TURKEY REPRODUCTION AS INFLUENCED BY RESERPINE

By

JOHN MARK CASEY

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Thesis Approved:

J. C. Gilbreath
Thesis Adviser

John W. West
Head of the Department

Lowell Hendricks
Dean of the Graduate School

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF TABLES (Cont'd)

LIST OF FIGURES

INTRODUCTION

A number of stresses have, by necessity, been imposed on turkeys produced in present day commercial breeding and growing operations. The breeding birds must be handled frequently in order to measure individual performance of the birds for certain economically important traits. Also, they are usually rather closely confined to facilitate collection of data on the traits being measured.

Along with the additional stresses resulting from close confinement of growing birds, the occurrence of aortic rupture has become of important consequence in certain strains of turkeys (McSherry et al., 1954; Gibson and deGruchy, 1955). This condition appears to occur most frequently in the faster growing birds of the strains in which it has been observed.

The use of a therapeutic agent for the control of aortic rupture and for the alleviation of stresses imposed on growing and breeding birds could possibly be of much economic importance to commercial turkey producers.

Several research workers (Carlson and Shinnick, 1959; Barnett, 1960; Barnett, 1962; Morrison, 1962; Patrias, 1962) have reported that reserpine incorporated into the diet of growing turkeys is an effective method of controlling aortic rupture. In addition, reserpine has been used as a sedative agent in numerous mammalian and avian species, with its effectiveness varying markedly among species (Earl, 1956; Hewitt, 1957; Carlson and Morgan, 1958; Barrett, 1959).

This study was designed with two major objectives:

1. To measure the effects of graded levels of reserpine administered orally to breeding turkeys.
2. To measure the effects of graded levels of reserpine on the growth rate of turkeys between 12 and 24 weeks of age and the subsequent influence on the reproductive performance of these birds after reserpine treatment was discontinued.

REVIEW OF LITERATURE

Reserpine was classified by Earl (1956) as the principal alkaloid in the Rauwolfia species. Woodson et al. (1957) described Rauwolfia as a tropical genus of woody plants of the natural family Apocynaceae. This family is of much interest to biochemists because of its complex alkaloid systems which have been demonstrated for nearly all genera investigated.

Numerous species of Rauwolfia have been identified in the regions where the plant is found. These regions, listed by Bein (1956), are the tropical and sub-tropical parts of India, the East Indies, Africa and Central and South America. The different species vary considerably in their content of active alkaloids.

The physical appearance of reserpine was described by Earl (1956) as a pale yellow powder with low solubility in water. It is readily soluble in acetic acid, ascorbic acid, citric acid and in mixed solvents such as N-Ndimethylacetamide, polyethylene glycol and benzyl alcohol.

Woodson et al. (1957) reported that small chemical changes destroy completely the pharmacological activity characteristic of reserpine. It would appear that reserpine is fairly stable chemically, since it is insoluble in water with a very high melting point of 262 - 263 degrees C.

Physiological Effects

It is logical to assume that any effect of reserpine on the behavior or performance of an animal would be the direct or indirect result of a

disruption of one or more of the animal's normal physiological processes. In recent years much research has been conducted in numerous mammalian and avian species to determine the effect of reserpine on various physiological functions.

Evidence was presented by Shore et al. (1957) that the central action of reserpine is mediated through the release of brain serotonin. After administration of reserpine to rabbits intravenously, the drug rapidly entered the brain and achieved its maximal concentration in about 10 minutes, a time when the pharmacological effects of the drug were just apparent. The levels in the brain then declined rapidly and in about two to 24 hours reserpine could no longer be detected. While the brain levels of reserpine were declining, the pharmacological effects progressively increased, becoming maximal in two to four hours. The low levels of serotonin and various pharmacological effects including sedation, miosis, hypothermia and hypotension persisted for about two days. The levels of serotonin then increased and the pharmacologic effects diminished. This indicates that certain central actions of reserpine are related in time to the change in concentration of brain serotonin and not to the concentration of reserpine.

Further evidence was presented by Brodie et al. (1956) that some of the central action of reserpine might be the result of a change of serotonin in the brain from a bound to a free form. It was demonstrated that a few hours after the intravenous administration of 5 mg. of reserpine per kg. of body weight to rabbits, the drug was no longer detectable in the brain, whereas the sedative effects and changes in brain serotonin persisted for 48 hours or more. The sedative effects seemed to be related to changes in the state of brain serotonin rather than the concentration

of reserpine. This was interpreted as further evidence that reserpine acts through free serotonin.

Moon and Turner (1959) reported that reserpine at doses of 5, 10 or 50 micrograms per 100 gram of body weight per day inhibited thyroid activity in rats. Thyroidal I^{131} output was decreased significantly and thyroid secretion rate was reduced approximately 84-90 percent below control values. It was suggested that reserpine alters thyroid function through inhibition of thyrotropin secretion.

The thyroid activity of chickens was measured by the uptake of inorganic I^{131} and the rate of release of organically bound I^{131} by Premachandra et al. (1959). Reserpine administered subcutaneously at levels of 10, 15 and 20 micrograms per 100 grams of body weight had no effect either on thyroid uptake of I^{131} or in affecting the normal rate of release of I^{131} from the thyroid.

Caged layer thyroid and cholesterol relationships were studied by Anderson and Smyth (1959). A small but consistent effect of reserpine fed at a level of 0.5 milligram per kilogram of feed on thyroid weight and total serum cholesterol was noted in this study. There was an inverse relationship found between thyroid size and serum cholesterol, with the serum cholesterol significantly lower in reserpine treated birds.

An increase in thyroid gland size in turkeys, as a function of reserpine dosage and duration of feeding, was also found by Anderson and Smyth (1960). Histological study of the thyroid glands from reserpine treated males showed a distinct atrophy of secretory epithelium accompanied by increased colloid storage in the follicles of a large portion of the glands. This condition, indicating mild hypothyroidism,

may have resulted from a partial inhibition of pituitary thyrotropin secretion.

The cardiovascular and respiratory effects of reserpine in dogs was studied by Trapold et al. (1954). There was a gradual, persistent fall in mean arterial pressure frequently accompanied by a reduction in cardiac rate. There was a progressive respiratory depression, which in two animals resulted in respiratory failure.

A significant decrease in the blood pressure of chickens treated with reserpine in doses from 0.006 to 0.75 milligram per kilogram of body weight was reported by Sturkie et al. (1958). All dosages from 0.01 milligram per kilogram of body weight and above produced a significant decrease in heart rate and the magnitude of the drop was greater than the drop in blood pressure.

The effectiveness of chlorpromazine and reserpine-free mother liquor in alleviating heat stress was studied by Burger and Lorenz (1960). The death of adult White Leghorn males during exposure to an acute thermal stressor was ordinarily preceded by a sudden and striking increase in heart rate. Pre-treatment of the birds with either agent delayed onset of this cardiac crisis and delayed death after the onset of tachycardia, thereby prolonging survival significantly. The reserpine-free mother liquor also depressed the average heart rate significantly under pre-stress resting conditions.

Oral levels of reserpine up to 2 mg./kg. of ration depressed respiratory rate, heart rate and blood pressure slightly but consistently as reported by Weiss (1960). When summer adapted birds were subjected to a heat stress of 105 degrees F., survival time of the birds treated with reserpine was found to be increased significantly from 23 to 38 percent.

Weiss (1961) again reported that reserpine fed to White Leghorn hens at the level of 1.6 mg./kg. of ration for 14 weeks had essentially no effect on blood pressure, pulse rate or respiratory rate.

The effectiveness of reserpine as a physiologically active dietary, hypotensive agent in Broad Breasted Bronze turkeys was demonstrated by Ringer (1959). Short-term (4 weeks) experiments revealed that all dosage levels between 0.1 p.p.m. and 4.0 p.p.m. of reserpine reduced blood pressure significantly. A further short-term experiment demonstrated a hemodynamic reduction by reserpine within 3 to 4 hours following oral administration. Long-term (9 to 12 weeks) experiments incorporating reserpine into the feed produced a gradual reduction in blood pressure in all lots, the magnitude of this reduction depending upon the level of reserpine administered. The greatest hypotensive action was produced by the highest level of reserpine, and the greatest significant difference was observed in males approaching sexual maturity.

Pure reserpine incorporated into the diet of Broad Breasted Bronze turkeys by Speckman and Ringer (1961) increased weight gains and reduced blood pressure between the levels of 0.1 p.p.m. and 0.3 p.p.m. of the ration. Levels above 0.3 p.p.m. of dietary reserpine reduced blood pressure but were apparently approaching toxicity, as evidenced by a reduction in weight gains of birds fed these levels. The circulatory effects noted in this study were a gradual, moderate drop in blood pressure and heart rate through an unknown mechanism. Long and short periods of administration of reserpine produced similar hemodynamic responses; however, the hemodynamic response became more pronounced during longer feeding trials. The blood pressure of the untreated lots increased phenomenally with age, especially

in the male, while the blood pressure of the treated lots increased but at a greatly reduced rate.

The effect of reserpine on the body temperature of chickens was studied by Sturkie et al. (1958). Dosages above 0.10 mg./kg. of body weight produced highly significant decreases in body temperature. It was concluded that larger doses of reserpine are required to depress body temperature than to decrease either heart rate or blood pressure.

A slight decrease in the body temperature of reserpine-treated, immature chickens that had been exposed to high environmental temperature was noted by Huston (1959). This difference was reported as statistically significant.

Oral levels or reserpine up to 2 mg./kg. of feed depressed the body temperature of White Leghorn hens slightly but consistently in a study by Weiss (1960).

Weiss (1961), in a different study, found that reserpine fed to White Leghorn hens at a level of 1.6 mg./kg. feed for 14 weeks depressed body temperature a significant 0.6 degrees C. The birds were subjected to immersion hypothermia in a water bath held at 15 degrees C. By the midpoint in the exposure interval, the body temperature differences between treated and control birds had essentially disappeared. There was no significant differences in survival time, body temperature at death, or in rate of cooling.

Tranquilizing Effects

Reserpine has been used as a tranquilizing agent in numerous mammalian and avian species. Its effectiveness seems to vary markedly among species, depending, at least in part, on route of administration.

Earl (1956) reported that the medicine men of India had advocated the use of Rauwolfia serpentina as a sedative agent for many years.

The effectiveness of reserpine as a calming and tranquilizing agent in dogs was demonstrated by Earl (1956). The onset of effect was somewhat delayed but it was prolonged. It was reported that excessive doses might produce signs of oversedation and gastrointestinal disturbance.

Reserpine produced sedation in all of the laboratory animals studied by Barrett (1959). Those studied included the dog, cat, rabbit, guinea pig, mouse, rat and monkey. The rapidity of the onset of the sedation state, its duration and intensity vary from species to species and with the route of administration of reserpine. A true hypnotic state was not observed in any of the species studied, since all could be aroused.

Hewitt and Reynolds (1957) indicated that a low level of reserpine in the diet of Ring-necked pheasants may be of value in preventing fighting among males in breeding condition. The incidence of feather picking among juveniles during the rearing period was also reduced in this study.

In a different study, Hewitt (1957) fed reserpine in concentrations of 5 and 7 milligrams per kilogram of ration to 2-week-old pheasants held in battery brooders for a period of 2 weeks. Both feather picking and scalping were effectively reduced.

A study with pheasant chicks from day-old to twelve weeks of age was conducted by Carlson and Morgan (1958). Reserpine was administered at levels of 2 mg. per pound of diet fed continuously and at 4 mg. per pound of diet from eight to twelve weeks of age. No difference was noted in feather condition of the reserpine treated birds compared with untreated birds.

Complete control of cannibalism was not effected in pheasants treated with reserpine in a later study by Hewitt (1959). In a test involving 200 adult pheasants, the administration of an average of 40 milligrams of reserpine per bird on the day prior to shipment did result in easier handling. It was concluded that, while reserpine appears to be the most effective tranquilizer tested on gallinaceous birds, it is less effective with birds than with mammals.

A study was conducted by Drye et al. (1959), involving approximately eight hundred male chickens in an attempt to find levels at which reserpine would reduce mortality and provide satisfactory growth when administered to segregated males on range. Levels ranging as high as twenty-five milligrams of reserpine per kilogram of diet did not appear to have any effect on growth, feed consumption, mortality or social conduct of the males under study.

The state of tranquility of adult White Leghorn capons before injection, and at 4 and 24 hours after injection, of single doses of 0.006, 0.01, 0.05, 0.10, 0.2, 0.3 and 0.75 mg./kg. body weight of reserpine injected intramuscularly was observed by Sturkie (1959). It was concluded that the sedative or tranquilizing dose was 0.2 or between 0.1 and 0.2 mg./kg. of body weight based upon observations of behavior.

The protective action of reserpine on broilers exposed to thermal stress was studied by Burger (1959). A quieting effect was noted from dosages above 5.0 mg./kg. of diet. Birds receiving the higher levels of reserpine were not different in excitatory behavior, as measured by gross observation, than were the controls. Reserpine injected at comparable or lower dosage levels than the orally administered dosages produced marked clinical symptoms of tranquilization, although actually shortening

survival time under acute thermal stress.

Reserpine fed at levels of 0.5 and 1.0 mg./kg. of diet for 8 weeks, to 18-week-old turkeys, seemed to quiet the birds and surpress their desire to fight, as reported by Carlson (1956).

In a study by Ringer (1959), no signs of reduced activity were noticed in Broad Breasted Bronze turkeys fed levels of reserpine between 0.1 p.p.m. and 4.0 p.p.m.

