was not statistically significant. The lowest percentage hatch of fertile eggs was observed for the birds in Treatment B. None of the treated birds were able to maintain a higher percentage hatch of fertile eggs than did the control birds toward the end of the breeding season. This trend was also apparent for hatch within insemination period.

A summary of the data for percentage hatch of total eggs set is presented in Table XX. No significant difference, at the five percent level of probability, was observed between treatments, as is shown in Table XXI. Treatment A showed the highest percentage hatch of total eggs set among the four experimental groups.

The difference for hatch of total eggs set between insemination periods was significant at the one percent level of probability. This might have been caused by the relatively low percentage hatch of total eggs set during the third period, as is presented in Figure 15. Both Treatments C and D, during the fourth insemination period, and Treatments B, C, and D, during the fifth period, showed higher hatch of total eggs set than Treatment A, but the effect of period-by-treatment interaction was not significant. The differences for treatment were not significant at the five percent level of probability.

The hatch effect and the hatch-by-treatment interaction were not significant at the five percent level of probability. This is presented in Figure 16. Only Treatment D during the second and the third hatch within insemination period showed a higher percentage hatch of total eggs set than did Treatment A.

These results indicate that antibiotic injections did not signifi-

TABLE XX

AVERAGE PERCENTAGE HATCH OF TOTAL EGGS SET PER TREATMENT BY HATCH BY PERIOD IN 1968

TREATMENT	PERIOD 1			PERIOD 2			PERIOD 3			PERIOD 4			PERIOD 5			OVERALL TREATMENT MEAN
	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	Hatch 1	Hatch 2	Hatch 3	
A	31.48	46.57	39.41	57.12	35.63	36.99	25.95	35.02	35.28	37.11	30.72	35.24	38.76	14.89	25.72	35.06
B	25.18	31.90	29.56	36.56	31.36	40.03	23.21	26.26	7.93	29.04	15.28	25.81	38.95	30.78	39.42	38.08
C	24.91	30.53	28.51	41.97	30.22	36.14	24.77	23.45	17.43	34.00	32.95	37.10	32.93	30.78	33.98	30.64
D	29.50	38.11	55.23	43.17	35.92	34.60	26.97	25.77	24.73	31.91	37.61	39.66	27.84	31.85	30.06	34.20

Standard error for treatment comparison:

1. Between two treatment means: ±5.71
2. Between two treatment means during the same period: ±12.77
3. Between two treatment means during the same period: ±9.90

TABLE XXI

ANALYSIS OF VARIANCE FOR PERCENTAGE HATCH OF TOTAL EGGS SET IN 1968

SOURCE OF VARIANCE	D.F.	S.S.	M.S.	F.
Treatment	3	0.3769	0.1256	0.6414
Error A	12	2.3492	0.1958	
Period	4	0.9601	0.2400	6.0913**
Period x Treatment	12	0.5826	0.0485	1.2309
Error B	48	1.8896	0.0394	
Hatch	2	0.0716	0.0358	
Hatch x Treatment	6	0.1105	0.0184	
Hatch x Period	8	0.6384	0.0798	2.3265*
Hatch x Period x Treatment	24	0.7050	0.0294	
Error C	120	4.1207	0.0343	
Swab	1	0.0170	0.0170	
Swab x Treatment	3	0.3640	0.1213	3.6563*
Swab x Period	4	0.1066	0.0266	
Swab x Period x Treatment	12	0.2512	0.0209	
Swab x Hatch	2	0.0055	0.0027	
Swab x Hatch x Treatment	6	0.0666	0.0111	
Swab x Hatch x Period	8	0.2316	0.0289	
Swab x Hatch x Period x Treatment	24	0.8536	0.0356	
Error D	180	5.9819	0.0332	

