3-1959

The effect of hygromycin B as a growth stimulant and as an anthelmintic for swine

Arthur Jones Jr.

To the Graduate Council:

I am submitting herewith a thesis written by Arthur Jones Jr. entitled "The effect of hygromycin B as a growth stimulant and as an anthelmintic for swine." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

Sumner A. Griffin, Major Professor

We have read this thesis and recommend its acceptance:

C. S. Hobbs, H. J. Smith, B. J. McSpadden

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

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

March 21, 1959

To the Graduate Council:

I am submitting herewith a thesis written by Arthur Jones, Jr. entitled "The Effects of Hygromycin B as a Growth Stimulant and as an Anthelmintic for Swine." I recommend that it be accepted for twelve quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

Sumner A. Griffin
Major Professor

We have read this thesis
and recommend its acceptance:

Charles S. Hobbs

Harold J. Smith

B. J. McSpadden

Accepted for the Council:

Dale Wantling
Dean of the Graduate School

THE EFFECTS OF HYGROMYCIN B AS A GROWTH STIMULANT AND AS AN ANTHELMINTIC FOR SWINE

A THESIS

Submitted to
The Graduate Council
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

by

Arthur Jones, Jr.

March 1959

ACKNOWLEDGEMENT

The writer desires to express his appreciation to Dr. Sumner A. Griffin of the Animal Husbandry Department under whose direction the study has been conducted. He also desires to express his appreciation to Dr. C. S. Hobbs and Dr. H. J. Smith of the Animal Husbandry Department and to Prof. B. J. McSpadden of the Poultry Department for criticism and advice.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Internal parasites are one of the major concerns in the production of swine today. The United States Department of Agriculture (1954) estimated that the annual loss to the swine industry from internal parasites was $276,726,000. These dollar losses represent an amount equal to $3.00 per pig on each farm.

Several anthelmintics have been used by swine growers. The most widely used anthelmintic has been sodium fluoride which is administered to the swine in a special mixture of feed. Also, piperazine has been used in a mixture of feed or by mixing with drinking water. Phenothiazine is sometimes used and administered to the swine in capsules. Another compound that is used is wormseed oil (oil of chenopodium), which is given to swine in liquid doses.

All of these anthelmintics with the exception of piperazine and phenothiazine act only on the intestinal roundworm or ascarid. Piperazine and phenothiazine act on ascarids and nodular worms.

Recently hygromycin B, a new antibiotic, has been placed on the market. This antibiotic has been reported to act as an anthelmintic for swine and to control ascarids,

nodular worms and whipworms. This antibiotic also has been reported to stimulate growth in swine.

In the South, and particularly in Tennessee, most swine are fed to market weight with a supplement and corn free choice. This experiment was conducted to evaluate hygromycin B as an anthelmintic and as a growth stimulant for swine when fed with a supplement and corn fed free choice.

CHAPTER II

LITERATURE REVIEW

According to Goldsby and Todd (1956a), an effective anthelmintic must be non-toxic when fed continuously, palatable, effective against all species of internal parasites, and capable of reducing the reproductive capacity of the worm species. To this list from the producer's standpoint, ease of administration should be added. The anthelmintics which have been used previous to hygromycin B were not effective anthelmintics when evaluated by Goldsby and Todd's specifications.

Sodium fluoride has been the most generally used treatment for the internal parasites of swine. However, according to the United States Department of Agriculture (1952), sodium fluoride is poisonous, is effective only against ascarids, must be used in a special mixture of feed and, further, the treatment should be repeated for good results.

Shelton and Crisler (1953) reported that phenothiazine is effective against nodular worms in their adult stage, but complications such as temporary blindness, swelling and abnormalities of the skin may occur.

Wormseed oil is effective against ascarids but the swine must be fasted for eighteen to twenty-four hours

before treatment and must not be fed or watered until three or four hours thereafter, according to the United States Department of Agriculture (1952).