Control of Aortic Rupture

A dissecting aneurism affecting the posterior aorta of turkeys was described by McSherry et al. (1954). Mortality was most prevalent in the faster growing birds with high feed consumption. Losses did not occur in a second group of birds where there was a slower rate of growth due to a decrease of protein level in the feed.

In six outbreaks of aortic rupture confirmed during 1954, losses occurred in birds 11 to 24 weeks of age, in a report by Gibson and deGruchy (1955). Four outbreaks diagnosed retrospectively as having occured in 1952 and 1953 showed an age incidence of 17 to 21 weeks. At this time the condition of aortic rupture had been observed only in Broad Breasted Bronze and American Mammoth Bronze turkeys. All of the turkeys in which aortic rupture was diaghosed in 1954 were males.

Hemodynamic changes associated with aging in Broad Breasted Bronze turkeys were studied by Ringer and Rood (1959). Pulse pressure and both systolic and diastolic blood pressure of 20 to 22-week-old males were significantly higher than for females, while the heart rate remained unchanged. Systolic pressure of the 22-week-old male turkey (296.7 mm. Hg) increased about 50 percent from the 8-week-old male (197.8 mm. Hg).

The systolic pressure in the females rose from 189.3 to 257.3 mm. Hg for the same ages, representing a change of 36 percent. It was suggested that blood pressure changes throughout aging might possibly be associated with aortic rupture in this breed.

An incidence of dissecting aneurysms in a flock of 3,000, five-week-old Empire White turkeys was encountered by Carlson and Shinnick (1959). At 12 weeks of age several more birds succumbed each day with violent deaths and hemorrhages. A total of 24 birds was believed to be lost to this malady in the earlier period and 33 during the latter period. Not all birds were posted, though many were posted and had shown the typical sudden death symptoms with massive internal hemorrhages. When the turkeys were 13 weeks of age, it was decided to try treating one-half of the flock with reserpine in the feed. On the day that treatment began, three turkeys from the treated group died. None died from the control group. In the succeeding 11 days, 14 birds died in the control group, many with violent deaths and hemorrhages. None of the treated group succumbed.

Feeding 0.8 and 1.6 mg. of reserpine per pound of diet reduced the incidence of aortic rupture caused by administration of beta-aminopropionitrile (BAPN) in the feed, in a study by Barnett (1960). In field cases of aortic rupture, 0.45 and 1.5 mg. of reserpine per pound of diet appeared to reduce mortality effectively. In one of three trials, mortality recurred when the drug level was reduced after a 5-day treatment.

An outbreak of internal hemorrhage in two flocks of eight-week-old turkeys was later reported by Barnett (1962). One of the flocks, numbering 8500, had lost 38 birds during a 10-day period prior to the feeding trial. Birds in this flock were fed reserpine at a level of 1.0 p.p.m. for 5 days and 0.2 p.p.m. thereafter. A 4000-bird flock, from which 19 birds had

been lost during the 10-day pre-trial period, was used as controls. No deaths occurred in the flock of 8500 birds that were fed 1.0 p.p.m. of reserpine for 5 days, while 15 deaths were recorded during the same period in the untreated flock.

A severe outbreak of aortic rupture in a flock of 3200 male turkeys was reported by Morrison (1962). The birds began to die at 11 weeks of age and, between the eleventh and sixteenth weeks, the losses amounted to 5 percent. Reserpine at a level of 1.0 p.p.m. was fed to 1600 of the birds. The other 1600 birds were used as a control without reserpine treatment. There were no deaths in the reserpine treated birds during the 6 days that reserpine was included in the diet. During the same period, 21 of the untreated birds died of aortic rupture.

An outbreak of internal bleeding in a flock of 1900 8-week-old Lancaster White turkeys was noted by Patrias (1962). Thirty poults had died by the sixth day after the epidemic started. A control group of 700 birds and a medicated group of 1200 birds were set up. The treated birds were fed 1.0 p.p.m. of reserpine for the first 7 days, followed by 0.2 p.p.m. thereafter. Results show that reserpine first reduced and then completely stopped aortic rupture in this 1900-bird flock.

Body Weight and Feed Efficiency

Two-week-old pheasants fed reserpine in concentration of 5.0 and 7.0 mg. per kg. of diet for two weeks consumed slightly less feed but gained slightly more weight than untreated birds, in a study by Hewitt (1957).

In a study with pheasant chicks from day-old to twelve weeks of age, Carlson and Morgan (1958) showed that reserpine at 2.0 mg. per pound of

diet fed continuously, or at 4.0 mg. per pound of diet from eight to twelve weeks of age, did not reduce mortality but may have actually caused an increase in mortality. Reserpine at these levels appeared to cause a reduction in growth rate, at least for a short time.

The effects of reserpine on body weight in growing and laying White Leghorn chickens were observed by Anderson and Smyth (1959). Growth and feed consumption for the control and reserpine-fed (0.5 milligrams per kilogram of feed) groups were comparable at 19 weeks of age. At sexual maturity (19 weeks) a portion of the initial control group was transferred to reserpine supplementation and all birds were housed in individual laying cages. The groups receiving reserpine consumed an average of 1.8 pounds of feed per bird less than the controls. The depressed body weights of the reserpine-fed birds (recorded during the early part of the production period) were mainly overcome by the end of the trial.

Reserpine fed to White Leghorn chicks at levels of 0.5 mg./kg. of diet produced a slight but significant increase in growth by the twenty-third day of age in a study by Burger et al. (1959). Reserpine fed at levels of 5.0 to 500.0 mg./kg. of diet depressed growth, and at 500.0 mg./kg. produced 96 percent mortality by the twenty-fourth day of age.

No difference in feed conversion in four groups of inbred hybrid laying pullets treated with 0.0, 0.25, 0.50 and 1.0 mg. reserpine per pound of diet was found by Couch (1959).

The level of reserpine used in broiler feeding appeared to be critical in a study by Fritz et al. (1959). The optimum quantity seemed to be below that which produced obvious sedation. Excessive levels depressed growth and also appeared to lower feed conversion. It was concluded that one or two grams of reserpine per ton of feed showed the most promise of favorable results.

A study by Gilbreath et al. (1959) showed that White Leghorn pullets receiving reserpine consumed significantly less feed than the controls. This difference appeared to be consistent throughout the 28-week period. The treated birds produced fewer eggs, which tended to nullify the advantage of feed saved.

The effect of continuous low-level feeding of reserpine on growth and feed conversion in large type white male turkeys from hatching to market age was studied by Anderson and Smyth (1960). Both dietary level of reserpine and age at drug administration appeared to influenced growth and feed utilization of confinement reared males under normal management conditions. Growth and feed conversion at three and six weeks of age were significantly ($P<.01$) depressed at the 0.25 mg./kg. level of reserpine. Increasing the dosage level at 10 weeks to 0.50 mg./kg. of diet had essentially no effect on either criterion. Growth was slightly retarded by the addition of 0.25 mg. of reserpine per kg. of diet to ten-week old birds previously maintained on the control ration.

Burger et al. (1959) reported that reserpine mother-liquor, (a crude Rauwolfia preparation from which approximately 90 percent of the reserpine content has been extracted) when fed to Broad Breasted Bronze poults at levels of 0.5 to 10.0 mg./kg. of diet, produced a slight increase in growth by the thirty-eighth day of age. A level of 1.0 mg./kg. of diet produced a significant increase in growth by the thirty-eighth day of age.

Levels of reserpine above 0.8 p.p.m. apparently became toxic, as evidenced by reduced weight gains in lots of Broad Breasted Bronze turkeys receiving these levels as reported by Ringer (1959). The levels of 0.1

p.p.m. and 0.2 p.p.m. of reserpine did not adversely affect weight gains in this study.

Pure reserpine incorporated into the feed of Broad Breasted Bronze turkeys by Speckman and Ringer (1961) increased weight gains between the levels of 0.1 p.p.m. and 0.3 p.p.m. of the ration. Levels above 0.3 p.p.m. of reserpine were apparently approaching toxicity, as evidenced by a reduction in weight gains of birds fed these levels.

It was concluded by Rudolph (1961) that graded levels of reserpine (0.0, 1.0, 2.0, 4.0 and 8.0 milligrams of reserpine per kilogram of diet) administered to White Holland turkey breeder hens caused a significant decrease in feed consumption and body weight gain.

In trial II of the same study, levels of 0.0, 0.25, 0.50 and 1.0 milligram of reserpine per kilogram of diet were administered to White Holland turkey breeder hens. Results indicate that as the levels of reserpine increased, there resulted a corresponding linear decrease in average body weight gain. No drug effect on average daily feed consumption was observed.

Trial III of the same study extended over a twenty-week treatment period and an eighteen-week post-treatment period. Reserpine was administered to Broad Breasted Bronze turkey males and females at levels of 0.0, 0.50, 1.0 and 2.0 milligrams per kilogram of diet. Results indicate that graded levels of reserpine added to the diet caused a significant linear decrease in average body weight gain. There was no significant effect on average body weight gain after treatment. Average daily feed consumption was not affected by reserpine, either during or after treatment.

Egg Quality

Reserpine fed at a level of 0.5 mg./kg. of diet by Anderson and Smyth (1959) significantly improved egg weight and albumen height prior to heat stress. However, reserpine supplementation did not counteract the significant reduction in egg weight, shell thickness and albumen height resulting from high environmental temperature.

Egg weight and percentage checks in eggs collected from inbred hybrid laying pullets treated with reserpine at levels of 0.0, 0.25, 0.50, and 1.0 mg. per pound of diet were measured by Couch (1959). There was no difference in egg weight, but there was a decrease in percentage checks at the end of 168 days. The percentage of checks was reduced from 4.33 to as low as 2.01 by reserpine supplementation.

Reserpine fed to caged layers at levels of 0.25, 0.50 and 1.0 mg. of reserpine per pound of feed had no significant effect on number of checks and cracks in egg shells in a study by Eoff et al. (1961). Reserpine fed at levels of 0.25 and 0.50 mg. per pound of feed produced significant increases in egg weight when compared to the basal group. A higher level of reserpine (1.0 mg. per pound of feed) produced a significant decrease in egg weight as compared to eggs from the other supplemented groups. The ash content of the egg shells was significantly altered by reserpine but calcium, phosphorous and nitrogen levels of egg shells were not significantly affected.

Reserpine administered at a level of 2.0 mg./kg. of diet supported egg weight and shell quality during periods of relatively high temperatures in a study by Gilbreath et al. (1959). Albumen quality was not affected under the conditions of this study.

In a later study, Gilbreath et al. (1960) reported that reserpine administered at levels of 0.0, 1.5, 2.0 and 2.5 mg./kg. of diet to Leghorn strain-cross pullets negatively influenced egg weight and shell thickness.

Treatments of 0.0, 0.25, 0.50 and 1.0 milligrams of reserpine per kilogram of diet administered to White Holland turkey breeder hens produced a significiant quadratic effect on average egg weight in a study by Rudolph (1961). No drug effect was observed on average egg shell thickness.

In a separate trial by Rudolph (1961), levels of 0.0, 0.5, 1.0 and 2.0 milligrams of reserpine per kilogram of diet were administered to Broad Breasted Bronze breeding turkeys. Average egg weight was not affected by reserpine either during or after treatment. Average egg shell thickness decreased significantly after reserpine treatment was withdrawn.

Reproductive Performance

Reserpine, when administered in food or water, caused a persistent diestrus in mice in a study by Cranston (1958).

A dosage level of 0.2 mg. of reserpine per kg. of diet delayed vaginal opening in infantile female rats, and postponed estrus in normally cycling female rats, as reported by Khazan et al. (1960). Histological sections of the ovaries of adult rats treated with reserpine showed absence of mature follicles, and presence of corpora lutea, similar to those seen during lactation. Sections of uteri showed the same pattern as in lactating rats. Reserpine delayed testicular descent in young male rats. In mature male rats, high dosage resulted in regressive atrophy of testes, seminal vesicles and prostates.

It was also reported by Khazan et al. (1960), that the testes of pigeons treated with reserpine weighed from 20 to 50 percent of the weight

of the controls. Histological sections showed the arrest of spermatogenesis at the state of spermatids or mitotic secondary spermatocytes.

Reserpine in the diet of pheasant breeding hens depressed ovulation and reduced fertility and hatchability of eggs produced, in a study by Hewitt and Reynolds (1957). There was an increase in egg production from birds that had been fed reserpine after they were placed on untreated feed.

Levels of 0.25, 0.50 and 1.0 mg. of reserpine per pound of feed did not significantly influence the egg production of caged layers in a study by Eoff et al. (1961).

Hybrid Leghorn females receiving 2.0 mg. of reserpine per kilogram of diet layed fewer eggs than untreated birds in a study by Gilbreath et al. (1959). This difference was significant at the 90 to 95 percent level of probability.

The effect of reserpine on the testicular weight of large-type white turkey poults was observed by Anderson and Smyth (1960). At twenty-four weeks of age the testes weights showed considerable variation within treatment groups and were difficult to interpret, due to widely different degrees of sexual maturity among individuals. There was an indication that reserpine fed at the 0.25 mg./kg. level during the latter part of the growing cycle may have stimulated testicular development. It was noted that further work is necessary to extend and clarify this observation.

The addition of 2.0 p.p.m. of reserpine to a practical type turkey breeder ration resulted in a marked reduction in egg production, fertility and hatchability in a study by Green et al. (1961). The decrease in egg production was first observed during the third month of lay; however, the effect on fertility and hatchability was noted in eggs produced during the first month.