**P < 0.01

*P < 0.05

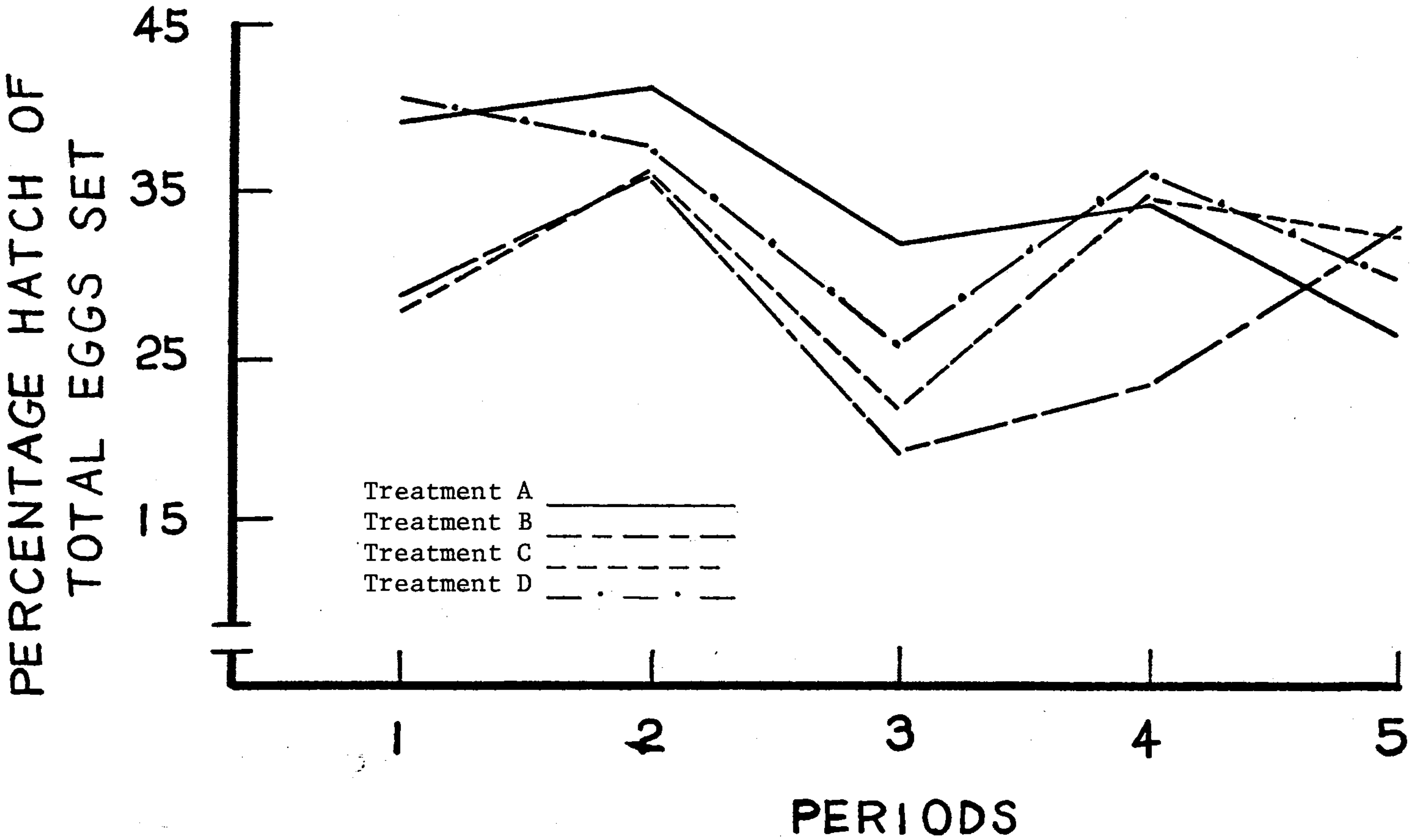

Figure 15. The Influence of Antibiotics on Percentage Hatch of Total Eggs Set by Period in 1968.

