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## EC58-1902 Worm Eggs Cost you Money : Controlling the Large Roundworm of Swine

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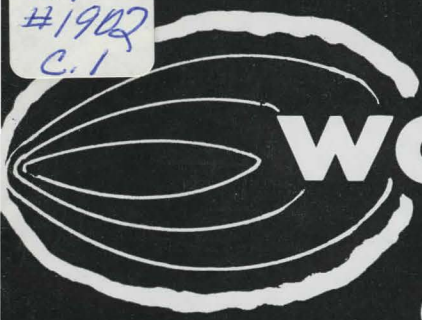
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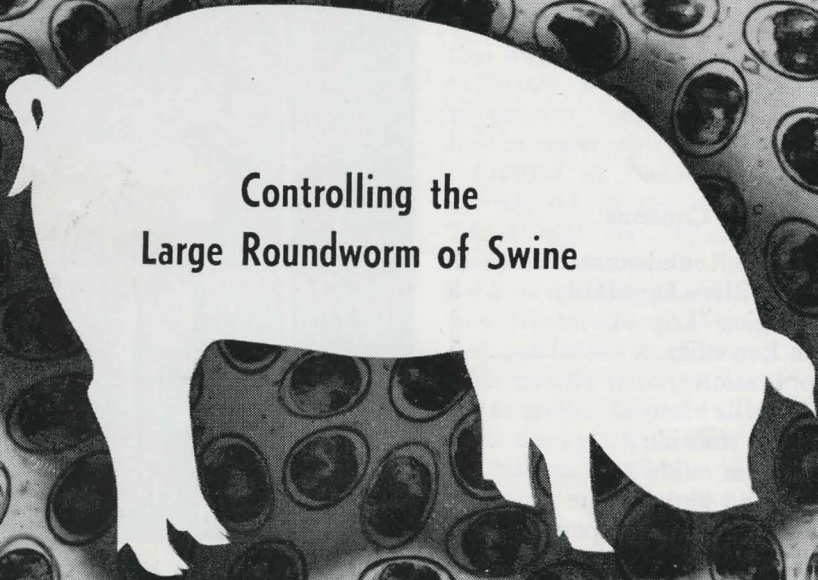
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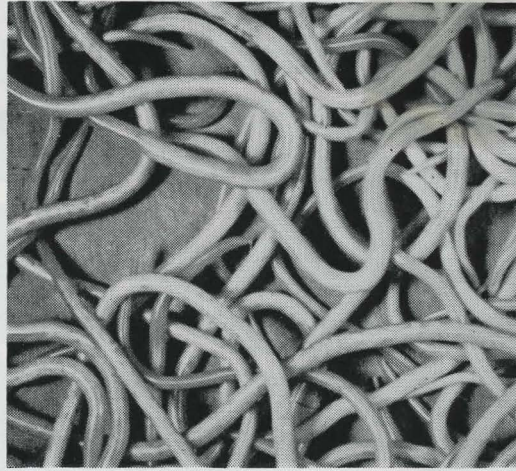
*COST YOU MONEY*



Controlling the  
Large Roundworm of Swine

EXTENSION SERVICE  
UNIVERSITY OF NEBRASKA COLLEGE OF AGRICULTURE  
AND U.S. DEPARTMENT OF AGRICULTURE  
COOPERATING  
W. V. LAMBERT, DIRECTOR





# Control of the

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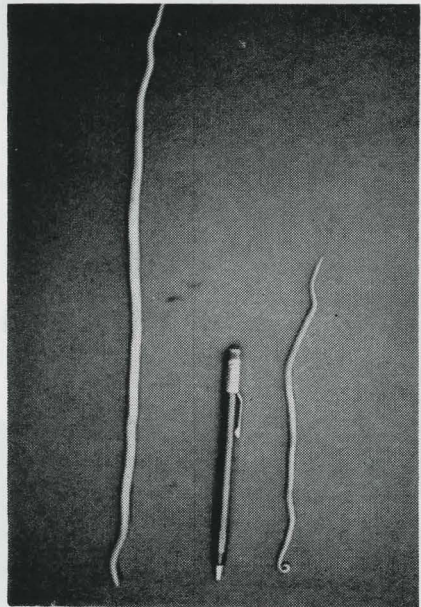


Fig. 2. Male (right) is identified by a sharply curled tail and small size. The female is filled with reproductive organs and can lay up to 2 million eggs each day.