The effect of reserpine on the reproductive performance of ducks was also studied by Greene et al. (1961). Levels of 0.5, 2.0, 5.0 and 10.0 p.p.m. of reserpine were added to breeder rations. Ducks receiving 0.5 p.p.m. of reserpine in the ration maintained egg production at a low level for approximately 3 months, while levels of 2.0 p.p.m. or higher completely inhibited egg production.

Reserpine administered at levels of 0.0, 0.25, 0.50 and 1.0 mg./kg. of diet to White Holland breeder turkeys had no effect on percentage egg production as reported by Rudolph (1961). As the levels of reserpine added to the diet were increased, there resulted a corresponding linear decrease in percentage of fertile eggs and percentage hatch of total eggs set.

In a separate trial of the same study, Broad Breasted Bronze breeder turkeys were treated with 0.0, 0.5, 1.0 and 2.0 milligrams of reserpine per kilogram of diet. Results indicated that graded levels of reserpine added to the diet caused a significant linear decrease in percentage egg production, percentage fertility and percentage hatch of total eggs set. There was no significant treatment effect on percentage egg production, percentage fertile eggs and percentage hatch of total eggs set. Percentage hatch of fertile eggs set was not affected by reserpine either during or after treatment.

EXPERIMENTAL PROCEDURE

This study was made up of two separate trials which were conducted during different growing and breeding seasons. Trial I was designed to measure the effects of different levels of orally administered reserpine on the reproductive performance of mature breeding turkeys. Trial II was designed to measure the effects of graded levels of reserpine administered orally to growing turkeys, and subsequent effects on the reproductive performance of these birds in the breeding flock after reserpine treatment was discontinued.

Trial I

The experimental birds used in this trial originated from a commercial strain of Broad Breasted Bronze turkeys which is now being maintained at the Oklahoma State University. Five hundred females and one hundred males were hatched on May 31, 1960.

The birds were sexed and the males de-snooded at one day of age. Males and females were brooded together in three brooder houses 12' x 16' in dimensions. This brooding area provided 0.96 square feet of floor space per bird.

The poults were fed a series of all-mash starter-grower rations recommended by the Oklahoma State University from one-day-old to twenty-four weeks of age. The calculated analysis and composition of this series of rations are shown in Table I. Feed was provided ad libitum from three

TABLE I

ALL-MASH TURKEY STARTER AND GROWER RATIONS USED IN TRIAL I

	SMT 601-3	SMT 602-3	GMT 603-3	GMT 604-3	GMT 605-3	GMT 606-3	GMT 607-3	GMT 608-3	GMT 609-3
Crude protein (percent)	30	28	26	24	22	20	18	16	14
Calories/lb. (M. E.)	1444	1455	1502	1508	1510	1516	1519	1521	1519
Calorie-protein ratio	48:1	52:1	55:1	62:1	66:1	75:1	82:1	89:1	107:1
Ingredients					percent				
Fat (tallow)	8	8	9	7.5	6.8	5.3	4.5	3.8	2.3
Ground yellow corn or milo	24.65	27.95	40	49.9	54.56	64.48	69.74	74.35	84.27
Pulverized oats	5	5	2.4	2	1.8	1.4	1.2	1.0	0.6
Corn gluten meal	5	5	3.6	3	2.7	2.1	1.8	1.5	0.9
Alfalfa meal (17% protein)	2	2	1.8	1.5	1.4	1.1	0.9	0.8	0.5
Fish meal (60% protein)	10	8	10.8	9	8.1	6.3	5.4	4.5	2.7
Blood meal (80% protein)	3	3	3	2.5	2.3	1.8	1.5	1.3	0.8
Meat & bone scrap (50% protein)	7	6	4.2	3.5	3.2	2.5	2.1	1.8	1.1
Soybean meal (44% protein)	27	25.7	18	15	13.5	10.5	9.0	7.5	4.5
Dried whey	2	2	1.8	1.5	1.4	1.1	0.9	0.8	0.5
Dried condensed fermented corn extractives[1]	3	3	1.8	1.5	1.4	1.1	0.9	0.8	0.5
VMC-60[2]	0.5	0.5	0.6	0.45	0.35	0.3	0.3	0.3	0.2
VC-60A[3]	0.25	0.25	---	---	---	---	---	---	---
Salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Di-calcium phosphate	1.0	1.0	1.2	1.0	0.9	0.7	0.6	0.5	0.3
Calcium carbonate	1.0	2.0	1.2	1.0	0.9	0.7	0.6	0.5	0.3
dl-Methionine	0.1	0.1	0.1	0.1	0.09	0.07	0.06	0.05	0.03
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[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.U.; vitamin E, 6 I.U.; vitamin K, 3 milligrams; vitamin B_{12}, 0,008 milligrams; riboflavin, 4 milligrams; niacin, 32 milligrams; panthothenic acid, 8 milligrams; choline chloride, 500 milligrams; manganese, 27.7 milligrams; iodine, .86 milligrams; cobalt, .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 milligrams; biotin, 0.3 milligrams; thiamin, 12 milligrams; folic acid, 2 milligrams; inositol, 50 milligrams; para-amino-benzoic acid, 4 milligrams; and ascorbic acid, 10 milligrams.

trough-type feeders, each 36 inches long, in each house. Water was provided ad libitum from one automatic waterer in each house.

The females were wingnotched (tenotomized) at three weeks of age to prevent flying after being placed in the breeding pens.

Males and females were moved together into two pole sheds at four weeks of age. Pens 24' x 48' in each of two pole-type sheds were used. Feed and water was provided ad libitum from two 8' automatic waterers and six tube-type feeders in each of the two pens.

The birds were vaccinated against fowl pox at nine weeks of age by the "stick" method.

The birds were placed on range at nine weeks of age on a range 200' x 500' in dimensions. Feed and water was provided ad libitum from six bulk-type feeders and six automatic waterers. Six portable shades were provided.

Three slight outbreaks of enterohepatitis occurred during the growing and breeding seasons. On September 17, 1960 and March 28, 1961, post-mortem examinations showed that on each of these dates one bird died of enterohepatitis infection. The birds were treated with Enheptin in the water, as recommended by Merck and Company, for a period of five days, beginning on the date that each of the post-mortem examinations was made. After a third bird died of enterohepatitis, on June 8, 1961, the birds were treated with one pound of Histostat (product of Dr. Salsbury's Laboratories) in each ton of all-mash diet until the study was terminated.

The birds were treated for worms using Dr. Salsbury's Wormal on September 23, 1960 and again on October 7, 1960.

Reserpine treatment was initiated on November 11, 1960 when the birds were twenty-four weeks of age. Levels of 0.0, 0.5, 1.0 and 2.0

mg. of reserpine per kg. of all-mash diet were administered to males and females. The composition of the all-mash turkey breeder ration is shown in Table II. At this time the birds were moved from the range and twenty-four females were randomly assigned to sixteen houses 12' x 16' each in dimensions that opened into pens 50' x 100' each in dimensions. Twenty-eight males per treatment were started in four separate pens 15' x 15' each in dimensions in a straw-loft poultry house at the Perkins Turkey Farm.

A completely randomized statistical design was used in this trial. There were four replications per treatment with each breeding pen making up one replication. Feed and water were provided ad libitum in each breeding pen from one pan-type automatic waterer and one cyclinder-type feeder which provided 6.5 linear feed of feeder space.

Fourteen hours of light were provided daily beginning on December 1, 1960 for the males and on December 15, 1960 for the females. The fourteen hours of light were maintained until the project was terminated.

Two males were randomly assigned to each breeding pen on December 22, 1960. Twelve males per treatment were held as spares in the four straw-loft pens until the trial was terminated. Reserpine treatment was continued on the spare males until the trial was terminated. The males in the breeding pens were rotated between replications within treatment at two-week intervals beginning on January 5, 1961 and continuing throughout the study. The males were rotated to minimize the occurrence of preferential mating in the breeding pens.

Body weight and feed consumption of the females were calculated on a pen basis at twenty-eight-day intervals beginning on November 11, 1960 and continuing through July 17, 1961. Feed consumption was calculated on an average bird-day basis. No measurements of body weight of the males

TABLE II

ALL-MASH TURKEY BREEDER RATION USED IN

TRIAL I AND TRIAL II

Ingredients	Percent
Ground yellow corn	27.77
Ground milo	20.07
Ground oats	10.03
Alfalfa meal (17% protein)	2.47
Wheat shorts	5.00
Soybean oil meal (50% protein)	7.50
Fish meal (70% protein)	5.00
Meat and bone scrap (50% protein)	4.00
Live yeast culture	0.98
Dried fish solubles	1.49
Distillers solubles[1]	1.49
Di-calcium phosphate (18% phosphorous)	1.99
Calcium carbonate	2.96
Salt	0.48
Fluidized pex	0.98
Tallow (fat)	6.01
VMC-60[2]	0.98
Vitamin E concentrate	0.01
NF-180[3]	0.02
dl-Methionine	0.05
Fermacto[4]	0.73
	100.00

[1]Distillers solubles--C.F.S. No. 3, Clinton Corn Processing Company, Clinton, Iowa.

[2]VMC-60-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.U.; vitamin E, 6 I.U.; vitamin K, 3 milligrams; vitamin B_{12}, 0.008 milligrams; riboflavin, 4 milligrams; niacin, 32 milligrams; panthothenic acid, 8 milligrams; chloride, 500 milligrams; manganese, 27.7 milligrams; iodine, .86 milligrams; cobalt, .59 milligrams; iron, 21.8 milligrams; copper, 1.65 milligrams; and zinc, 22.7 milligrams.

[3]NF-180--furazolidone (n-(5-nitro-2 furfurylidene)-3 amino-2-oxozolidone).

[4]Fermacto--a dried extracted streptomces fermentation residue. Borden Company, Feed Supplements Department, New York 17, New York.

were collected. A record of mortality was kept throughout the study. A post-mortem examination of all dead birds was made by a veterinarian and the cause(s) of death recorded. Adjustments were made for mortality in calculating body weight and feed consumption data.

The birds were blood tested for Pullorum disease on January 5, 1961. No Pullorum infection was found in the flock.

Initial egg production was noted on January 17, 1961. Age at sexual maturity was determined on a pen basis by calculating the number of days from lighting of the females until the date that a rate of twenty percent egg production was recorded for the pen. Eggs were collected and set at fourteen-day intervals beginning on January 31, 1961 and continuing through July 17, 1961. The eggs were pen-marked and dated while being collected three times daily. Percentage egg production was calculated on an average hen-day basis. Percentage fertility was determined by candling the eggs after nine days of incubation. All eggs not readily identified as fertile by candling were broken out after a twenty-eight-day incubation period to determine if the eggs were actually infertile or if a "dead germ" was present.

Measurements of egg weight and shell thickness were made at twenty-eight day intervals beginning on February 15, 1962 and continuing until the study was terminated. One day's eggs were weighed individually to the nearest gram before being broken, to obtain a measurement of shell thickness. The shell, with the inner shell membrane attached, was measured to the nearest 10^{-3} inches with a convex anvil micrometer.

Trial II

The experimental birds used in this trial were hatched from eggs laid by females in Trial I. Four hundred ninety two females and two hundred males were hatched on June 5, 1961.

The birds were sexed and the males de-snooded at one day of age. Both males and females were wing banded at one day of age. Males and females were brooded together in six brooder houses 12' x 16' each in dimensions. This provided 1.66 square feet of floor space per bird.

Feed and water was provided ad libitum from three 36-inch trough-type feeders and one automatic waterer in each house. The birds were fed a series of all-mash starter-grower rations from day-old to twenty-four weeks of age. The composition and calculated analysis of this series of rations are presented in Table III.

Twenty-nine females and six males were randomly assigned to each of sixteen pens, each 12' x 24' in dimensions, in two pole-type sheds when the birds were four weeks of age. The pens were arranged in a randomized complete block design with each of the four blocks being made up of four pens. Males and females were weighed separately on a pen basis at this time and at each succeeding twenty-eight-day interval until the birds were twelve weeks of age. Body weight measurements were made to determine the presence of any block effects in the design.

Feed and water was provided ad libitum from three tube-type hanging feeders and one automatic waterer in each pen.

The females were wing-notched (tenotomized) at five weeks of age to prevent flying after being placed in the breeding pens.

The birds were vaccinated against fowl pox by the "stick" method at eight weeks of age.

