

Poultry Coccidiosis Control by the Chemical Treatment of Litter*

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ATTEMPTS to control on a practical scale the various coccidiosis of poultry have in the past been either unsuccessful or unprofitable. The object of this paper is to indicate a simple method of coccidiosis control by the chemical treatment of litter and to describe briefly the experiments demonstrating the value of the method (Andrews, 1933).

EXPERIMENTAL

Object.—The object of the first experiment described was to test the effectiveness of this preparation in controlling coccidiosis under conditions of good and of poor sanitation, other things being as nearly equal as possible.

Descriptive.—The experiments were conducted in various pens of a ten-section Shenandoah brooder-house. The floor space in each pen was 240 square feet (10 by 24 feet). The sections were separated by low wooden partitions which were continued nearly to the roof with wire netting. The hovers at the rear were heated by a hot-

water system. Water from an artesian well was piped to each pen, and was maintained at a constant level within each fountain by means of automatic valves. The floors were of wood. Pine shavings were used as litter, one bale (about 60 pounds) in each pen after each cleaning.

Feed in metal hoppers was kept before the birds at all times. They were fed exclusively on the dry mash mixture which was in use on the premises. Its composition is as follows:

- 150 lbs. yellow corn meal
- 100 lbs. wheat bran
- 100 lbs. red dog (wheat) flour
- 100 lbs. oat flour
- 50 lbs. dried skim milk
- 25 lbs. 55 per cent beef scrap
- 25 lbs. fish meal
- 50 lbs. alfalfa leaf meal
- 15 lbs. linseed oil meal
- 10 lbs. calcium carbonate
- 3 lbs. sodium chloride

The chemical spray used was a mixture of coal-tar acids in a light mineral oil known as "Toxite."** The apparatus used to spray the floors and litter was a ten-gallon hand-

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** The name "Toxite" has been registered at the U. S. Patent Office by the Truslow Poultry Farm, Inc. to describe the chemical used in the patent-applied-for process of treating litter to control diseases which are transmitted by contaminated litter. Its exact composition has not been made public, but judging from its appearance and odor, the base is a mixture of the higher phenols. The name "Toxite" is used throughout this publication as a matter of convenience in referring to this preparation.

power pump sprayer of the type which is ordinarily employed in spraying insecticides on trees.

Procedure.—The first and second sections of the brooder-house were thoroughly cleaned and were supplied with new litter. One pen was sprayed with toxite (one quart to 100 square feet of floor area) and was similarly treated† once each week thereafter; the other received no toxite at all. Two hundred and fifty White Leghorn chicks sixteen days old were carefully counted and weighed into each pen. These chicks had been removed from the incubator to electric batteries where they were maintained until used in an experiment. These two pens referred to as “clean pens” were each cleaned and supplied with fresh litter once a week, and were otherwise similarly managed except that one received toxite each week whereas the other did not.

The ninth and tenth sections of the same brooder-house were occupied by broilers and had not been cleaned for about a week. The birds were removed, but the old litter was left in the pens. The previous occupants of these pens had shown no evidences of coccidiosis, so to insure the presence of infective organisms the litter was deliberately contaminated with oöcyst-containing material. A quantity of litter obtained from another poultry farm where coccidiosis had been prevalent was thoroughly stirred until its coöcidia content was presumably uniform throughout. Eight and one-half pounds of this infective litter were scattered upon the old litter in each of the pens. One pen was immediately treated with toxite (one quart to 100 square feet of floor area) and was similarly treated once each week thereafter. The other pen received no

toxite. Two hundred and fifty chicks of the same hatch and history as those used in the clean pens were liberated into each pen. These pens were not cleaned until three weeks after the beginning of the experiment. With the exception of the fact that one pen was sprayed with toxite each week while the other was not, these two pens, referred to as the “dirty pens,” were both managed in the same way.

With the exception of cleaning and spraying with toxite, all pens were treated as nearly alike as possible. No precautions were taken to avoid tracking infective material from one pen to another. Inasmuch as the work was done on a poultry farm where the opportunities for the mechanical transfer of various species of oöcysts from one part of the farm to another were numerous, no attempt was made to restrict the number of species of coccidia involved.* In all probability, each of the known species was well represented. It was desired above all else to test the efficiency of toxite in controlling coccidiosis under the usual conditions which might be expected to prevail on a well-kept (sanitary) poultry farm, “clean pens,” in contrast to the usual conditions existing on a dirty, poorly-managed farm, “dirty pens.”