The new antibiotic hygromycin B, meets Goldsby and Todd's specifications for an effective anthelmintic, with the exception of being effective against all internal parasites of swine. Goldsby and Todd (1956) reported that hygromycin B had a practical effect against lung worms, whipworms, strongyloids and possibly ascarids in swine when fed in a complete ration on dry lots. Again Goldsby and Todd (1957) reported that hygromycin B, when fed in a complete feed to stunted and heavily parasitized pigs on dry lot, was an effective anthelmintic against lung worms, whipworms, and possibly the ascarids. Ova produced by all of these species showed marked reduction after fourteen days.

Teague and Rutledge (1957) reported that the reduction in the number of ascarid and nodular worm ova would indicate that hygromycin B was effective in the elimination of these internal parasites of swine when pigs were fed a complete ration either on pasture or dry lot. Teague et al. (1958) in another experiment reported that hygromycin B when added to a complete feed was effective in reducing the infestation of ascarids, nodular and whipworms in pigs on dry lot.

Lindquist (1958) reported that the recommended level

of hygromycin B fed in complete feeds to five pigs did not prevent the occurrence of the migratory phase of ascarids; however, the worm load decreased as the pigs increased in age and growth. Worm load of pigs fed unmedicated feeds on the same pastures in previous years also decreased with the increasing age and growth of pigs.

Conrad and Beeson (1958a) reported that hygromycin B fed in a complete feed effectively controlled roundworms with pigs on pasture. Later Conrad and Beeson (1958b) reported that hygromycin B effectively not only controlled roundworms, but also nodular worms and whipworms when fed in a complete ration to pigs on dry lot.

The foregoing literature agrees that hygromycin B is an effective anthelmintic for swine when incorporated in a complete ration. However, the literature which follows does not agree as to the effectiveness of hygromycin B as a growth stimulant.

Means et al. (1956a) reported that swine in dry lot fed 13,000,000 units of hygromycin B per ton of complete feed during the finishing period gained 11 per cent faster and required 3 per cent less feed per pound of gain than pigs fed the basal ration. The increase in rate of gain was statistically highly significant.

Teague and Rutledge (1957) reported no difference in average daily gains and average daily feed intake between

pigs fed hygromycin B and the control lots when pigs were fed complete feed either on dry lot or on pasture.

Teague et al. (1958) reported that the feeding of hygromycin B resulted in increased rate and efficiency of gain during the period from weaning to a weight of 120 pounds. Pigs which received hygromycin B gained slower than the controls during the period from 120 pounds to market weight. These pigs were fed a complete ration and were on dry lot.

Hoefer and Luecke (1958) reported that hygromycin B fed in a complete feed did not have a growth stimulating effect on worm-free pigs. They suggest that the effect of this antibiotic on growth is apparently associated with its anthelmintic properties.

Lindquist (1958) found that the worm load in pigs was reduced as the age and growth of the pigs increased. However, when pigs were fed hygromycin B in a complete feed, they showed an advantage in weight gain over two infested lots of pigs which did not receive hygromycin B. The pigs were taken from sows at two to three days of age and raised in screen cages until they were placed in dry lots at the beginning of the experiment.

Conrad and Beeson (1958a) concluded that although worms were controlled, feeding hygromycin B in a complete feed for 108 days to wormed pigs and non-wormed pigs failed

to improve gains on dry lot. In the non-wormed group hygromycin B depressed daily gains 8 per cent and reduced the feed intake 2.3 per cent. During the first forty-nine days of the experiment, hygromycin B had no effect on gains when fed to non-wormed pigs but increased gains 9 per cent when fed to wormed pigs. During the second fifty-nine days of the experiment, hygromycin B fed to non-wormed pigs significantly depressed gains, reduced feed intake and more feed was needed per hundred pounds of gain as compared to control pigs. In another experiment, Conrad and Beeson (1958b) found that non-wormed control pigs and hygromycin B fed pigs made similar gains, but the wormed control pigs gained 7.9 per cent faster than wormed pigs fed hygromycin B. Pigs were fed a complete ration on pasture.