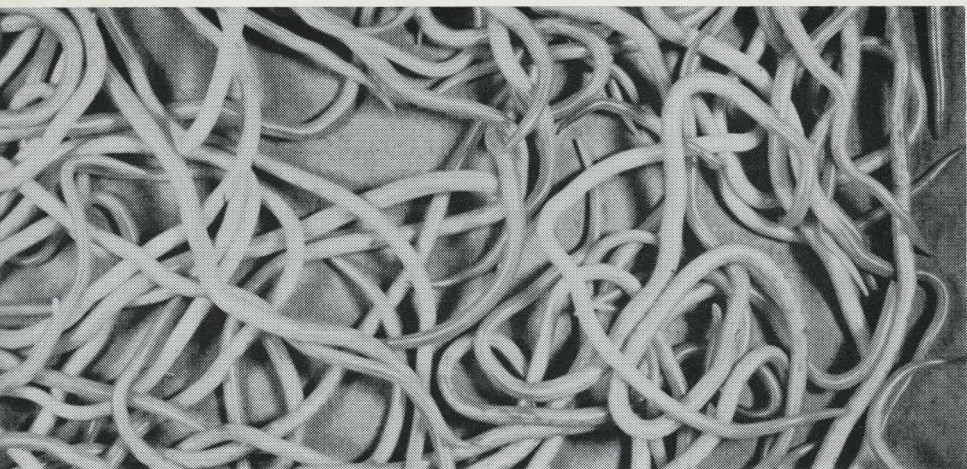


Fig. 1. Adult roundworms taken from the gut of a pig. These worms are pink and resemble large earthworms

# Large Roundworm in Swine

George W. Kelley, Jr., Leland S. Olsen and E. Crosby Howe\*

The large roundworm of swine, *Ascaris suum*, (Fig. 1 and 2) is the pig's most widespread worm parasite. You can find this parasite in almost every herd in Nebraska. It is not unusual to find several hundred worms per pig.

## 2,000,000 Eggs Daily

*Ascaris* infections are common because of the extremely prolific female worms. Each female can lay up to two million eggs daily. (Fig. 3). A pig harboring five worms and enclosed in a 100 square foot pen will shed eggs at the rate of 100,000 per square foot daily.

In a short time the worms in such a moderately infected pig can seed so many eggs onto the ground

that infection of new animals is unavoidable because it is impossible to prevent contamination of pig feed or water with the eggs.

Control of *Ascaris* depends on getting rid of the infective eggs. These eggs are about the same diameter as a human hair and are hard to see with the naked eye. A tiny worm must develop within each egg before it will harm the pig. This usually requires two or three weeks under favorable conditions. After the eggs have developed they are extremely resistant to many disinfectants and can live for many years.

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\* George W. Kelly Jr., is Assoc. Prof. Parasitology, L. S. Olsen is Asst. Animal Pathologist and E. C. Howe is Extension Veterinarian.



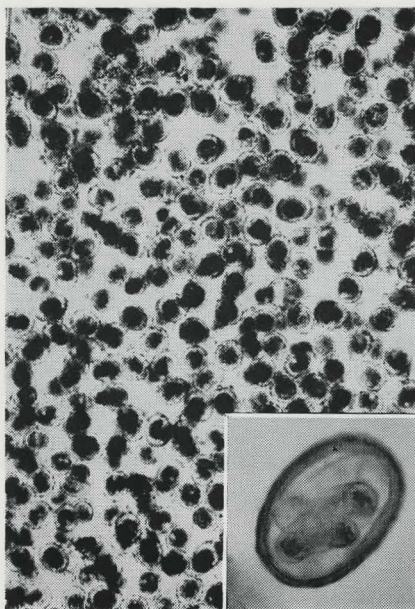


Fig. 3. Eggs of the large roundworm are about the same diameter as a hair and are resistant to disinfectants. Insert: Egg containing worm.