TABLE III

ALL-MASH TURKEY STARTER AND GROWER RATION USED IN TRIAL II

	SMT 602-3	GMT 603-3	GMT 604-3	GMT 605-3	GMT 607-3	GMT 608-3
Crude protein (percent)	28	26	24	22	18	16
Calories/lb. (M.E.)	1455	1502	1508	1510	1519	1521
Calorie: protein ratio	52:1	55:1	62:1	66:1	82:1	89:1
Ingredients			Percent			
Fat (Tallow)	8	9	7.5	6.8	4.5	3.8
Ground yellow corn	27.65	43	52.9	57.6	72.7	77.4
Oat mill feed	5	2.4	2	1.8	1.2	1.0
Corn gluten meal	5	3.6	3	2.7	1.8	1.5
Alfalfa meal (17% protein)	2	1.8	1.5	1.4	0.9	0.8
Fish meal (60% protein)	10	10.8	9	8.1	5.4	4.5
Blood meal (80% protein)	3	3	2.5	2.3	1.5	1.3
Meat and bone scrap (50% prot.)	7	4.2	3.5	3.2	2.1	1.8
Soybean oil meal (50% protein)	24	16	12	10.5	6.0	4.5
Dried whey	2	1.8	1.5	1.4	0.9	0.8
Dried condensed fermented corn extractives[1]	3	1.8	1.5	1.4	0.9	0.8
VMC-60[2]	0.5	0.6	0.5	0.45	0.3	0.3
VC-60A[3]	0.25	---	---	---	---	---
Salt	0.5	0.5	0.5	0.5	0.5	0.5
Di-calcium phosphate	1.0	1.2	1.0	0.9	0.6	0.5
Calcium carbonate	1.0	1.2	1.0	0.9	0.6	0.5
dl-Methionine	0.1	0.1	0.1	0.09	0.06	0.05
Histostat	0.05	0.05	0.05	0.05	0.05	0.05
TM-10 (Terramycin supplement)	0.1	0.1	0.1	0.1	---	---
	100.0	100.00	100.00	100.00	100.00	100.00

[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.U.; vitamin E, 6 I.U.; vitamin K, 3 milligrams; vitamin B_{12}, 0.008 milligrams; riboflavin, 4 milligrams; niacin, 32 milligrams; panthothenic acid, 8 milligrams; choline chloride, 500 milligrams; manganese, 27.7 milligrams; iodine, .86 milligrams; cobalt, .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 milligrams; biotin, 0.3 milligrams; thiamin, 12 milligrams; folic acid, 2 milligrams; inositol, 50 milligrams, para-amimo-benzoic acid, 4 milligrams; and ascorbic acid, 10 milligrams.

The birds were completely re-randomized among the sixteen pens at twelve weeks of age in an attempt to distribute evenly any block effects that had been noted during the previous eight-week period. Twenty-four females and six males were assigned to each of the sixteen pens. Reserpine treatment was initiated at this time. The four levels of reserpine administered were: (1) 0.0 mg./kg. of diet for twelve weeks; (2) 0.2 mg./kg. of diet for twelve weeks; (3) 1.0 mg./kg. of diet for two weeks, then 0.2 mg./kg. of diet for ten weeks; (4) 1.0 mg./kg. of diet for 4 weeks, then 0.2 mg./kg. of diet for eight weeks. There were four replications per treatment, with one pen making up each replication.

During the growing phase of the study, the males and females were weighed separately on a pen basis at twenty-eight-day intervals beginning on August 29, 1961 and continuing until November 21, 1961. Feed consumption was calculated on a per-bird-per-day basis for each pen at twenty-eight-day intervals during this period. A record of mortality was kept throughout this phase of the study. A post-mortem examination of dead birds was conducted by a veterinarian and cause of death was recorded. Adjustments were made for mortality in calculating average body weight and feed consumption.

Reserpine treatment was discontinued on November 21, 1961 when the birds were twenty-four weeks of age. Four replications of twenty-two females were then drawn at random from each group of birds previously treated with reserpine. The females were moved to sixteen houses, each 12' x 16' in dimensions, that opened into pens 50' x 100' each in dimensions. Sixteen males per treatment were moved to four pens, each 15' x 15' in dimensions, in a straw-loft poultry house on the Perkins Turkey Farm. Males and females were fed a standard breeder ration until the study

was terminated. The composition and calculated analysis of this ration are given in Table II. Feed and water were provided ad libitum in the breeding pens from one tube-type feeder which provided 6.5 linear feet of feeder space and one pan-type automatic waterer per pen.

A completely randomized statistical design was used during the breeding phase of the study.

Fourteen hours of light were provided daily, beginning on December 18, 1961 for the males and on January 2, 1962 for the females. The fourteen hours of light were maintained until the project was terminated.

Two males were randomly assigned to each breeding pen on January 16, 1962. Eight males from each of the four groups of birds previously treated with reserpine were held as spares in the four straw-loft pens until the study was terminated. The males in the breeding pens were rotated among replications within treatment at two-week intervals beginning on January 29, 1962 and continuing throughout the study. The males were rotated to minimize the occurrence of preferential mating in the breeding pens.

Body weight and feed consumption data for the females were calculated at twenty-eight day intervals as in Trial I, beginning on November 21, 1961 and continuing throughout the study. Mortality records were kept and post-mortem examinations were made as in Trial I. Adjustments were made for mortality in calculating average body weight and feed consumption.

The birds were blood-tested for Pullorum disease on February 15, 1962. No Pullorum infection was found in the flock.

Initial egg production was noted on January 27, 1962. The age at sexual maturity was determined as in Trial I. The eggs were collected and set at fourteen-day intervals beginning on February 13, 1962 and continuing

until the study was terminated. The eggs were pen-marked and dated while being collected three times daily. Percentage egg production was calculated on a hen-day basis. Percentage fertility was determined by candling the eggs after nine days of incubation. All eggs not readily identified as fertile by candling were broken-out after a twenty-eight day incubation period to determine if the eggs were actually infertile or if a "dead germ" was present.

Measurements of egg weight and shell thickness were taken at twenty-eight day intervals, as in Trial I, beginning on February 15, 1962 and continuing throughout the study.

RESULTS AND DISCUSSION

Trial I

A report of the performance of mature turkeys receiving graded levels of reserpine is presented in this discussion. A table of means and an analysis of variance are presented for each of the nine variables measured in Trial I. Those variables measured were: body weight change, feed consumption, egg weight, egg shell thickness, onset of sexual maturity, hen-day egg production, fertility, hatch of fertile eggs and hatch of total eggs set.

The average body weight change of females receiving different levels of reserpine during the breeding season is shown in Table IV. The body weight of females fed 0.5 p.p.m. of reserpine increased by 0.77 pounds per bird, as compared to an increase of 0.50 pounds per bird for the control females. A decrease in body weight of 0.08 pounds per bird was noted in females receiving 1.0 p.p.m. of reserpine, while those fed 2.0 p.p.m. of reserpine had an increase in body weight of 0.10 pound per bird. These differences in body weight change were statistically significant at the five percent level of probability, as shown in Table V. The differences noted here would tend to indicate that low levels of reserpine might aid in maintaining the body weight of mature females, while higher levels might have a depressing effect on body weight.

A summary of average bird-day feed consumption is presented in Table VI. There was no statistically significant difference in the feed

TABLE IV

AVERAGE BODY WEIGHT CHANGE
Trial I

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
			Pounds		
0.0	+1.32	-0.78	+0.62	+0.84	+0.50
0.5	+0.19	+0.71	+0.90	+1.27	+0.77
1.0	+0.52	-0.52	+0.31	-0.62	-0.08
2.0	+0.09	+0.20	+0.04	+0.05	+0.10

TABLE V

ANALYSIS OF VARIANCE OF BODY WEIGHT CHANGE
Trial I

Source	d.f.	S.S.	M.S.	F
Total	159	351.1417		
Period	9	318.7823		
Treatment	3	6.0566	2.018867	3.53*
Treatment error	12	6.8650	0.572083	
(Replications)	(3)	(1.7146)		
(R X T)	(9)	(5.0504)		
Treatment X Period	27	8.4783	0.314011	
T X P Error	108	10.9595	0.101477	
(R X P)	(27)	(3.5322)		
(R X P X T)	(81)	(7.4273)		

*Significant treatment effect at the 5% level of probability.

TABLE VI

AVERAGE BIRD-DAY FEED CONSUMPTION
Trial I

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
	Pounds				
0.0	0.4782	0.4951	0.4921	0.4927	0.4894
0.5	0.4680	0.5236	0.4958	0.5082	0.4989
1.0	0.5066	0.5126	0.5139	0.4884	0.5054
2.0	0.5074	0.5185	0.5181	0.5330	0.5193

TABLE VII

ANALYSIS OF VARIANCE OF FEED CONSUMPTION
Trial I

Source	d.f.	S.S.	M.S.	F
Total	143	1.639583		
Period	8	1.289569		
Treatment	3	0.014571	0.004857	2.42
Treatment error	12	0.024136	0.002011	
(Replications)	(3)	(0.008997)		
(R X T)	(9)	(0.015139)		
Treatment X Period	24	0.103498	0.004312	
T X P Error	96	0.207809	0.002165	
(R X P)	(24)	(0.089479)		
(R X P X T)	(72)	(0.118330)		

consumption of birds receiving different levels of reserpine (Table VII); however, the treatment averages in Table VI indicate a slight increase in feed consumption with each increase in level of reserpine. The birds receiving 0.5 p.p.m. of reserpine consumed 0.4989 pounds per bird per day as compared to 0.4894 pounds for the controls. The average feed consumption of birds fed 1.0 p.p.m. of reserpine was 0.5054 pounds per bird per day, while those receiving 2.0 p.p.m. of reserpine consumed 0.5193 pounds per bird per day.

The average weight and shell thickness of eggs from females treated with different levels of reserpine are shown in Tables VIII and X. Although the differences noted in egg weight and shell thickness were not statistically significant (Tables IX and XI), there appeared to be a slight increase in both weight and shell thickness of eggs from birds treated with reserpine, as compared to the weight and thickness of shells of eggs from control females. The increase in egg weight was especially noticeable, with an average egg weight of 84.14 grams from females receiving 0.5 p.p.m. of reserpine as compared to 82.19 grams for control females. The average weight of eggs from females receiving 1.0 p.p.m. of reserpine was 85.86 grams. Those eggs from females fed 2.0 p.p.m. of reserpine had an average weight of 86.31 grams. Egg shell thickness (as measured to the nearest 10^{-3} inches) increased from 0.0147 for the controls to 0.0149 for females receiving both 0.5 and 1.0 p.p.m. of reserpine. Those females receiving 2.0 p.p.m. of reserpine produced eggs with an average shell thickness of 0.0148 (10^{-3} inches).

Table XII shows the marked delay that was noted in onset of egg production for all females treated with reserpine. Twenty percent egg production was first recorded for control females at an average of 40.75

TABLE VIII

AVERAGE EGG WEIGHT
Trial I

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
	Grams				
0.0	83.62	89.82	80.18	83.52	82.19
0.5	85.76	82.78	84.67	83.72	84.14
1.0	84.00	84.05	89.41	85.52	85.86
2.0	88.12	85.22	87.24	84.49	86.31

TABLE IX

ANALYSIS OF VARIANCE OF EGG WEIGHT
Trial I

Source	d.f.	S.S.	M.S.	F
Total	96	1,471,704.00		
Period	5	313,266.00		
Treatment	3	51,170.00	17,056.6700	2.47
Treatment error	12	82,916.00	6,909.6667	
(Replications)	(3)	(17,654.00)		
(R X T)	(9)	(65,263.00)		
Treatment X Period	15	443,268.00	29,551.2000	
T X P Error	60	581,084.00	9,684.7333	
(R X P)	(15)	(131,226.00)		
(R X P X T)	(45)	(449,858.00)		

TABLE X

AVERAGE EGG SHELL THICKNESS
Trial I

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
			10^{-3} Inches		
0.0	.0147	.0146	.0146	.0149	.0147
0.5	.0150	.0147	.0150	.0151	.0149
1.0	.0149	.0142	.0158	.0146	.0149
2.0	.0152	.0148	.0145	.0148	.0148

TABLE XI

ANALYSIS OF VARIANCE OF EGG SHELL THICKNESS
Trial I

Source	d.f.	S.S.	M.S.	F
Total	96	0.00045326		
Period	5	0.00007440		
Treatment	3	0.00002157	0.00000719	2.11
Treatment error	12	0.00004083	0.00000340	
(Replications)	(3)	(0.00000889)		
(R X T)	(9)	(0.00003194)		
Treatment X Period	15	0.00011767	0.00000784	
T X P Error	60	0.00019879	0.00000331	
(R X P)	(15)	(0.00007445)		
(R X P X T)	(45)	(0.00012434)		

TABLE XII

ONSET OF SEXUAL MATURITY[1]
Trial I

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
			Days[1]		
0.0	35	43	41	44	40.75
0.5	63	51	47	53	53.50
1.0	72	69	72	65	69.50
2.0	77	67	67	64	68.75

[1]Onset of sexual maturity was based on number of days from lighting of the females until twenty percent egg production was recorded for the pen.

TABLE XIII

ANALYSIS OF VARIANCE OF ONSET OF SEXUAL MATURITY
Trial I

Source	d.f.	S.S.	M.S.	F
Total	15	2,579.75		
Treatment	3	2,262.25	754.08	28.50**
Error	12	317.50	26.46	

**Significant treatment effect at the 1% level of probability.

days after lighting, as compared to 53.50 days for females receiving 0.5 p.p.m. of reserpine. Those females fed 1.0 p.p.m. of reserpine reached twenty percent egg production at an average of 69.50 days from lighting, while females receiving 2.0 p.p.m. of reserpine reached twenty percent production in 68.75 days. These differences in onset of egg production were statistically significant at the one percent level of probability (Table XIII).

The delay in onset of egg production was apparently temporary since a recovery in egg production was noted for all females receiving reserpine treatment. Figure 1 shows this delay and recovery of egg production in the reserpine-treated birds. The most noticeable recovery in egg production was for females receiving 0.5 p.p.m. of reserpine. Egg production for this group of birds remained higher than that of control females after the third hatching period. Overall egg production for females fed 0.5 p.p.m. of reserpine was 42.29 percent as compared with 38.95 percent for the controls, as shown in Table XIV. Egg production of females receiving 1.0 and 2.0 p.p.m. of reserpine was noticeably higher than for the controls in the fourth and fifth hatching periods. After the fifth hatching period, egg production for these two groups of females fluctuated slightly above or slightly below that of the controls at different hatching periods throughout the remainder of the breeding season. The over-all egg production of females fed 1.0 and 2.0 p.p.m. of reserpine was 32.37 and 35.54 percent, respectively. These differences noted in over-all egg production were statistically significant at the 5 percent level of probability, as shown in Table XV.