Many feed additives may be suitable for use in feeds as growth stimulants, anthelmintics, etc.; but to be of any value to the animals they must be palatable.

Means et al. (1956b) found that the total feed consumption was not affected when 13,000,000 or 26,000,000 units of hygromycin B per ton of complete feed was fed to swine. Means et al. (1958a) further reported that experimental data indicate that the addition of hygromycin B at the recommended level in a complete feed does not adversely affect the palatability of pig starters when fed to pigs in dry lot.

The value of hygromycin B when used in combination with other antibiotics in complete feeds has not been previously proven. However, Means et al. (1958b) reported that hygromycin B or vancomycin when added to a swine ration did not adversely affect the palatability, but more study was needed to determine the palatability of the combination of vancomycin and hygromycin B in complete swine rations.

Hoefer and Luecke (1958) reported that the combination of hygromycin B and aureomycin did not increase daily gains as much as aureomycin alone when fed in a complete feed to pigs on dry lot.

A search of the literature shows that hygromycin B has been used only as an additive in complete feeds. In the State of Tennessee many farmers feed their swine corn and supplement free choice. This experiment was planned to determine the effectiveness of hygromycin B as an anthelmintic for swine and as a growth stimulant when added only to the supplement using corn and supplement free choice.

CHAPTER III

EXPERIMENTAL PROCEDURE

Forty-eight Duroc and Hampshire weanling pigs were allotted to twelve lots on the basis of weight, breed, and sex. Two lots were randomly assigned to each of the following treatments:

1. Supplement and corn fed free choice to pigs that were wormed with sodium fluoride prior to experiment.
2. Supplement plus seventy-two grams aureomycin per ton of mix and corn fed free choice to pigs that were wormed with sodium fluoride prior to experiment.
3. Supplement plus 24,000,000 units hygromycin B per ton of mix and corn fed free choice to pigs that were wormed with sodium fluoride prior to experiment.
4. Supplement and corn fed free choice.
5. Supplement plus 72 grams aureomycin per ton of mix and corn fed free choice.
6. Supplement plus 24,000,000 units hygromycin B per ton of mix and corn fed free choice.

Composition of the Basal supplement is presented in Table I.

TABLE I

COMPOSITION OF CONTROL SUPPLEMENT

Ingredient	Pounds
Soybean oil meal	515
Meat and bone meal	200
17 per cent dehydrated alfalfa meal	150
Dicalcium phosphate	100
Salt	25
Trace mineral	5
B vitamin supplement[a]	3
B_{12} supplement[b]	1
Brewers yeast	1
Approximate protein 36%	

[a]Contains 2 gm. riboflavin, 4 gm. pantothenic acid, 9 gm. niacin, 10 gm. choline chloride per lb.

[b]Contains 9 mg. vitamin B_{12} per lb.

The pigs were started on experiment at an average weight of 54.2 pounds and were fed until they reached approximately 200 pounds. Each pig was removed from its lot on the first weigh day after it reached 200 pounds. When three pigs in a lot had been removed, the fourth pig was also removed which concluded that experimental lot. Pigs were weighed at two-week intervals. All feed was weighed and recorded at two-week intervals to correspond with pig weigh dates.

Pigs were sprayed for lice at the beginning of the experiment and again approximately at the middle of the experiment with a solution of four pounds of DDT in fifty gallons of water.

Feces samples were taken from each lot three times (January 18, February 15 and February 28). These samples were placed in air tight plastic bags, tagged, and placed under refrigeration. Worm egg counts of ascarids, whipworms and nodular worms were determined at the completion of the experiment. To determine the egg counts, a flask with etched markings at fifty-six and sixty cc was filled with 0.1 N NaOH to the fifty-six cc mark. Feces from a sample was then added to the NaOH in the flask to bring the level of the fluid up to the sixty cc mark. Several glass beads were added to the solution and the flask was stoppered with a rubber stopper. The solution was then shaken until the

feces was thoroughly suspended. At this time 0.075 cc was quickly withdrawn from the flask by pipette and placed on a three by two inch slide. The slide was then covered with a cover slip and the ova were counted. The numbers of ova counted were multiplied by 200 to obtain the number of ova per gram of feces.