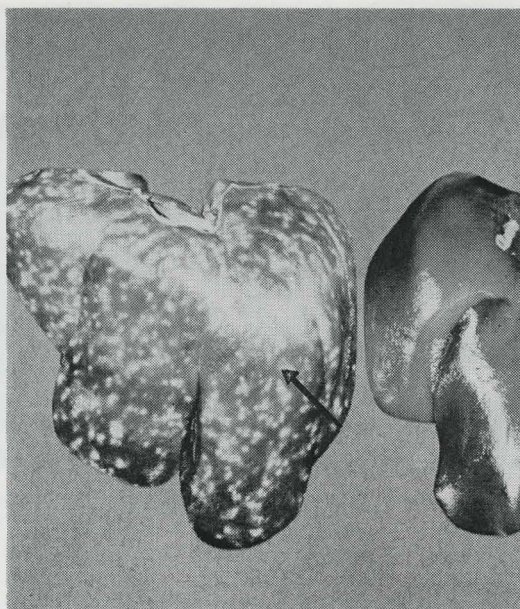


Fig. 4. Liver damaged when worms passed through it during migration within the pig. Healthy liver is shown on right.

### Damaging Trip

When the eggs are eaten in contaminated food and water they hatch in the small intestine and the liberated worms penetrate the gut wall to be carried in the blood to the liver.

They burrow through the tissue of the liver until they penetrate the large blood vessels and are swept along by the blood to the heart. The heart pumps them on into the lungs. Here the worms penetrate the walls of the small air sacs of the lungs and work their way up through the air tubes into the windpipe. At this time the worms are barely visible.

From the windpipe the worms are carried into the throat by coughing. When they reach the throat

they are swallowed, again passing into the intestine where they are now able to feed and grow into egg laying adults.

Worms reach the liver within a few hours after the eggs are eaten and can be found in the lungs shortly thereafter. However, it generally takes around four days for the majority of the worms to reach the liver and about nine days to reach the lungs. Almost all of the worms have found their way back into the small intestine 15 days after the eggs were eaten. After being eaten the tiny worm which was within the egg requires approximately 60 days to grow into a mature worm.

Both young and adult worms produce damage. The young worms



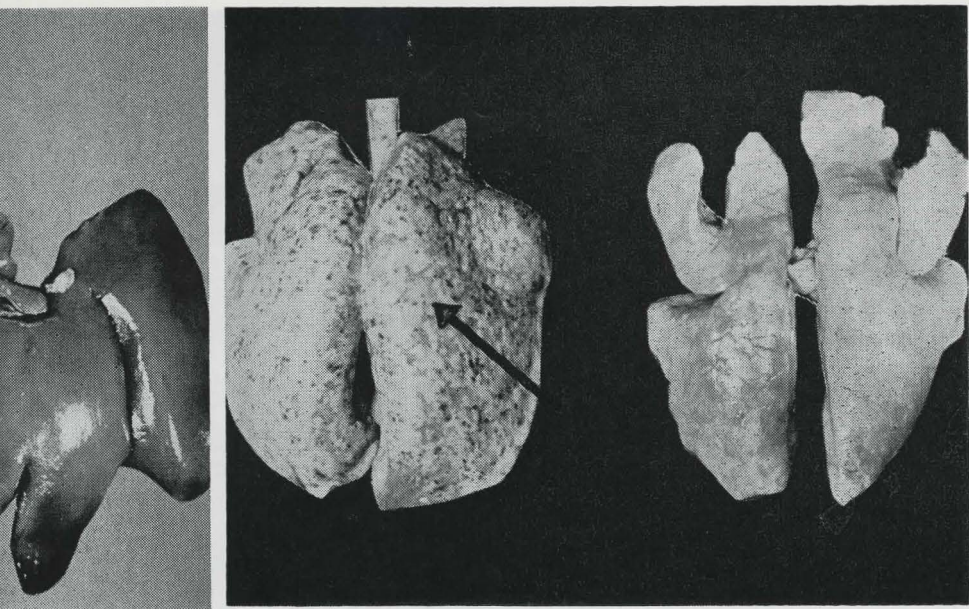


Fig. 5. Worms cause bleeding (arrow) of lungs when they burst into the air sacs. Normal lung on right.