There was a definite decline in percentage of fertile eggs with each increase in reserpine level, as shown in Table XVI. The percentage

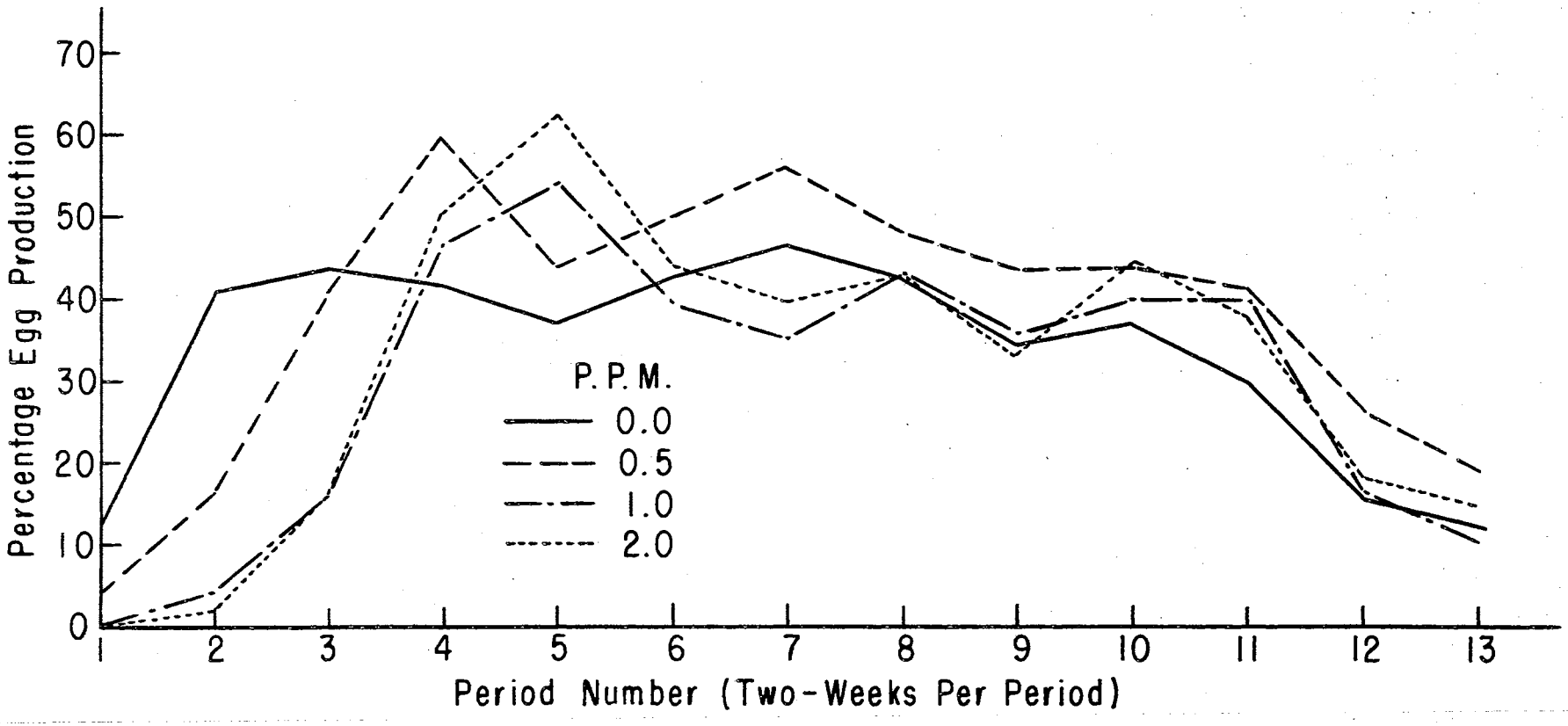

Figure 1. Egg Production as Influenced by Reserpine Administered to Mature Turkeys.

TABLE XIV

PERCENTAGE EGG PRODUCTION
Trial I

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
			Percent		
0.0	36.30	40.74	42.70	36.35	38.95
0.5	36.49	43.63	48.36	40.85	42.29
1.0	31.37	28.56	36.06	33.48	32.37
2.0	30.88	36.61	42.69	32.23	35.54

TABLE XV

ANALYSIS OF VARIANCE OF PERCENTAGE EGG PRODUCTION
Trial I

Source	d.f.	S.S.	M.S.	F
Total	111	4,297,913.00		
Period	6	3,319,762.00		
Treatment	3	149,046.00	49,682.00	3.82*
Treatment error	12	156,105.00	13,008.75	
(Replications)	(3)	(115,349.00)		
(R X T)	(9)	(40,756.00)		
Treatment X Period	18	508,182.00	28,232.33	
T X P Error	72	164,818.00	2,289.14	
(R X P)	(18)	(54,955.00)		
(R X P X T)	(54)	(109,863.00)		

*Significant treatment effect at the 5% level of probability.

TABLE XVI

PERCENTAGE FERTILE EGGS
Trial I

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
	Percent				
0.0	89.75	93.59	93.85	90.64	92.01
0.5	71.12	69.97	71.51	77.61	72.52
1.0	66.79	59.93	49.67	60.16	58.67
2.0	32.04	20.70	21.54	31.31	25.76

TABLE XVII

ANALYSIS OF VARIANCE OF PERCENTAGE FERTILE EGGS
Trial I

Source	d.f.	S.S.	M.S.	F
Total	207	176,741.2		
Period	12	9,328.7		
Treatment	3	110,406.1	36,802.0333	82.83**
Treatment error	12	5,331.8	444.3166	
(Replications)	(3)	(2,039.2)		
(R X T)	(9)	(3,292.6)		
Treatment X Period	36	24,190.2	671.9500	
T X P Error	144	27,484.4	190.8639	
(R X P)	(36)	(8,072.9)		
(R X P X T)	(108)	(19,411.5)		

**Significant treatment effect at the 1% level of probability.

of fertile eggs from control females was 92.01 percent as compared to 72.52, 58.67 and 25.76 percent for females fed 0.5, 1.0 and 2.0 p.p.m. of reserpine, respectively. This reduction in the percentage of fertile eggs from reserpine-treated birds apparently remained fairly consistent throughout the breeding season, as illustrated in Figure 2. The relatively high percentage of fertile eggs noted in periods one and two from females fed 2.0 p.p.m. of reserpine probably resulted from the limited number of eggs set, due to the previously described delay in onset of egg production (Figure 1). A temporary recovery in percentage of fertile eggs from females receiving 1.0 and 2.0 p.p.m. of reserpine was noted between the third and eighth hatching periods. After the eighth hatching period, a gradual decline was noted in percentage of fertile eggs from these two groups of females. This decline was probably due to seasonal effects, since a comparable decline was noted in control females and females receiving 0.5 p.p.m. of reserpine. The differences noted for percentages of fertile eggs from females receiving different levels of reserpine were statistically significant at the one percent level of probability, as shown in Table XVII.

There was a small but consistent decrease in percentage hatch of fertile eggs with each increase in level of reserpine, as shown in Table XVIII. Hatch of fertile eggs from control females was 81.70 percent as compared with 79.13 percent for females fed 0.5 p.p.m. of reserpine. Females receiving 1.0 p.p.m. of reserpine had 78.58 percent hatch of fertile eggs while those females fed 2.0 p.p.m. of reserpine decreased to 74.55 percent. These differences in percentage hatch of fertile eggs from females receiving different levels of reserpine were significant at the one percent level of probability (Table XIX).

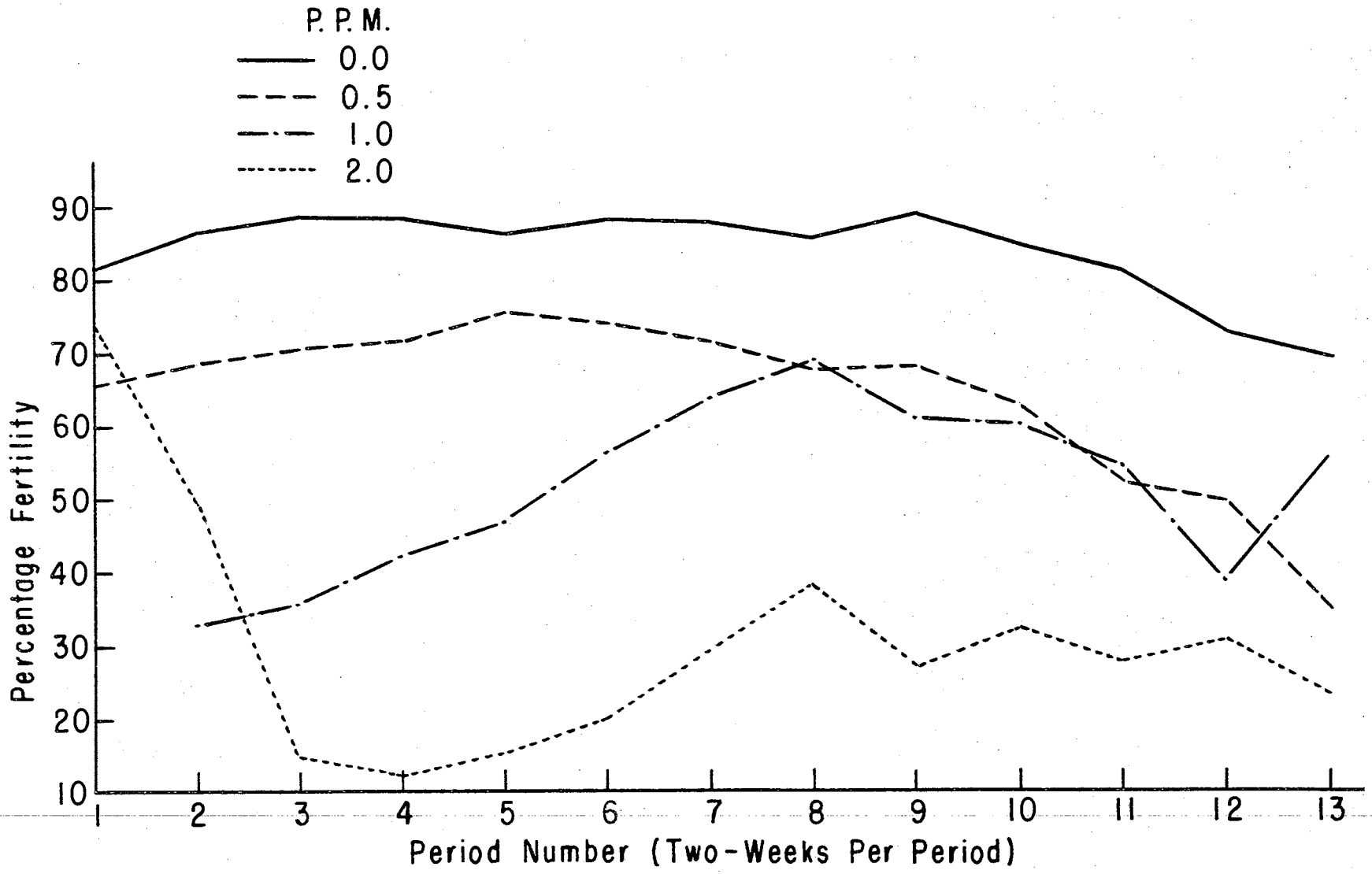

Figure 2. Percentage of Fertile Eggs as Influenced by Reserpine Administered to Mature Turkeys.

TABLE XVIII

PERCENTAGE HATCH OF FERTILE EGGS
Trial I

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
			Percent		
0.0	80.77	78.61	81.02	86.28	81.70
0.5	74.28	82.55	80.45	78.40	79.13
1.0	80.43	79.26	76.49	78.06	78.58
2.0	76.86	78.45	71.74	71.58	74.55

TABLE XIX

ANALYSIS OF VARIANCE OF PERCENTAGE HATCH OF FERTILE EGGS
Trial I

Source	d.f.	S.S.	M.S.	F
Total	207	104,365.0		
Period	12	22,097.5		
Treatment	3	10,982.6	3,660.8667	18.02**
Treatment error	12	2,437.4	203.1167	
(Replications)	(3)	(1,035.1)		
(R X T)	(9)	(1,402.3)		
Treatment X Period	36	24,772.9	688.1361	
T X P Error	144	44,074.6	306.0736	
(R X P)	(36)	(11,054.6)		
(R X P X T)	(108)	(33,020.0)		

** Significant treatment effect at the 1% level of probability.

A decrease in percentage hatch of total eggs set was noted with each increase in level of reserpine, as shown in Table XX. These differences were statistically significant at the one percent level of probability (Table XXI). Hatch of total eggs set was 75.17 percent for control females as compared to 57.39 percent for females fed 0.5 p.p.m. of reserpine. Hatch of total eggs set from females fed 1.0 p.p.m. of reserpine was 46.10 percent, while the hatch of total eggs set from females receiving 2.0 p.p.m. of reserpine was 19.21 percent. This decrease in hatch of total eggs set was probably due to the marked reduction in the percentage of fertile eggs noted with each increase in reserpine level (Table XVI), and also to the decrease in percentage hatch of fertile eggs with each increase in reserpine level (Table XVIII).