Dead birds were removed from the pens early each morning and late each afternoon. They were immediately autopsied with the particular objective of determining whether or not evidences of coccidiosis existed at the time of death. Birds were recorded as dying *with*, not *from*, coccidiosis (or “coccidia found”) if oöcysts, merozoites, or schizonts were found. Coccidial parasites

*It was definitely ascertained that *Eimeria tenella* Railliet and Lucet, 1891), *E. maxima* Tyzzer, 1929, *E. acervulina* Tyzzer, 1929, and *E. necatrix* Johnson, 1930, were present. It is probable that *E. mitis* Tyzzer, 1929, and *E. praecox* Johnson, 1930, were also present, but they were never definitely identified.

† If birds were in the pen during this operation, they were temporarily confined in a corner while the remainder of the floor was being sprayed. The birds were liberated immediately thereafter, and the area which they had occupied was treated.

may figure as (1) the direct and sole cause of death, (2) as a contributory cause of death, or (3) as having no relation whatever to the death of the host. Because in many cases it is impossible to determine the causal relation of the coccidia to the death of the bird, it has been a matter of convenience to include all the birds in which coccidia were found at death in one group, and those in which no coccidia were found in another.

the chicks were hatched. Owing to the necessity of separating the cockerels from the pullets, it was concluded approximately seven weeks later.

The final results of this experiment are shown in Table 1. The relative total mortalities per week with coccidiosis for each pen are shown in Figure 1; comparative costs per pen in terms of feed consumed are shown in Figure 2.

Briefly summarized, the following conclu-

TABLE 1. Mortality, weights, and feed consumption in Experiment I

	Clean pens*		Dirty pens†	
	No Toxite	Toxite‡	Toxite‡	No Toxite
Total number of chicks started.....	250	250	250	250
Number of chicks dying—Total.....	35	23	29	136
—No coccidia found.....	14	16	19	15
—Coccidia found.....	21	7	10	121
Mortality in percent—Total.....	14.0%	9.2%	11.6%	54.4%
—No coccidia found.....	5.6%	6.4%	7.6%	6.0%
—Coccidia found.....	8.4%	2.8%	4.0%	48.4%
Final pen weight.....	237.0 lbs.	244.0 lbs.	248.0 lbs.	116.5 lbs.
Total feed consumption§.....	853.0 lbs.	879.0 lbs.	771.0 lbs.	512.0 lbs.
Pounds of feed consumed in producing one pound of bird.....	3.6lbs.	3.6lbs.	3.1lbs.	4.5lbs.

N.B. This experiment commenced when the birds were 16 days old and was concluded seven weeks later.

* Cleaned once each week.

† Cleaned at end of third week; not cleaned thereafter.

‡ Toxite applied once each week.

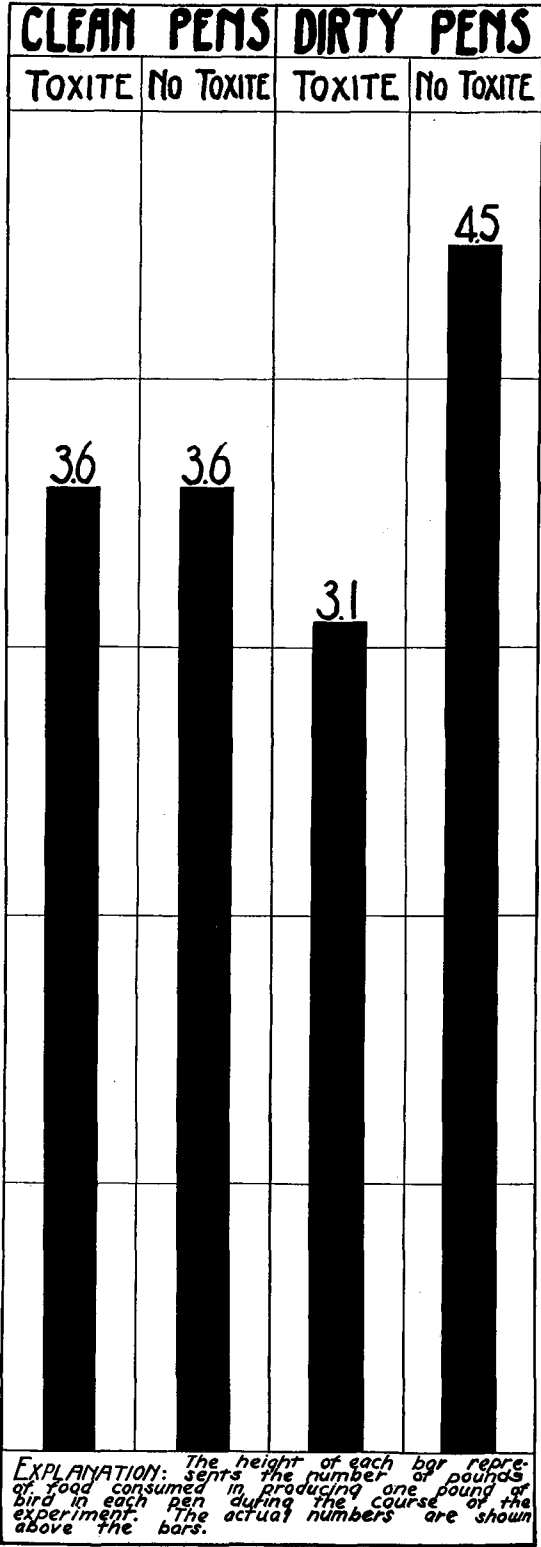
§ Total feed consumption after the chicks were 16 days old; feed consumption during the first 15 days was not determined but was presumably about the same for each pen.