destroy liver tissue, leading to the formation of minute abscesses, scars, cirrhosis, and granulomas (Fig. 4). When they rupture into the air sacs of the lungs they break blood vessels causing bleeding and impairment of the respiratory system (Fig. 5). Numerous young worms bursting into the lungs can produce labored breathing, thumping, and pneumonia.

The adults in the intestine secrete substances which interfere with the digestive process. They rob the pig of nutrients and at times form a knot which blocks passage through the intestine, resulting in death of the pig. The adults crawl up any tube and frequently become lodged in the bile duct, stopping it up (Fig. 6). This results in the bile being distributed throughout the flesh, making it unsuitable for food

—a common cause for condemning swine carcasses at slaughter houses.

Probably the greatest loss caused by *A. suum* results from increasing the severity of respiratory infections by migrating worms. Professors Underdahl and Kelley (University of Nebraska) found that virus pneumonia was ten times more severe in pigs with migrating worms than in pigs without worms (Fig. 7). Underdahl has observed similar effects in swine influenza. Prevention of the migratory phase is of great importance and can only be brought about by eliminating the egg-producing adult females by planned treatment coupled with pasture rotation.

### WORM REMEDIES

The usefulness of a worming remedy depends upon: (1) how it

must be given, (2) how poisonous it is to the pig, (3) its ability to remove both young and old parasites and, (4) its cost.

Remedies that can be mixed into feed or drinking water are more practical for treatment of herds of livestock than those that must be given individually.

Worm remedies are poisonous to a degree, since they must kill the worms, which are in some respects similar to the host. In general, the newer wormers are more poisonous to the worms than to the host and can be given safely, if reasonable care is used. This is especially true of the piperazines. Some worm remedies previously used were so poisonous that, although they removed the parasites, the treatment was almost as severe as the disease.

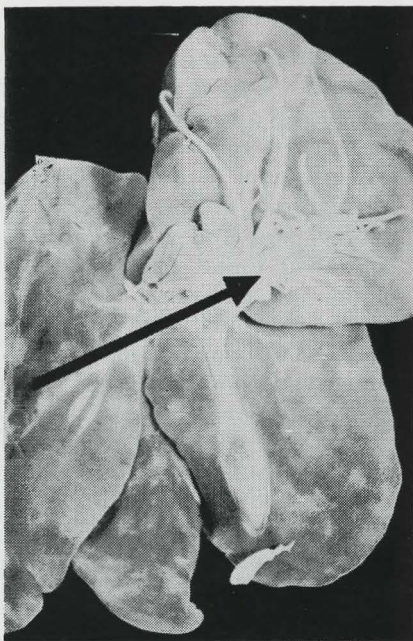


Fig. 6. Adult worms often crawl into the gall bladder tube (arrow) obstructing bile flow and causing jaundice in the pig.

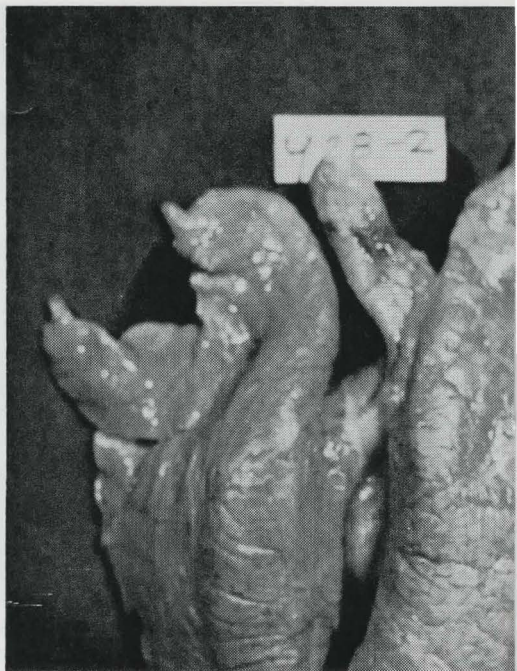


Fig. 7. The migrating worms increase severity of r the right had virus pneumonia when wor