Trial II

The means and analyses of variance for feed consumption, body weight gain of males and body weight gain of females during the twelve-week reserpine treatment period (12 to 24 weeks of age) are presented in Tables XXII through XXVII.

The effects of reserpine on growth rate seemed more noticeable in males than in females during the twelve-week growing period. A definite decrease in average body weight gain of the males was noted with each increase in level of reserpine (Table XXII). The average body weight increase of males receiving no reserpine was 14.10 pounds per bird for the twelve-week period. The most noticeable depression in body weight gain was in males fed 1.0 p.p.m. of reserpine for 4 weeks, then 0.2 p.p.m. for 8 weeks. These males gain an average of 11.80 pounds per bird during the growing period. Males receiving 0.2 p.p.m. of reserpine had an average

TABLE XX

PERCENTAGE HATCH OF TOTAL EGGS SET
Trial I

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
			Percent		
0.0	72.50	73.58	76.36	78.20	75.17
0.5	52.83	57.76	57.30	60.84	57.39
1.0	53.72	47.50	37.99	46.96	46.10
2.0	24.62	16.24	15.45	22.41	19.21

TABLE XXI

ANALYSIS OF VARIANCE OF PERCENTAGE HATCH OF TOTAL EGGS SET
Trial I

Source	d.f.	S.S.	M.S.	F
Total	207	133,038.1		
Period	12	13,176.9		
Treatment	3	73,577.7	24,525.9000	83.09**
Treatment error	12	3,542.0	295.1667	
(Replications)	(3)	(1,373.0)		
(R X T)	(9)	(2,169.0)		
Treatment X Period	36	18,898.1	524.9472	
T X P Error	144	23,843.4	165.5792	
(R X P)	(36)	(7,689.3)		
(R X P X T)	(108)	(16,154.1)		

**Significant treatment effect at the 1% level of probability.

TABLE XXII

AVERAGE BODY WEIGHT GAIN OF MALES DURING RESERPINE TREATMENT
(12-24 weeks of age)
Trial II

P.P.M. of Reserpine	Replications				Treatment average
	1	2	3	4	
	Pounds/bird				
0.0	13.96	14.63	13.33	12.67	14.10
0.2	13.38	13.75	13.41	13.12	13.42
1.0 for 2 weeks, then 0.2 for 10 weeks	13.58	13.34	12.00	13.42	13.09
1.0 for 4 weeks, then 0.2 for 8 weeks	12.08	13.42	11.10	10.58	11.80

TABLE XXIII

ANALYSIS OF VARIANCE OF BODY WEIGHT GAIN OF MALES DURING RESERPINE TREATMENT (12-24 weeks of age)
Trial II

Source	d.f.	S.S.	M.S.	F
Total	47	22.4919		
Block	3	2.8614		
Period	2	3.0960		
Treatment	3	3.7299	1.2433	5.61*
Treatment error (BXT)	9	1.9944	0.2216	
Treatment X Period	6	2.5388	0.4231	
T X P Error	24	8.2714	0.3446	

*Significant treatment effect at the 5% level of probability.

increase in body weight of 13.42 pounds while those fed 1.0 p.p.m. for 2 weeks, then 0.2 p.p.m. of reserpine for ten weeks gained an average of 13.09 pounds per bird during the twelve-week period. These differences were statistically significant at the five percent level of probability (Table XXIII).

Slight decreases were noted in the body weight gain of females treated with reserpine (Table XXIV); however, these differences were not statistically significant (Table XXV). The body weight of control females increased by 8.64 pounds per bird during the reserpine treatment period, as compared to an increase of 8.31 pounds per bird for females receiving 0.2 p.p.m. of reserpine. The body weight of females receiving the two higher levels of reserpine (1.0 p.p.m. for 2 weeks, then 0.2 p.p.m. for 10 weeks and 1.0 p.p.m. for 4 weeks, then 0.2 p.p.m. for 8 weeks) increased by 8.06 and 8.07 pounds per bird, respectively.

The slight differences noted in feed consumption indicated that low levels of reserpine might result in decreased feed consumption, while higher levels tended to cause an increase in feed consumption (Table XXVI). Birds receiving 0.2 p.p.m. of reserpine consumed an average of 0.6003 pounds of feed per bird per day, while feed consumption of control birds was 0.6080 pounds per bird per day. Feed consumption of birds receiving 1.0 p.p.m. of reserpine for 2 weeks, then 0.2 p.p.m. for 10 weeks was 0.6136 pounds per bird per day. Those birds fed 1.0 p.p.m. of reserpine for 4 weeks, then 0.2 p.p.m. for 8 weeks consumed an average of 0.6263 pounds per bird per day. The differences noted in feed consumption of the reserpine-treated and untreated birds during the twelve-week growing period were not statistically significant (Table XXVII).

TABLE XXIV

AVERAGE BODY WEIGHT GAIN OF FEMALES DURING RESERPINE TREATMENT
(12-24 weeks of age)
Trial II

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
	Pounds/bird				
0.0	7.79	8.48	8.60	8.33	8.64
0.2	8.61	8.27	8.29	8.06	8.31
1.0 for 2 weeks, then 0.2 for 10 weeks	8.02	7.85	8.16	8.18	8.06
1.0 for 4 weeks, then 0.2 for 8 weeks	7.99	8.60	7.80	7.53	8.07

TABLE XXV

ANALYSIS OF VARIANCE OF BODY WEIGHT GAIN OF FEMALES DURING RESERPINE TREATMENT (12-24 weeks of age)
Trial II

Source	d.f.	S.S.	M.S.	F
Total	47	4.9117		
Block	3	0.0859		
Period	2	1.7932		
Treatment	3	0.2903	0.0968	1.59
Treatment error (BXT)	9	0.5485	0.0609	
Treatment X Period	6	0.5563	0.0927	
T X P Error	24	1.6375	0.0682	

TABLE XXVI

FEED CONSUMPTION OF MALES AND FEMALES DURING RESERPINE TREATMENT
(12-24 weeks of age)
Trial II

P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
	Pounds/bird/day				
0.0	0.6112	0.6330	0.5933	0.5897	0.6080
0.2	0.6280	0.6063	0.5891	0.5952	0.6003
1.0 for 2 weeks, then 0.2 for 10 weeks	0.6114	0.6377	0.6075	0.5940	0.6136
1.0 for 4 weeks, then 0.2 for 8 weeks	0.6389	0.6377	0.5972	0.6302	0.6263

TABLE XXVII

ANALYSIS OF VARIANCE OF FEED CONSUMPTION OF MALES AND FEMALES DURING RESERPINE TREATMENT (12-24 weeks of age)
Trial II

Source	d.f.	S.S.	M.S.	F
Total	47	1.1183		
Block	3	0.0106		
Period	2	1.0864		
Treatment	3	0.0043	0.0014	2.80
Treatment error (BXT)	9	0.0046	0.0005	
Treatment X Period	6	0.0046	0.0008	
T X P Error	24	0.0078	0.0003	

After the termination of reserpine treatments during the growing period, data were collected during the breeding period for the nine variables that were measured in Trial I. These data were then analyzed to determine if there were any residual effects, from the reserpine administered during the growing period, on the reproductive performance of the mature turkeys. A table of means and the accompanying analysis of variance are presented for each variable measured during the breeding season of Trial II.

Reserpine when administered during the growing period (12 to 24 weeks) apparently had little effect on the body weight change or feed consumption of the birds as mature turkeys (Tables XXVIII through XXXI). A slight decrease in body weight was noted during the breeding season for both control females and females previously treated with reserpine (Table XXVIII). The difference in these decreases in body weight between the controls and the reserpine-treated birds were not statistically significant (Table XXIX).

A slight increase in the feed consumption of the mature birds was noted for the birds that had previously received reserpine treatment (Table XXX). Feed consumption of the control birds was 0.4846 pounds per bird per day during the breeding season as compared to 0.4956 pounds per bird per day for birds that had received 0.2 p.p.m. of reserpine during the twelve-week growing period. Birds that had previously received 1.0 p.p.m. of reserpine for 2 weeks, then 0.2 p.p.m. for 10 weeks consumed 0.4967 pounds per bird per day during the breeding season. Those birds that had previously received 1.0 p.p.m. of reserpine for 4 weeks, then 0.2 p.p.m. for 8 weeks consumed 0.5083 pounds of feed per bird per day. These differences noted in feed consumption were not statistically significant, as shown in Table XXXI.

TABLE XXVIII

AVERAGE BODY WEIGHT CHANGE OF MATURE FEMALES AFTER RESERPINE ADMINISTRATION DURING GROWTH
Trial II

* P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
			Pounds		
0.0	-1.93	-1.77	-1.48	-1.56	-1.68
0.2	-2.50	-2.93	-0.97	-1.54	-1.98
1.0 for 2 weeks, then 0.2 for 10 weeks	-1.86	-1.81	-2.08	-1.10	-1.72
1.0 for 4 weeks, then 0.2 for 8 weeks	-1.11	-1.04	-1.19	-2.89	-1.56

*No reserpine was administered after age 24 weeks.

TABLE XXIX

ANALYSIS OF VARIANCE OF BODY WEIGHT GAIN OF MATURE FEMALES AFTER RESERPINE ADMINISTRATION DURING GROWTH
Trial II

Source	d.f.	S.S.	M.S.	F
Total	159	371.74768		
Period	9	303.99414		
Treatment	3	4.86654	1.62218	2.25
Treatment error	12	8.63622	0.71968	
(Replications)	(3)	(3.69632)		
(R X T)	(9)	(4.93990)		
Treatment X Period	27	7.59315	0.28122	
T X P Error	108	46.59753	0.43145	
(R X P)	(27)	(12.08332)		
(R X P X T)	(81)	(34.51421)		

TABLE XXX

AVERAGE BIRD-DAY FEED CONSUMPTION AFTER RESERPINE ADMINISTRATION
Trial II

P.P.M. of Reserpine*	Replications 1	2	3	4	Treatment average
	Pounds/bird/day				
0.0	0.5014	0.4680	0.4646	0.5084	0.4846
0.2	0.4859	0.5410	0.4814	0.4757	0.4956
1.0 for 2 weeks, then 0.2 for 10 weeks	0.5188	0.4935	0.4777	0.4988	0.4967
1.0 for 4 weeks, then 0.2 for 8 weeks	0.5089	0.4764	0.5152	0.5331	0.5083

*No reserpine was administered after age 24 weeks.

TABLE XXXI

ANALYSIS OF VARIANCE OF FEED CONSUMPTION AFTER RESERPINE ADMINISTRATION
Trial II

Source	d.f.	S.S.	M.S.	F
Total	143	1.12969		
Period	8	0.86854		
Treatment	3	0.00842	0.00280	0.64
Treatment error	12	0.05290	0.00440	
(Replications)	(3)	(0.00674)		
(R X T)	(9)	(0.04516)		
Treatment X Period	24	0.03381	0.00140	
T X P Error	96	0.16602	0.00172	
(R X P)	(24)	(0.04035)		
(R X P X T)	(72)	(0.12567)		

Egg quality, as measured by egg weight and shell thickness, was apparently not influenced by the administration of reserpine during the twelve-week growing period. Only very slight differences were noted in average weight and shell thickness of eggs from females that had previously received different levels of reserpine (Tables XXXII and XXXIV). These differences did not even approach statistical significance as shown in Tables XXXIII and XXXV.

Reserpine administered during the growing period had little effect upon the onset of sexual maturity, as measured by number of days from lighting until twenty percent egg production was recorded for each pen (Table XXXVI). The analysis of variance of the onset of sexual maturity (Table XXXVII) showed no statistically significant difference between birds previously treated with the various levels of reserpine.

Over-all egg production for the three groups of females treated with reserpine during the growing period was slightly lower than that for the control females (Table XXXVIII); however, these differences did not even approach statistical significance (Table XXXIX). The average bird-day egg production of control females was 41.31 percent, while females receiving 0.2 p.p.m. of reserpine during the growing period had an average egg production of 38.13 percent. Egg production for females that had received the two highest levels of reserpine was 40.30 percent for females fed 1.0 p.p.m. for 2 weeks, then 0.2 p.p.m. for 10 weeks and 39.44 percent for females that had received 1.0 p.p.m. for 4 weeks, then 0.2 p.p.m. for 8 weeks.

Figure 3 shows the percentage of fertile eggs from each group of birds for each two-week hatching period throughout the breeding season. A summary of the data on the percentage of fertile eggs is presented in

TABLE XXXII

AVERAGE WEIGHT OF EGGS FROM FEMALES TREATED WITH RESERPINE DURING THE GROWING PERIOD (12-24 weeks of age)
Trial II

*P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
	Grams				
0.0	81.92	83.03	85.31	81.12	82.79
0.2	82.26	82.90	84.46	82.17	83.03
1.0 for 2 weeks, then 0.2 for 10 weeks.	82.82	83.21	82.34	79.89	82.83
1.0 for 4 weeks then 0.2 for 8 weeks	84.65	83.51	83.14	81.92	83.19

*No reserpine was administered after age 24 weeks.