Each pen of birds was weighed each week. The dry mash was weighed into each pen. Accordingly it was possible to record the approximate feed consumption of each pen.

In order to permit poultrymen to adjust the economic significance of these results to their own local conditions, the amount of feed consumed in producing one pound of live bird has been reckoned from the above data.

Results.—This experiment was commenced on June 4, the sixteenth day after

sions in respect to the clean pens seem justified: (1) while the difference in total mortality was not great, it was in favor of the toxite pen; (2) the weight of the birds in the toxite-treated pen exceeded that of the untreated group; (3) the ration between feed consumed and weight produced was the same for both pens. The use of toxite in clean pens did not reduce the cost of production as measured by the ratio between feed consumption and pen weight. From purely economic considerations, therefore, the use of toxite with weekly cleaning does



not seem to be justified. From the standpoint of taking all precautions possible to prevent coccidiosis, the combined procedure is undoubtedly desirable.

The results in the dirty pens were much more spectacular and may be summarized as follows: (1) the birds in the toxited pen remained thrifty, active, well-plumed, and were less variable in size, whereas their mates in the non-toxited pen were poorly feathered, pale, sluggish, dejected-looking, and varied greatly in size; (2) for every

experiment is that toxite has been demonstrated to be highly effective in controlling coccidiosis under practical conditions of either good or bad sanitation.

Confirmation.—While the deductions from the above experiment seem to be unequivocal, another experiment differing only in details was conducted in an attempt to verify (1) the action of toxite under conditions of inadequate sanitation; (2) the length of time that toxite alone would protect flocks from coccidiosis; and (3)

TABLE 2. *Mortality, weights, and feed consumption in Experiment II*

	No Toxite	Toxite base in oil*	Toxite base in water*
Total number of chicks started.....	200	200	200
Number of chicks dying—Total.....	127	92	116
—No coccidia found.....	29	49	42
—Coccidia found.....	98	43	74
Mortality in per cent—Total.....	63.5%	46.0%	58.0%
—No coccidia found.....	14.5%	24.5%	21.0%
—Coccidia found.....	49.0%	21.5%	37.0%
Final pen weight.....	78.0 lbs.	111.5 lbs.	89.5 lbs.
Total feed consumption†.....	598.0 lbs.	690.0 lbs.	644.0 lbs.
Pounds of feed consumed in producing one pound of bird..	7.7 lbs.	6.2 lbs.	7.1 lbs.

* Applied once each week.

† Total feed consumption after the chicks were 14 days old; feed consumption during the first 14 days was not determined but was presumably about the same for each pen.

bird dying with coccidiosis in the toxited pen, twelve died in the non-toxited pen; (3) over twice as many pounds of salable poultry meat were produced in the treated pen; and (4) it cost 1.4 lbs. of feed less to produce each pound of bird in the pen in which toxite was used.

These results show that weekly application of toxite is at least as good as weekly cleaning from the standpoint of coccidiosis control. Actually the ratio between feed consumption and meat production was less by a significant fraction of a pound (0.5 pound) in the dirty pen receiving toxite treatment than in either clean pen.

The conclusion to be derived from this

whether or not a disinfectant chemically identical with toxite except that it was emulsified in a soap solution instead of being dissolved in oil would be as effective in controlling coccidiosis.