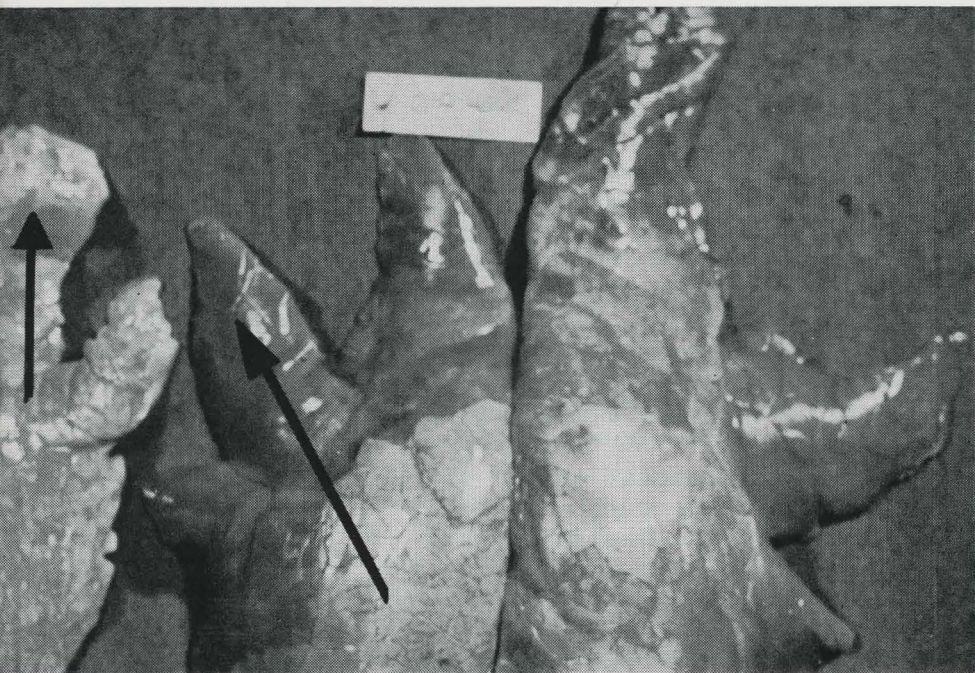
Young worms are generally harder to kill with drugs. It is important that the remedy kill them; otherwise they mature and lay eggs between treatment periods, unless treatment is administered continuously.

The cost of the treatment may be offset by additional production by the animal being treated and by fewer worms in future pigs. But you must carefully consider the unit cost of the treatment in your choice of remedies.

### Application

1. **Skim milk.** U.S.D.A. scientists reported in 1944 that many worms were eliminated when skim milk was substituted for feed and water for three days. In a 1955 trial at the





spiratory infections. The lungs at left had only virus pneumonia (VPP) while the two lungs on the right were moving through the lungs. Darkened areas (arrow) are regions of pneumonia.

North Platte Experiment Station, North Platte, Nebraska, poor results were obtained with this remedy. However, the pigs in this experiment had access to pasture forage which may have reduced the purging effect of the skim milk.

**2. Sodium fluoride.** Sodium fluoride was introduced as a worm remedy in 1945 when the U.S.D.A. found that it removed 97 per cent of the worms from pigs. This compound is highly poisonous, being tolerated by pigs simply because of their ability to vomit up poisonous substances. When directions are followed, sodium fluoride can usually be given with no difficulty; however, poisonous effects are sometimes experienced.

Sodium fluoride is given by mixing one (1) pound of the drug into 99 pounds of feed (1%). The feed is then placed before the animals for only 24 hours and excess feed remaining in the troughs at the end of this period must either be picked up or carefully mixed into the next day's ration.