When the pigs were slaughtered at a local packing house the intestines, as they came off the processing line, were tagged and stored in a cooler at approximately forty degrees temperature. Two days later the contents of the intestines were washed and screened and the ascarids were removed and counted.

CHAPTER IV

RESULTS AND DISCUSSION

Anthelmintic

The number of ascarids that were recovered from two pigs in each of the wormed and non-wormed lots are presented in Table II and Figure 1. Only one ascarid was found in an examination of intestines of two pigs each from the four lots which were fed hygromycin B. Although worm counts in all lots were low, pigs fed a aureomycin or no antibiotic were relatively higher in worm counts than the pigs that were fed hygromycin B. These results confirm the reports of the workers that hygromycin B will reduce the infestation of ascarids in swine.

The number of worm eggs per gram of feces are presented in Table III. Worm egg counts indicate that hygromycin B will control the infestation of ascarids, nodular and whipworms. The worm egg counts, for pigs that were not wormed prior to the experiment, were much higher in the lots that were fed the control and aureomycin rations than the lots that were fed the hygromycin B ration. The worm egg counts obtained in this experiment are in agreement with those obtained by Goldsby and Todd (1957) who have reported that hygromycin B controlled worm egg counts of ascarids, nodular worms and whipworms.

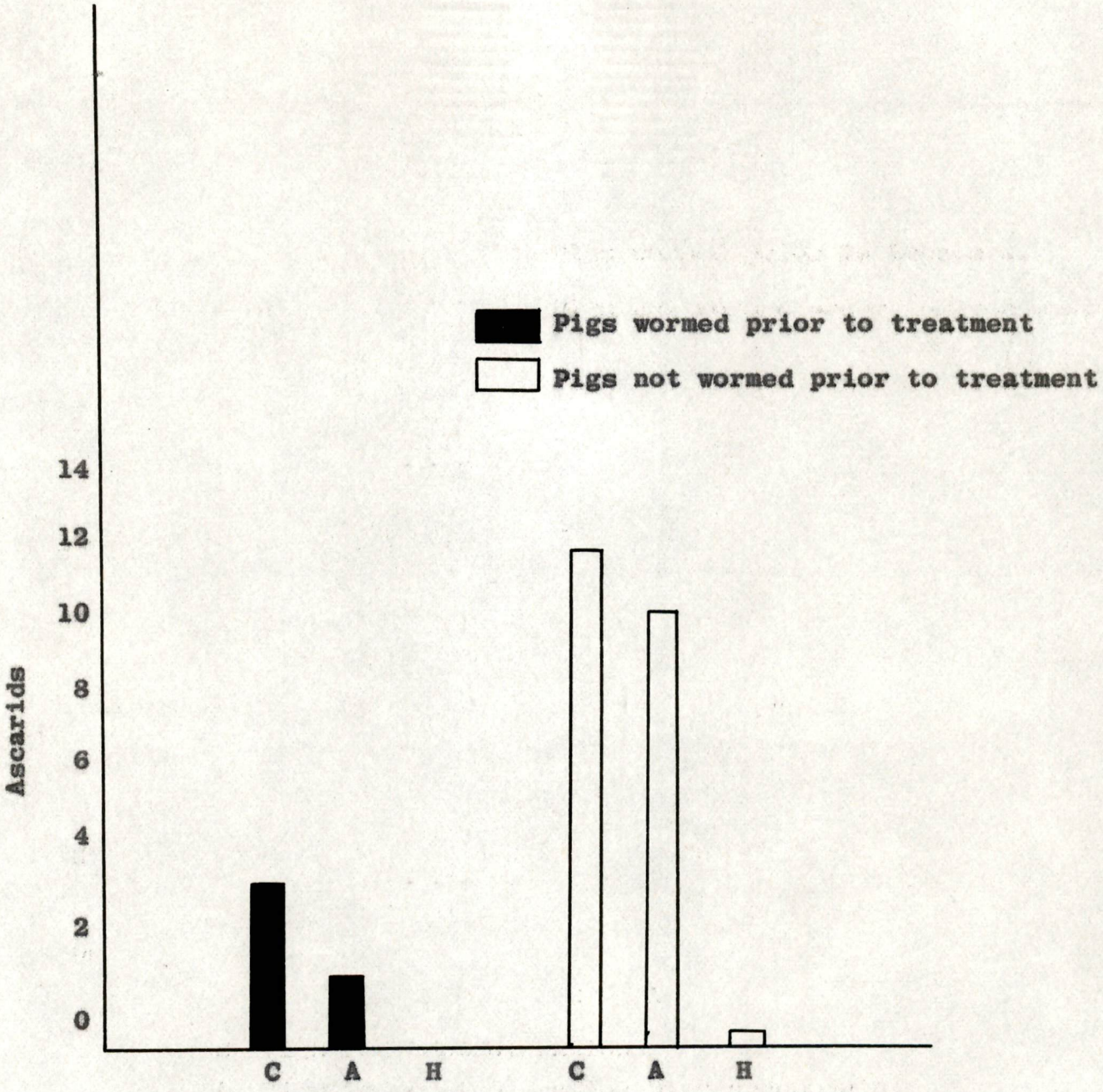
TABLE II

ASCARIDS RECOVERED AT TIME OF SLAUGHTER

	Number of Ascarids					
	Pigs Wormed Prior To Treatment			Pigs Not Wormed Prior To Treatment		