TABLE XXXIII

ANALYSIS OF VARIANCE OF EGG WEIGHT
Trial II

Source	d.f.	S.S.	M.S.	F
Total	95	2073.6696		
Period	5	1383.4421		
Treatment	3	7.8321	2.6107	0.23
Treatment error	12	137.6008	11.4667	
(Replications)	(3)	(13.4854)		
(R X T)	(9)	(124.1154)		
Treatment X Period	15	112.3904	7.4927	
T X P Error	60	432.4042	7.2067	
(R X P)	(15)	(125.3271)		
(R X P X T)	(45)	(307.0771)		

TABLE XXXIV

AVERAGE SHELL THICKNESS OF EGGS FROM FEMALES TREATED WITH RESERPINE DURING THE GROWING PERIOD (12-24 weeks of age)
Trial II

P.P.M. of Reserpine*	Replications 1	2	3	4	Treatment average
		10^{-3} Inches			
0.0	0.0146	0.0149	0.0151	0.0146	0.0148
0.2	0.0150	0.0148	0.0147	0.0151	0.0149
1.0 for 2 weeks, then 0.2 for 10 weeks	0.0149	0.0149	0.0150	0.0143	0.0149
1.0 for 4 weeks, then 0.2 for 8 weeks	0.0148	0.0147	0.0149	0.0147	0.0148

*No reserpine was administered after age 24 weeks.

TABLE XXXV

ANALYSIS OF VARIANCE OF EGG SHELL THICKNESS
Trial II

Source	d.f.	S.S.	M.S.	F
Total	95	0.00003101		
Period	5	0.00001641		
Treatment	3	0.00000057	0.00000019	1.73
Treatment error	12	0.00000138	0.00000011	
(Replications)	(3)	(0.00000025)		
(R X T)	(9)	(0.00000113)		
Treatment X Period	15	0.00000235	0.00000015	
T X P Error	60	0.00001030	0.00000017	
(R X P)	(15)	(0.00000251)		
(R X P X T)	(45)	(0.00000779)		

TABLE XXXVI

ONSET OF SEXUAL MATURITY OF FEMALES TREATED WITH RESERPINE DURING THE GROWING PERIOD (12-24 weeks of age)[1]
Trial II

* P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
	Days				
0.0	31	33	32	32	32
0.2	35	35	34	32	34
1.0 for 2 weeks, then 0.2 for 10 weeks	37	27	32	40	34
1.0 for 4 weeks, then 0.2 for 8 weeks	29	35	30	36	32

*No reserpine was administered after age 24 weeks.
[1]Onset of sexual maturity was based on number of days from lighting of the females until twenty percent egg production was recorded for the pen.

TABLE XXXVII

ANALYSIS OF VARIANCE OF ONSET OF SEXUAL MATURITY
Trial II

Source	d.f.	S.S.	M.S.	F
Total	15	155.75		
Treatment	3	12.75	4.25	0.36
Error	12	143.00	11.92	

TABLE XXXVIII

PERCENTAGE EGG PRODUCTION
Trial II

P.P.M. of Reserpine*	Replications 1	2	3	4	Treatment average
			Percent		
0.0	45.90	38.98	38.47	42.00	41.31
0.2	35.90	38.24	42.75	34.85	38.13
1.0 for 2 weeks, then 0.2 for 10 weeks	47.35	43.80	42.30	36.89	40.30
1.0 for 4 weeks, then 0.2 for 8 weeks	34.60	39.95	45.27	38.17	39.44

*No reserpine was administered after age 24 weeks.

TABLE XXXIX

ANALYSIS OF VARIANCE OF PERCENTAGE EGG PRODUCTION
Trial II

Source	d.f.	S.S.	M.S.	F
Total	111	31,037.5192		
Period	6	27,074.0610		
Treatment	3	95.3067	31.7689	0.32
Treatment error	12	1,202.8411	100.2368	
(Replications)	(3)	(279.1631)		
(R X T)	(9)	(923.6780)		
Treatment X Period	18	546.5290	30.3627	
T X P Error	72	2,118.7814	29.4275	
(R X P)	(18)	(767.3226)		
(R X P X T)	(54)	(1,351.4588)		

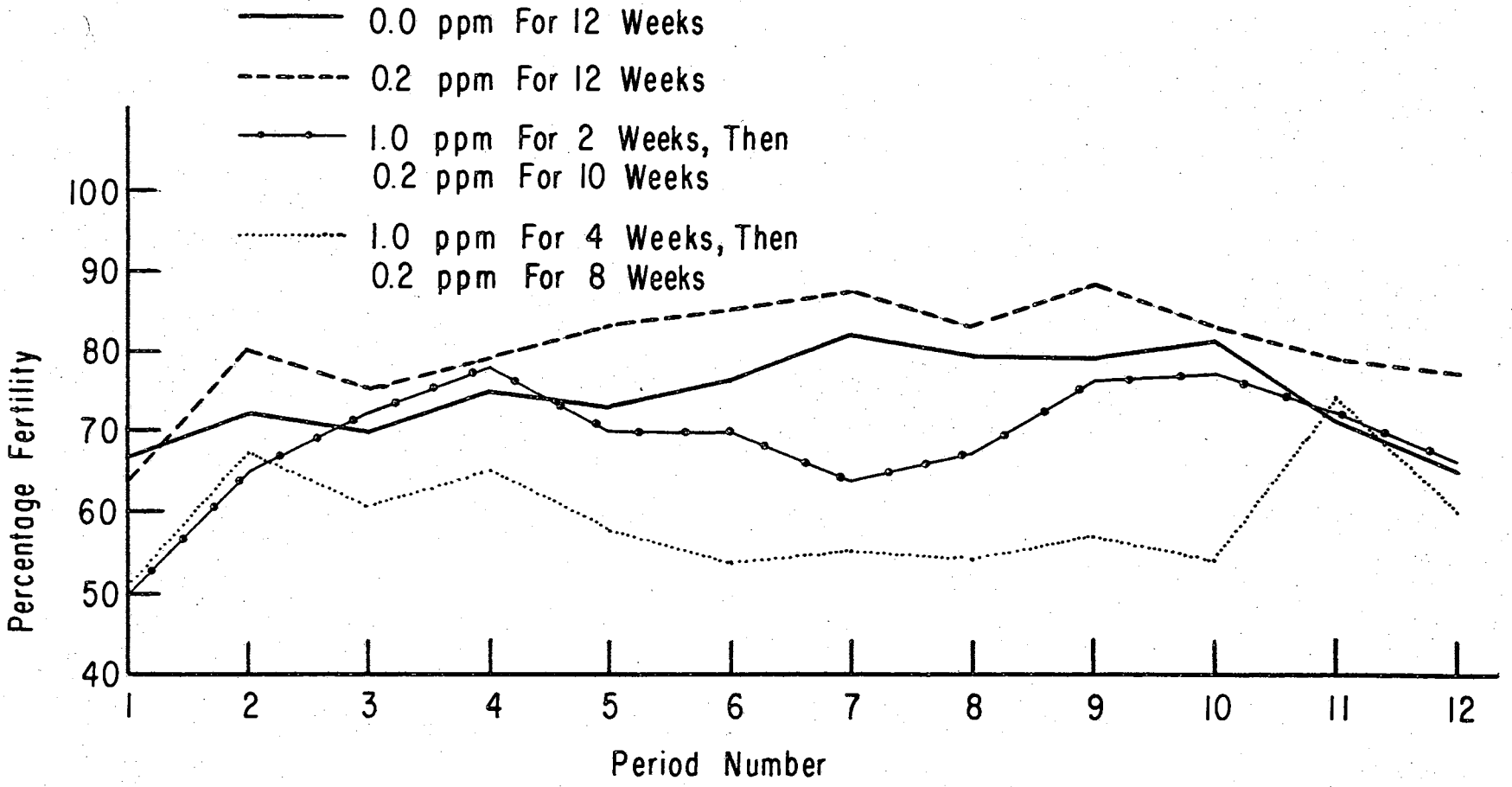

Figure 3. Residual Effects of Reserpine on Percentage of Fertile Eggs from Mature Turkeys Treated With Reserpine from 12 to 24 Weeks of Age.

Table XL. Percentage of fertile eggs from those birds receiving 0.2 p.p.m. of reserpine was 6.75 percent greater than that of the controls, for total eggs set during the breeding season. Percentage fertile eggs from those birds that had received 1.0 p.p.m. of reserpine for 2 weeks, then 0.2 p.p.m. for 10 weeks was 4.80 percent less than for the controls for total eggs set during the breeding season. The most noticeable depression in fertility of eggs from this group of birds occurred between the fourth and tenth hatching periods (Figure 3). Fertility of eggs from those birds that had received 1.0 p.p.m. of reserpine for 4 weeks, then 0.2 p.p.m. for 8 weeks was 14.07 percent below that of the controls for total eggs set during the breeding season. The apparent recovery in fertility of eggs from this group of birds in the eleventh hatching period may have been the result of the limited number of eggs set due to a seasonal decline in egg production. There was a highly significant difference ($P < .01$) in percentage of fertile eggs from birds that had received the four different levels of reserpine during the growing period (Table XLI)

Percentage hatch of fertile eggs was not significantly influenced by administration of reserpine during the twelve-week growing period. It may be noted in Table XLII that percentage hatch of fertile eggs from birds that had received 1.0 p.p.m. of reserpine for 4 weeks, then 0.2 p.p.m. for 8 weeks was 9.59 percent below that of the controls. Hatch of fertile eggs from females that had received 0.2 p.p.m. of reserpine was 1.82 percent above that of the controls, while the percentage hatch of fertile eggs from females that had received 1.0 p.p.m. of reserpine for 2 weeks, then 0.2 p.p.m. for 10 weeks was 3.54 percent above the controls. These differences in hatch of fertile eggs did approach

TABLE XL

PERCENTAGE FERTILE EGGS
Trial II

* P.P.M. of Reserpine	Replications 1	2	3	4	Treatment average
			Percent		
0.0	68.03	79.07	73.77	76.37	74.13
0.2	83.39	77.39	80.03	83.12	80.88
1.0 for 2 weeks, then 0.2 for 10 weeks	67.54	70.21	71.21	67.08	69.33
1.0 for 4 weeks, then 0.2 for 8 weeks	63.32	54.13	56.18	61.07	60.06

*No reserpine was administered after age 24 weeks.

TABLE XLI

ANALYSIS OF VARIANCE OF PERCENTAGE FERTILE EGGS
Trial II

Source	d.f.	S.S.	M.S.	F
Total	191	30,900.7182		
Period	11	2,685.2594		
Treatment	3	10,222.4061	3,407.4687	25.69**
Treatment error	12	1,591.6537	132.6378	
(Replications)	(3)	(337.0790)		
(R X T)	(9)	(1,254.5747)		
Treatment X Period	33	4,193.1126	127.0640	
T X P Error	132	12,208.2864	92.4870	
(R X P)	(33)	(3,954.9247)		
(R X P X T)	(99)	(8,253.3617)		

**Significant treatment effect at the 1% level of probability.

TABLE XLII

PERCENTAGE HATCH OF FERTILE EGGS
Trial II

P.P.M. of Reserpine*	Replications 1	2	3	4	Treatment average
	Percent				
0.0	58.28	70.69	69.69	65.83	65.79
0.2	73.30	62.62	66.82	68.10	67.61
1.0 for 2 weeks, then 0.2 for 10 weeks	72.87	65.74	66.85	74.28	69.33
1.0 for 4 weeks, then 0.2 for 8 weeks	64.34	46.64	58.63	59.53	56.20

*No reserpine was administered after age 24 weeks.

TABLE XLIII

ANALYSIS OF VARIANCE OF PERCENTAGE HATCH OF FERTILE EGGS
Trial II

Source	d.f.	S.S.	M.S.	F
Total	191	35,282.1992		
Period	11	15,488.5604		
Treatment	3	3,043.7217	1,014.5739	3.13
Treatment error	12	3,887.4641	323.9553	
(Replications)	(3)	(1,178.8083)		
(R X T)	(9)	(2,708.6558)		
Treatment X Period	33	2,156.7271	65.3554	
T X P Error	132	10,705.7219	81.1040	
(R X P)	(33)	(1,626.1955)		
(R X P X T)	(99)	(9,079.5264)		

statistical significance, as shown in Table XLIII. It is possible that the observed differences in treatment averages were not statistically significant because of the very noticeable variations among replications within treatments as shown in Table XLII.

Percentage hatch of total eggs set increased from 48.97 percent for control females to 54.68 percent for females that had received 0.2 p.p.m. of reserpine during the growing period (Table XLIV). A slight decrease in hatch of total eggs set was noted for females receiving 1.0 p.p.m. of reserpine for 2 weeks, then 0.2 p.p.m. for 10 weeks (48.07 percent as compared to 48.97 percent for the controls). Hatch of total eggs set for females that had received 1.0 p.p.m. of reserpine for 4 weeks, then 0.2 p.p.m. for 8 weeks was 33.87 percent, or 15.10 percent below that of the controls. There was a highly significant difference ($P < .01$) in percentage hatch of total eggs set from females that had received the different levels of reserpine during the growing period (Table XLV).

These differences in hatch of total eggs set from females receiving different levels of reserpine followed a trend that was very similar to that of the percentage of fertile eggs (Table XL). This would indicate that the differences noted in hatch of total eggs set was due in part to the difference in the percentage of fertile eggs from females receiving different levels of reserpine.

TABLE XLIV

PERCENTAGE HATCH OF TOTAL EGGS SET
Trial II

P.P.M. of Reserpine*	Replications 1	2	3	4	Treatment average
	Percent				
0.0	39.65	55.90	51.41	50.28	48.97
0.2	61.13	48.46	53.47	56.60	54.68
1.0 for 2 weeks, then 0.2 for 10 weeks	49.21	46.15	47.61	49.82	48.07
1.0 for 4 weeks, then 0.2 for 8 weeks	40.74	25.25	33.31	36.36	33.87

*No reserpine was administered after age 24 weeks.