The ration must be dry or poisoning may result. Pigs do not like the taste of sodium fluoride and as a result will eat less feed than usual; therefore, only about one half of the usual ration should be mixed for the treatment.

Sodium fluoride is highly effective against *A. suum*, the large roundworm, but has only slight effect against other parasites of swine. It effectively removes the



young worms as well as the adults.

This is probably the cheapest worm remedy available. In the North Platte trial it cost only four cents to treat a 100 pound pig.

**3. Cadmium oxide.** Cadmium oxide has been shown to effectively remove 98 per cent of the worms when fed for three consecutive days as 0.015% of the diet. No tests of effectiveness of cadmium oxide have been made at the University of Nebraska but others have reported that feeds containing 0.015% are palatable and well tolerated.

**4. Cadmium anthranilate.** The worm-killing properties of cadmium anthranilate were discovered in 1954. When this compound is added to the diet for three consecutive days it removes 90% of the worms.

Cadmium anthranilate is much less poisonous than sodium fluoride and can be fed at ten times the recommended level with no poisonous effects. However, the cadmium is not readily excreted and accumulates in the liver and kidneys to the extent that treated pigs must be held for 30 days before slaughter. This is also true of cadmium oxide.

Cadmium anthranilate is sold in a premix which, when mixed with feed at the rate of one pound premix to 99 pounds feed, yields a mixture of 0.044 per cent cadmium anthranilate. This mixture is fed as the complete diet for three consecutive days.

The 1955 North Platte trial indicated that cadmium anthranilate missed some of the young parasites. The compound is also slow acting, requiring about 14 days to get full effect of the treatment. For this

reason, large numbers of expelled worms are not usually evident in treated pens as are seen with other remedies.

In the North Platte trial it cost 19 cents to treat a 100-lb. pig with cadmium anthranilate.

**5. The Piperazine Compounds.** The piperazine compounds were introduced as wormers in 1947 and since 1955 they have been intensively applied by swine raisers. Various salts of piperazine are being sold—citrate, dihydrochloride, adipate, hexahydrate, etc.; however, it appears that only the piperazine part of the compound has worming activity. The piperazine products have a wide margin of safety, being practically non-poisonous for swine, other domestic animals and man. They are generally given by putting them into the feed or drinking water.

Dosages are based on the average weight of the pigs and the remedy must be consumed within a short period of time. For this reason, the animals are generally fasted for nearly 24 hours prior to treatment and the piperazine is mixed into a fraction of the total ration.

There is a possibility that some animals will be crowded away from the troughs before a full treatment can be consumed. If so, some pigs may retain a few of their worms, and may infect future inhabitants.

Piperazine adipate cost 37 cents per 100 lb. pig in the 1955 North Platte trial but this cost has been reduced within the past two years.

**6. Betaine of 1-piperazine carbodithioic acid.** Although this compound is related to the piperazines it is separated from them because it

breaks down in the stomach into piperazine and carbon disulfide, both effective wormers.

Betaine of 1-piperazine carbo-dithioic acid is sold in this country under the name of Parvex. Parvex is relatively non-poisonous to domestic animals; however, it may irritate the lining of the stomach, leading to vomiting if an excessive amount is given. It is mixed into  $\frac{1}{4}$  ration at the rate of 0.26 grams per pound body weight. This preparation is placed before the animals after about 20 hours of fasting. Further feed should be withheld for eight hours. Worms will be present and readily seen in the droppings by the next morning.

Parvex is highly effective against worms, but some pigs are occasionally crowded away from the medicated feed, which causes some infections to be missed. In the 1955 North Platte trial the Parvex-treated pigs had an initial count of 825 eggs per gram which was reduced to 5.6 EPG after 8 days and had risen to only 52 eggs per gram after 47 days. This is comparable in efficiency to sodium fluoride but it apparently misses some young worms, hence the increased egg count 47 days following treatment.

In the 1955 trial it cost 27 cents to treat 100-lb. pigs with Parvex.