	Control	Control plus aureomycin	Control plus hygromycin B	Control	Control plus aureomycin	Control plus hygromycin B
Lots[a]	4.5	1.0	0	8.5	10.5	0.0
Lots[a]	3.0	2.0	0	16.0	11.0	0.5
Av.[b]	3.75	1.5	0	12.25	10.75	0.25

[a]Average worm count of two pigs in each lot

[b]Average worm count of four pigs in each treatment



C Pigs fed control ration

A Pigs fed control ration plus aureomycin

H Pigs fed control ration plus hygromycin B

Figure 1. Ascarids recovered from intestines at time of slaughter.

TABLE III

SUMMARY OF WORM EGG COUNTS[a]

Sample	Pigs Wormed Prior To Treatment			Pigs Not Wormed Prior To Treatment		
	Control	Control plus aureomycin	Control plus hygromycin B	Control	Control plus aureomycin	Control plus hygromycin B
1[b]						
Ascarids	0	400	0	22,400	3,600	600
Nodular	0	800	400	4,400	3,000	5,200
Whipworm	0	0	0	600	400	0
2[c]						
Ascarids	0	3,800	1,200	14,200	18,200	4,200
Nodular	0	400	800	4,000	2,400	2,000
Whipworm	0	0	4,000	9,400	1,400	600
3[d]						
Ascarids	0	0	0	800	2,000	0
Nodular	0	0	0	800	4,200	0
Whipworm	0	0	0	0	0	0

[a]Pigs started on experiment 12-19-57

[b]Sample taken 1-18-58

[c]Sample taken 2-15-58

[d]Sample taken 2-28-58

Sodium fluoride will reduce the egg counts of ascarids, nodular and whipworms as shown by the data obtained from the results of this experiment. In all lots that were wormed prior to the experiment with sodium fluoride, there were very few worm eggs found (Table III).

The worm load in all lots was very low. A possible answer may be because the pigs were raised under very good sanitary conditions from birth until the experiment was completed.