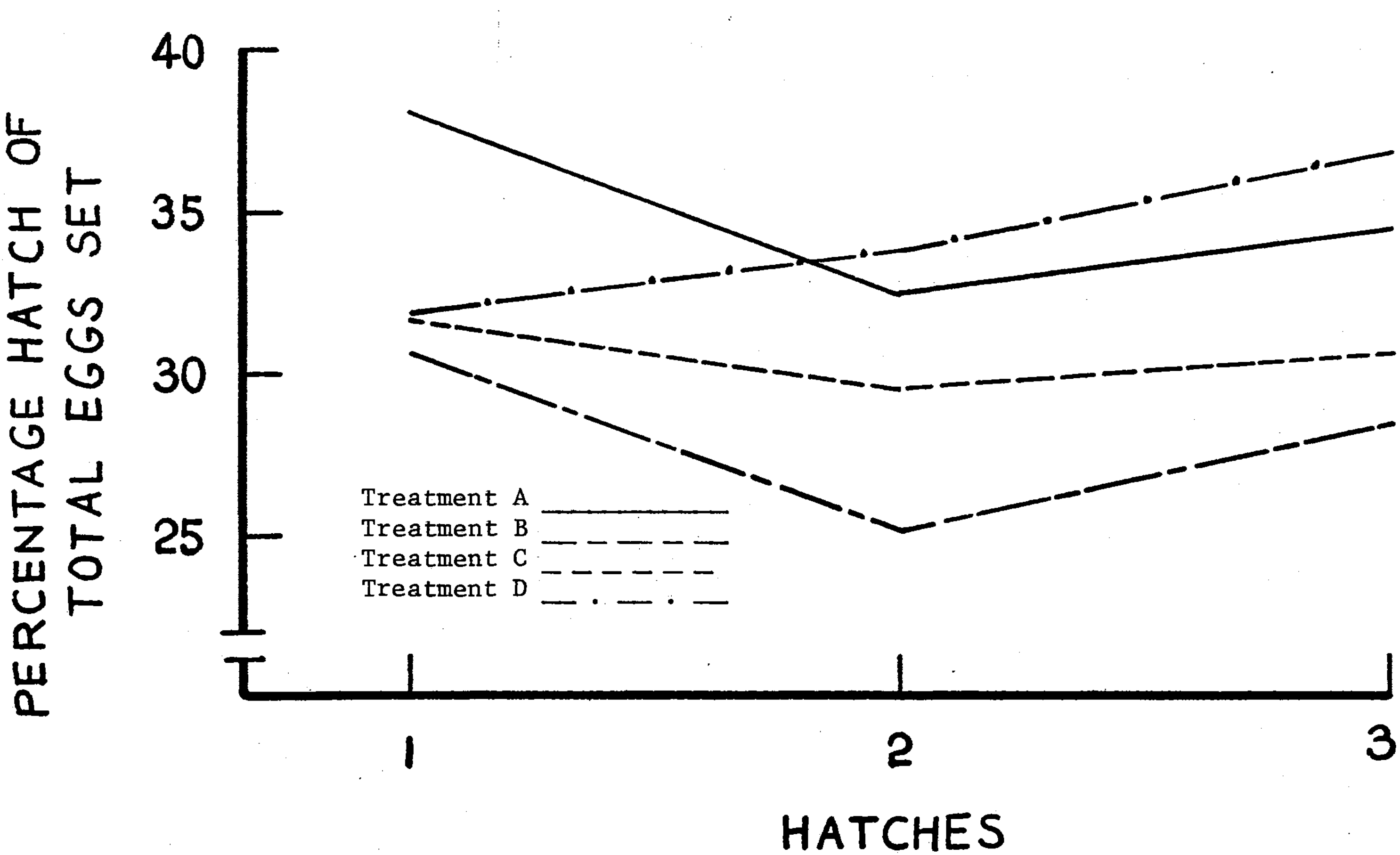

Figure 16. The Influence of Antibiotics on Percentage Hatch of Total Eggs Set by Hatch in 1968.

cantly affect the percentage hatch of total eggs set. The lowest percentage hatch of total eggs set was yielded by the birds in Treatment B. The hatch of total eggs set for Treatments C and D was greater than for the control during the last two insemination periods; however, the difference was not significant.

The female body weights recorded at 28-day intervals are presented in Table XXII. A comparison of the body weight change throughout the experiment between treatments was not significant at the five percent level of probability. These results indicate that female body weight was not affected by the antibiotic administration during the breeding season.

TABLE XXII

AVERAGE FEMALE BODY WEIGHT PER TREATMENT BY 28-DAY INTERVALS IN 1968

Treatment	Period				
	1	2	3	4	5
A	23.03	22.45	21.40	20.78	20.30
B	23.19	22.18	21.03	20.60	19.93
C	23.35	22.51	21.45	20.59	20.23
D	22.99	22.31	21.14	20.85	20.18

CHAPTER V

SUMMARY AND CONCLUSIONS

Four treatments with three different antibiotic combinations were used in this study to investigate the effect upon reproductive performance of female breeding turkeys receiving artificial insemination. Antibiotics were administered by subcutaneous injection one day after artificial insemination throughout the experiment. This study was initiated when the female turkeys reached approximately 40 percent egg production, and was continued throughout a 15-week period.

The results indicated that although the difference in egg production between treatments was not significant, a higher percentage egg production was exhibited by the birds receiving antibiotics than by the control females. This trend was the same for both the 1967 and 1968 data. It was also indicated that the birds receiving the penicillin and combistrep mixture showed the highest percentage egg production among all of the treatment females. This trend was more pronounced during the second year (1968) study. During the late breeding season in 1967, the birds injected with antibiotics showed higher egg production than the control birds. This same trend was not observed in 1968 excepting for the birds in the pencillin-combistrep treatment group.

No statistically significant effect was observed for percentage fertility as a result of the administration of antibiotics during the 1967 and 1968 phases of this experiment. In 1968 there was a more favorable level of fertility for the antibiotic treatments than was observed for the control. This was particularly noted in the case of the penicillin-combistrep treatment. It was also noteworthy that the females receiving antibiotics exhibited a higher percentage fertility than did the controls for the final three weeks of the study in 1968. This trend was not evident in the 1967 data. Considering the trends for fertility within the five artificial insemination periods, it is apparent that none of the antibiotics which were administrated were able to prevent the reduction which occurred during the third week after the female turkeys were inseminated.

The effect of the administration of antibiotics on percentage hatch of fertile eggs was not significant for either 1967 or 1968. The comparatively high percentage hatch of fertile eggs attained by the birds receiving the penicillin-combistrep combination in the 1967 study was probably caused by the last two weeks of the experiment. None of the antibiotic treatments successfully maintained the percentage hatch of fertile eggs at the initial level toward the latter part of breeding season.

None of the antibiotic combinations was shown to have a significant effect on percentage hatch of total eggs set. As indicated by the data for percentage hatch of fertile eggs, the birds injected with antibiotics, especially in the penicillin-combistrep treatment group, showed a higher percentage than did the control females. Again, these antibiotic combinations could not maintain throughout the breeding season, the percentage hatch of total eggs set which was observed during the beginning of the season.

Female body weight change was not significantly affected by the administration of antibiotics in this experiment.

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