**7. Hygromycin B** is an antibiotic which is one of the fermentation products of *Streptomyces hygroscopicus*, a mold found in the woods near Indianapolis, Indiana. Hygromycin B has a wide margin of safety and can be tolerated in doses several times higher than the effective recommended dosage. Hygromycin B is added to the diet at

the level of 12,000,000 units per ton and is fed continuously for an indefinite period.\*

Originally it was recommended that hygromycin B be fed for only 60 days. This period was later extended to 100 days and presently it is being suggested that this remedy be given throughout the entire life time.

Hygromycin B is highly effective and more nearly meets the requirements of an ideal wormer than any of the former compounds. In the 1957 North Platte trial it eliminated almost all of the worms.

Hygromycin B also resulted in an increased gain and more efficient feed utilization. In the 1957 North Platte trial it cost 20 cents to feed hygromycin B to pigs for 60 days after they reached 30 pounds.

There are no satisfactory treatments for the migratory stage of the *Ascaris* infection. Tests conducted at the University of Nebraska indicate that although hygromycin kills *Ascaris* within the intestine, it will not kill the migrating worms. When hygromycin B is fed while the young worms are migrating smaller worms will result, but they are able to establish themselves within the intestine in spite of their small size and hygromycin bath.

## CONTROL PROGRAM

The aim of a worm control program is to reduce or eliminate the scattering of eggs onto swine lots. This will result in breaking the life cycle of the parasite, reducing and eventually eliminating parasitic in-

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\*Hygromycin B is sold in a premix called Hygromix which contains sufficient antibiotic so that five pounds mixed into a ton of feed yields the desired level.



fections in future inhabitants. The parasite must be attacked at this point in order to prevent damage by worm migration in succeeding pig crops.

No females should be allowed to mature. This is accomplished by a planned treatment program. Almost any of the commonly used treatments will accomplish this if properly applied. It appears that the application of hygromycin B is the simplest protection against *Ascaris* egg production; however, any of the piperazines will accom-

lish the same end if applied at frequent intervals.

In addition to reduction of egg production, pigs should be frequently rotated to fresh premises. Rotation is most effective when done shortly following farrowing. It is recommended that the sow be brought into the farrowing house and thoroughly scrubbed. After farrowing the sow and litter should be hauled to clean ground. These sanitation practices help protect the baby pigs from damaging, infective *Ascaris* eggs.

Table of Worm Remedies

Compound	Toxicity	Efficiency	Cost*	Administration
Skim milk	non-poisonous	Low	—	All feed and water replaced with skim milk for 3 days.
Sodium fluoride	high	Good	0.05/pig	1 lb. sodium fluoride thoroughly mixed into 99 lbs. feed and fed dry for 24-hour period. Mix only $\frac{1}{2}$ usual ration.
Cadmium anthranilate	slight <sup>1</sup>	Fair	.19	Bought as a premix which is added 1 lb. to 99 lbs. of feed and fed dry for 3 days—makes a mixture of 0.044% cadmium anthranilate.
Cadmium oxide <sup>2</sup>	slight <sup>1</sup>	Fair	—	As cadmium anthranilate above.
Piperazines	very low	Good	.30	Includes numerous remedies introduced since 1955—are added to ration for one day or put into drinking water according to directions of manufacturer—in some cases too small a dose has been recommended to cut cost.
Hygromycin B	low	Excellent	.20	Sold in premix called Hygromix which is added to ration at rate of 5 lbs. per ton of feed and fed continuously for varying lengths of time.

<sup>1</sup> Residue in flesh; animals cannot be slaughtered until 30 days following treatment.

<sup>2</sup> We have had no actual experience with this compound.

\* Based on costs for medicaments in 1955 and 1957 North Platte trials.

### **ACKNOWLEDGMENT**

Mr. James Adams, Superintendent, North Platte Experiment Station, and the members of the University of Nebraska Department of Animal Husbandry have been most generous in providing swine for the evaluation of commercial worm remedies.



# **Controlling the Large Roundworm In Swine**

**Each female worm lays up to 2 million eggs daily.**

**This egg source must be eliminated to prevent worms in baby pigs.**

**The merits and application of commonly used wormers for removing this egg source are presented in this circular.**