Gains

The differences in average daily gains among treatments were not significant. These differences are found in Table IV. The average daily gains obtained in this experiment are in agreement with those reported by Conrad and Besson (1958) and Hoefer and Luecke (1958). Conrad and Beeson (1958) have also reported that there was no difference between pigs fed hygromycin B and pigs fed a control ration from starting weight to 120 pounds; however average daily gains were depressed between the weights of 120 pounds to 200 pounds. Results obtained by Teague et al. (1958) are in agreement with the results reported by Conrad and Beeson (1958) from weights of 120 pounds to 200 pounds, but they reported that average daily gains were increased from starting weight to 120 pounds.

TABLE IV

SUMMARY OF THE EFFECT OF HYGROMYCIN B AND AUREOMYCIN ON DAILY GAINS, FEED CONSUMPTION AND FEED CONVERSION OF GROWING FINISHING SWINE

	Pigs Wormed Prior To Treatment			Pigs Not Wormed Prior To Treatment		
	Control	Control plus aureomycin	Control plus hygromycin B	Control	Control plus aureomycin	Control plus hygromycin B
No. of lots per treatment	2	2	2	2	2	2
No. of pigs per treatment	8	8	8	8	8	8
Av. days on experiment	85	89	87	85	85	87
Av. starting weight, lbs.	53	54	58	55	52	52
Av. final weight, lbs.	206	212	206	208	203	197
Av. daily gains, lbs.	1.80	1.78	1.71	1.80	1.78	1.67
Corn consumed, lbs.	4,130	4,300	4,298	4,336	4,048	3,943
Supplement consumed, lbs.	571	746	572	672	672	717
Total feed consumed, lbs.	4,701	5,046	4,870	5,008	4,720	4,660

TABLE IV (continued)

SUMMARY OF THE EFFECT OF HYGROMYCIN B AND AUREOMYCIN ON DAILY GAINS, FEED CONSUMPTION AND FEED CONVERSION OF GROWING FINISHING SWINE

	Pigs Wormed Prior To Treatment			Pigs Not Wormed Prior To Treatment		
	Control	Control plus aureomycin	Control plus hygromycin B	Control	Control plus aureomycin	Control plus hygromycin B
Av. daily feed:						
Corn, lbs.	6.07	6.04	6.18	6.38	5.95	5.67
Supplement, lbs.	.84	1.05	.84	.99	.99	1.03
Total, lbs.	6.91	7.09	7.02	7.37	6.94	6.70
Feed per pound gain:						
Corn, lbs.	3.38	3.40	3.63	3.54	3.35	3.40
Supplement, lbs.	.47	.59	.48	.55	.56	.62
Total, lbs.	3.85	3.99	4.11	4.09	3.91	4.02

All lots of pigs in this experiment made good gains during the entire experiment, except during one two-week period in February, when the weather was extremely cold.

Feed Conversion and Feed Consumption

The differences in feed conversion among treatments (Table IV), were not significant. There was a wastage of feed in all lots causing a higher feed conversion figure than would be expected. There were no differences among treatments in total feed consumption (Table IV). These results are in agreement with those of Teague and Rutledge (1957); however, Conrad and Beeson (1958ab) reported that, in six of eight comparisons, feeding hygromycin B reduced feed intake.

CHAPTER V

SUMMARY

Forty-eight Hampshire and Duroc weanling pigs were alotted to twelve lots of four pigs each and fed in concrete pens from a weight of approximately fifty to 200 pounds. Six treatments were used with two replicates per treatment. All pigs were fed corn and supplement free choice. The treatments were: I and IV control supplement, II and V control supplement plus seventy-two grams aureomycin per ton of supplement, and III and VI control supplement plus 24,000,000 units of hygromycin B per ton of supplement. To permit a more reliable comparison of the anthelmintic and growth stimulant properties, pigs on treatments I, II and III were wormed with sodium fluoride prior to the experiment and pigs on treatments IV, V and VI were not wormed.

Aureomycin or hygromycin B had no significant effect on rate of gain. There was no significant differences in average daily gains or feed conversion between treatments or replications within treatments.