TABLE XLV

ANALYSIS OF VARIANCE OF PERCENTAGE HATCH OF TOTAL EGGS SET
Trial II

Source	d.f.	S.S.	M.S.	F
Total	191	34,992.7926		
Period	11	5,667.3234		
Treatment	3	8,636.3258	2,878.7753	10.99**
Treatment error	12	3,143.0744	261.9229	
(Replications)	(3)	(824.8451)		
(R X T)	(9)	(2,318.2293)		
Treatment X Period	33	4,310.1478	130.6105	
T X P Error	132	13,235.9212	100.2721	
(R X P)	(33)	(2,260.4141)		
(R X P X T)	(99)	(10,975.5071)		

**Significant treatment effect at the 1% level of probability.

SUMMARY AND CONCLUSIONS

Trial I

Four levels of reserpine (0.0, 0.5, 1.0 and 2.0 p.p.m.) administered orally to mature Broad Breasted Bronze turkeys significantly ($P<.05$) influenced body weight change of females during the twenty-six week treatment period. The differences noted indicate that low levels of reserpine might aid in maintaining body weight of mature females, while higher levels could have the effect of decreasing the body weight.

No statistically significant difference in feed consumption for birds receiving different levels of reserpine was noted in this trial. The treatment averages did indicate that there was a slight increase in feed consumption with each increase in level of reserpine.

Egg quality, as measured by egg weight and shell thickness, was not significantly influenced by reserpine administered to the mature birds. A slight increase was noted in egg weight with each level of reserpine. The shell thickness of eggs from all females receiving reserpine was slightly higher than that of the controls.

A marked delay was noted in the onset of egg production for all females treated with reserpine. This delay was apparently temporary, since a recovery in egg production was noted later in the breeding season for all females receiving reserpine. The egg production of females receiving 0.5 p.p.m. of reserpine was slightly higher than that of the controls for the entire breeding season, while a decrease in egg

production was noted for females receiving 1.0 and 2.0 p.p.m. of reserpine. The differences in onset of egg production were statistically significant at the one percent level of probability. The differences in percentage egg production were significant at the five percent level of probability.

A definite decrease in percentage of fertile eggs was noted with each increase in the level of reserpine. This reduction in percentage of fertile eggs from reserpine-treated birds remained fairly consistent throughout the breeding season. A slight recovery in percentage of fertile eggs from females receiving 1.0 and 2.0 p.p.m. of reserpine was noted between the third and the eighth hatching periods. This recovery in fertility was not complete as compared with the fertility of the controls. Percentage of fertile eggs from females receiving 0.5, 1.0 and 2.0 p.p.m. of reserpine remained noticeably below that of the controls throughout the breeding season. The differences in percentage of fertile eggs from females receiving different levels of reserpine were statistically significant at the one percent level of probability.

A small but consistent decrease was noted in the percentage hatch of fertile eggs with each increase in the level of reserpine. These differences were statistically significant at the one percent level of probability.

Percentage hatch of total eggs set decreased significantly ($P < .01$) with each increase in level of reserpine. This decrease in percentage hatch of total eggs set was probably due to the decrease in the percentage of fertile eggs and in the percentage hatch of fertile eggs noted with each increase in reserpine level.

Trial II

The effects of graded levels of reserpine ((1) 0.0 p.p.m. for 12 weeks; (2) 0.2 p.p.m. for 12 weeks; (3) 1.0 p.p.m. for 2 weeks, then 0.2 p.p.m. for 10 weeks; (4) 1.0 p.p.m. for 4 weeks, then 0.2 p.p.m. for 8 weeks), on the growth rate of Broad Breasted Bronze turkey from twelve to twenty-four weeks of age seemed more noticeable in males than in females. A definite decrease in average body weight gain of the males was noted with each increase in level of reserpine. The differences in body weight gain of males receiving different levels of reserpine were statistically significant at the five percent level of probability. Slight decreases in the body weight gain of females treated with reserpine were noted; however, these differences were not statistically significant.

The differences in feed consumption of reserpine-treated and untreated birds during the twelve-week growing period were not statistically significant. The slight differences noted in feed consumption indicated that low levels of reserpine might result in decreased feed consumption, while higher levels could cause an increase in feed consumption.

Reserpine administered during the growing period (12 to 24 weeks of age) apparently had little effect on the body weight change or feed consumption of the same birds as mature turkeys. A slight increase in feed consumption of the mature birds was noted for birds that had previously received reserpine treatment; however, this increase did not even approach statistical significance.

Onset of sexual maturity, total egg production, egg weight and egg shell thickness were not significantly influenced by reserpine

treatment during the twelve-week growing period (12 to 24 weeks).

A highly significant difference ($P < .01$) was noted in the percentage of fertile eggs from birds that had received the four different levels of reserpine during the growing period. The percentage of fertile eggs from birds that had received 0.2 p.p.m. of reserpine was 6.75 percent higher than that of the controls, while that of females receiving 1.0 p.p.m. for 2 weeks, then 0.2 for 10 weeks was 4.80 percent less than that of the controls for total eggs set. The fertility of eggs from females that had received 1.0 p.p.m. reserpine for 4 weeks, then 0.2 p.p.m. for 8 weeks was 14.07 percent below that of the controls for total eggs set.

Percentage hatch of fertile eggs was not significantly influenced by the administration of reserpine during the twelve-week growing period. A slight increase in percentage hatch of fertile eggs above that of controls was noted for birds that had received the two lower levels of reserpine (0.2 p.p.m. and 1.0 p.p.m. for 2 weeks, then 0.2 for 10 weeks). A decrease of 9.59 percent below that of the controls was noted in the percentage hatch of fertile eggs from females that had received 1.0 p.p.m. of reserpine for 4 weeks, then 0.2 p.p.m. for 8 weeks. These differences in percentage hatch of fertile eggs approached statistical significance.

A highly significant difference ($P < .01$) was noted in the percentage hatch of total eggs set from females that had received the different levels of reserpine during the twelve-week growing period. These differences were probably due to the differences noted in the percentage of fertile eggs and in the percentage hatch of fertile eggs from birds receiving the different levels of reserpine.

BIBLIOGRAPHY

Anderson, D. L., and J. R. Smyth, Jr., 1959. Effect of serpasil on caged layer-thyroid and cholesterol relationships. Rutgers Conference on Serpasil: 44-50.

Anderson, D. L., and J. R. Smyth, Jr., 1960. Effect of reserpine on growth and endocrine relationships in large type white turkeys. Poultry Sci. 39: 1080-1086.

Barnett, B. D., 1960. Serpasil for stress. Research Report Number 3. Ciba Pharmaceutical Products, Inc.; Summit, New Jersey.

Barnett, B. D., 1962. Serpasil for stress. Research Report Number 9. Ciba Pharmaceutical Products, Inc.; Summit, New Jersey.

Barrett, W. E., 1959. The pharmacology of reserpine. Rutgers Conference on Serpasil: 3-5.

Bein, H. J., 1956. The pharmacology of Rauwolfia. Pharm. Rev. 8: 435-483.

Brodie, B. B., E. G. Tomich, R. Kuntzman and P. A. Shore, 1956. Possible role of serotonin in brain function and in reserpine action. J. Pharmacol. and Exper. Therap. 116: 9 (abstract).

Burger, R. E., 1959. Protective action of serpasil in broilers exposed to thermal stress. Rutgers Conference on Serpasil: 58.

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

Burger, R. E., and F. W. Lorenz, 1960. Pharmacologically induced resistance to heat shock. Poultry Sci. 39: 981-985.

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

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

Carlson, C. W., and F. L. Shinnick, 1959. Control of field outbreaks of dissecting aneurysms and laying hen studies with reserpine. Rutgers Conference on Serpasil: 9-10.

Couch, J. R., 1959. Reserpine in poultry nutrition. Rutgers Conference on Serpasil: 11-12.

Cranston, Elizabeth M., 1958. Proc. Soc. Exp. Biol. Med. 98: 320-322.

Drye, K. J., J. C. Gilbreath and R. D. Morrison, 1959. The effects of reserpine on chicken males on range. Poultry Sci. 38: 781-786.

Earl, A. E., 1956. Reserpine (serpasil) in veterinary practice. J. Amer. Vet. Med. Assoc. 129: 227-233.

Eoff, H. J., R. E. Davies, T. M. Ferguson and J. R. Couch, 1961. The effect of tranquilizers on egg production and egg shell quality in caged layers. Poultry Sci. 40: 1315-1321.

Fritz, J. C., F. D. Wharton, Jr. and L. J. Classen, 1959. Experiments with tranquilizers and sedatives in broiler production. Poultry Sci. 38: 1474-1475.

Gibson, E. C., and P. R. deGruchy, 1955. Aortic rupture in turkeys subsequent to dissecting aneurysms. Vet. Record 67: 650-654.

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.

Gilbreath, J. C., Q. B. Welch, R. E. Waggoner and R. D. Morrison, 1960. The effects of trifluoperazine and reserpine on reproductive efficiency in chickens. Poultry Sci. 39: 735-739.

Greene, D. E., R. C. Eaton, H. L. Wilcke and R. M. Bethke, 1961. Species differences in the effect of reserpine on reproductive performance. Poultry Sci. 40: 1410-1411 (abstract).

Hewitt, O. H., 1957. Experimental use of reserpine to control cannibalism among Ring-necked pheasants. New York Fish and Game J. 4: 228-233.

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

Hewitt, O. H., 1959. The use of serpasil in the rearing and handling of pheasants. Rutgers Conference on Serpasil: 13-14.

Huston, Till M., 1959. The effects of serpasil on controlled and naturally occurring climatic thermal stresses on immature domestic fowl. Rutgers Conference on Serpasil: 21-23.

Khazan, N., F. G. Sulman and H. Z. Winnik, 1960. Effect of reserpine on pituitary-gonadal axis. Proc. Soc. Exp. Biol. Med. 105: 201-204.

McSherry, B. J., A. E. Ferguson and J. B. Ballantyne, 1954. A dissecting aneurysm in internal hemorrhage in turkeys. J. Amer. Vet. Med. Assoc. 124-125: 279-283.

Moon, R. C., and C. W. Turner, 1959. Effect of reserpine on thyroid activity in rats. Proc. Soc. Exp. Biol. Med. 100: 679-681.

Morrison, W. D., 1962. Serpasil for stress. Research Report Number 9. Ciba Pharmaceutical Products, Inc.; Summit, New Jersey.

Patrias, G., 1962. Serpasil for stress. Research Report Number 9. Ciba Pharmaceutical Products, Inc.; Summit, New Jersey.

Premachandra, B. N., G. W. Pipes and C. W. Turner, 1959. Reserpine and thyroid activity in chickens. Poultry Sci. 38: 1237 (abstract).

Ringer, R. K., 1959. The influence of reserpine on early growth, blood pressure and dissecting aneurysms in turkeys. Rutgers Conference on Serpasil: 21-28.

Ringer, R. K., and K. G. Rood, 1959. Hemodynamic changes associated with aging in the Broad Breasted Bronze turkey. Poultry Sci. 38: 395-397.

Rudolph, J. Warren, 1961. The effect of reserpine on the reproductive performance of turkeys. (Thesis)

Shore, P. A., A. P. Letacher, E. G. Tomick, A. Carlson, R. Kuntzman and B. B. Brodie, 1957. Role of brain serotonin in reserpine action. New York Acad. Sci. Ann. 66: 609-617.

Speckman, E. W., and R. K. Ringer, 1961. Hemodynamic responses following reserpine feeding to turkeys. Poultry Sci. 40: 1292-1298.

Sturkie, P. D., W. K. Durfee and M. Sheahan, 1958. Effects of reserpine on the fowl. Am. J. Physiol. 194: 184-186.

Sturkie, P. D., 1959. Cardiovascular effects of reserpine on the fowl. Rutgers Conference on Serpasil: 5.

Trapold, J. H., A. J. Plummer and F. F. Yonkman, 1954. Cardiovascular and respiratory effects of serpasil. J. Pharmacol. and Exp. Therap. 110: 205.

Weiss, H. S., 1960. The effect of continuous treatment with reserpine on body temperature, respiratory-cardiovascular function and heat tolerance of the hen. Poultry Sci. 39: 366-373.

Weiss, H. S., 1961. The effect of reserpine on immersion hypothermia in the hen. Poultry Sci. 40: 64-67.

Woodson, R. E., Jr., H. W. Youngken, E. Schlittler and J. A. Schneider, 1957. Rauwolfia: Botany, Pharmacognosy, Chemistry and Pharmacology. Little, Brown & Co.; Boston, Mass.

VITA

John Mark Casey

Candidate for the Degree of

Master of Science

Thesis: TURKEY REPRODUCTION AS INFLUENCED BY RESERPINE

Major Field: Poultry Breeding

Biographical:

Personal data: Born: Stillwater, Oklahoma, September 24, 1937.

Education: Undergraduate study: Bachelor of Science degree in Poultry Science from Oklahoma State University, May, 1961.

Professional Experience: Private in the United States Army from June, 1957 to December, 1957. Student employee of Poultry Science Department, Oklahoma State University from October, 1958 to May, 1961. Graduate Assistant, Poultry Science Department, Oklahoma State University, June, 1961 to January, 1962.

Organizations: Poultry Science Club, Alpha Zeta and Poultry Science Association.