The data obtained from the worm counts at time of slaughter indicate that hygromycin B has an anthelmintic effect on swine ascarids. The data obtained from worm egg counts indicate that hygromycin B has an anthelmintic effect on swine ascarids, nodular and whipworms. In this

experiment sodium fluoride was an effective anthelmintic on swine ascarids, nodular and whipworms.

BIBLIOGRAPHY

BIBLIOGRAPHY

Conrad, J. H. and W. M. Beeson. 1958a. Effect of Hygromycin B and a Combination of Antibiotics on Growing-finishing Swine. Purdue Field Day Report. Mimeo. 233.

Conrad, J. H. and W. M. Beeson. 1958b. Effects of Hygromycin B and a Combination of Antibiotics on Growing-finishing Swine. Purdue Field Day Report. Mimeo. 242.

Goldsby, A. I. and A. C. Todd. 1956. A New Swine Anthelmintic. The Swine Parasite Problem. Eli Lilly and Company.

Goldsby, A. I. and A. C. Todd. 1957. Hygromycin, A Broad-Spectrum Anthelmintic of Swine. Jour. Animal Sci. 131: 471.

Gossett, F. O., M. C. McGowen, T. M. Means, C. F. Chappel and J. F. Downing. 1956. Effect of Feeding Streptomyces Hygroscopicus Fermentation Crude Broth to Sows During Gestation. The Swine Parasite Problem. Eli Lilly and Company.

Hoefer, J. A. and R. W. Luecke. 1958. Hygromycin Fed Alone and in Combination With Aureomycin to Weaning Pigs. Third Annual Michigan Swine Day Report.

Lindquist, W. D. 1958. Some Effects of Hygromycin on Early Natural Infection of Ascaris Lumbricoides in Swine. Jour. Amer. Vet. Med. Assoc. 132:72-5.

Means, R. M., C. F. Chappel and J. F. Downing. 1956a. The Effect of the Antibiotic Streptomycies Hygroscopius (Crude Spray-Dried) on Weight Gains and Feed Efficiency of Fattening Swine. The Swine Parasite Problem. Eli Lilly and Company.

Means, T. M., C. F. Chappel and J. F. Downing. 1956b. The Palatability of Different Antibiotics Self-fed to Growing-fattening Swine. The Swine Parasite Problem. Eli Lilly and Company.

Means, T. M., C. F. Chappel, F. O. Gossett and J. F. Downing. 1957. Effect of The Antibiotic Produced by Streptomyces Hygroscopices on Breeding During Their Growing State and The Effect of The Same Antibiotic on These Same Gilt's Reproductive Performance. The Swine Parasite Problem. Eli Lilly and Company.

Means, T. M., C. F. Chappel, W. P. Waitt and J. F. Downing. 1958a. The Palatability of Hygromix in Pig Starter Rations. The Swine Parasite Problem. Eli Lilly and Company.

Means, T. M., C. F. Chappel, W. P. Waitt, and J. F. Downing. 1958b. The Palability of Hygromix, Vancomycin, and The Combination of The Two Antibiotics in Swine Grower Rations. The Swine Parasite Problem. Eli Lilly and Company.

Shelton, F. C. and O. S. Crisler. 1953. Common Parasites of Swine. Mo. Agr. Exp. Sta. Bul. 597.

Teague, H. S. and E. A. Rutledge. 1957. The Value of Certain Feed Additives for Growing-finishing Swine on Pasture and in Dry Lot. Ohio Agr. Exp. Sta. Animal Sci. Mimeo. 106.

Teague, H., H. R. Smith and E. A. Rutledge. 1958. Hygromycin B and Piperaqine Phosphate as Worming Agents for Swine and Their Influence on Performance When Fed Continuously. Ohio Swine Day Report.

United States Department of Agriculture. 1952. Internal Parasites of Swine. Farmers Bul. 1787. pp. 16-24.

United States Department of Agriculture. 1954. Losses in Agriculture. pp. 146-47.