In this experiment consecutive sections in the center of the same brooder were used. They were thoroughly cleaned and supplied with fresh litter. Each pen was deliberately contaminated with twenty pounds of litter which had first been removed from the dirty non-toxited pen of the first experiment. This litter had been shoveled back and forth on the floor until the oöcyst-content was presumably homogeneous. Before placing chicks on the litter, one pen was

sprayed with toxite, and one with the water-borne mixture of coal-tar acids. These pens were similarly sprayed each week. The third pen was left untouched.

Two hundred fourteen-day-old Barred Rock chicks were removed from the electric batteries which had housed them since hatching, and were counted, weighed, and liberated into each pen. As in the first experiment, all pens were treated alike. The birds were weighed each week, and their feed was weighed into each pen. This experiment was commenced on June 28, and the temperature and humidity throughout

to huddle at night in pen corners as they chose, rather than being trained to roost properly. As a consequence the general mortality was high, and the birds did not eat or grow as well as in the first experiment.

Final mortality figures, weights, and feed consumption in these pens are shown in Table 2. Inasmuch as the "dirty pens" in Experiment 1 were not cleaned for the first three weeks, a comparison of the mortalities and feed-weight ratios can be made with the first three weeks of Experiment 2. This has been done in Table 3. After three weeks

TABLE 3. *Comparison of mortality and feed-weight ratios in dirty pens during first three weeks of Experiment I and Experiment II*

	Experiment I		Experiment II	
	No Toxite	Toxite	No Toxite	Toxite
Total number of chicks started.....	250	250	200	200
Number of chicks dying—Total.....	114	18	48	27
—No coccidia found.....	7	12	12	20
—Coccidia found.....	107	6	36	7
Mortality—Total.....	45.6%	7.2%	24.0%	13.5%
—No coccidia found.....	2.8%	4.8%	6.0%	10.0%
—Coccidia found.....	42.8%	2.4%	18.0%	3.5%
Pounds of feed consumed in producing one pound of bird.....	3.7 lbs.	2.1 lbs.	3.0 lbs.	2.1 lbs.

the duration of the experiment were very difficult for the birds to endure.

It is to be emphasized that in this experiment it was the deliberate intention to duplicate the conditions of careless management typical of many farm flocks in order to test the limits of the effectiveness of toxite under the worst possible conditions of sanitation and management. The pens were not cleaned at all during the first seven weeks of the experiment. No attempts were made to anticipate and to make proper adjustment for temperature changes. Windows were not closed during rainy weather nor when the direction of the wind exposed the birds to drafts. Birds were permitted

the two experiments differed from each other materially from the standpoint of management and sanitation, and therefore cannot be fairly compared after that period.

Briefly summarized, the results of the second experiment were as follows: (1) within the first three weeks (the period of time comparable to the interval *before* cleaning in the first experiment), severe coccidial epidemics occurred in the non-toxited pen and the pen which had been sprayed with the water-borne coal-tar acid mixture, but no coccidial epidemic had occurred in the toxited pen; (2) toxite, in the absence of any cleaning, protected the toxited pen for a period of about four weeks, a coccidial

epidemic taking place in the fifth week; and (3) the epidemic in the pen treated with the water-borne coal-tar acid mixture made its appearance in the same period of time to a day as in the untreated pen, the pre-epidemic period in each pen being sixteen days.

The deductions to be made from these results are (1) that the activity of toxite in controlling coccidiosis under conditions of poor sanitation as indicated in the first experiment was confirmed in the second; (2) that toxite without cleaning protected a flock under the most trying conditions of contamination and weather for at least four weeks; and (3) that the toxite base carried in water was not effective in controlling coccidiosis when compared directly with toxite base in oil.

This last point is of especial interest since the water-borne disinfectant mixed for the experiment corresponded in all essentials to the commercial coal-tar acid disinfectants dispensed for farm sanitation purposes in general, and frequently for poultry sanitation in particular, except that it was at least twice as strong chemically.

The fact that toxite was able to protect flocks from coccidiosis for three weeks without cleaning but not for more than four weeks indicates that for satisfactory results, weekly applications of toxite should be supplemented by regular cleaning. Inasmuch as the necessity for cleaning varies with every situation in respect to number and age of birds, floor area, type and amount of litter, diet, and other factors, the best rule by which to regulate the interval between cleanings is probably the empirical one of cleaning the premises as often as they be-

come dirty. There is every indication that, with regular weekly applications of toxite, the above rule may be safely followed *provided* the interval between cleanings is not greater than three weeks.* Cleaning at least once a week is preferable if coccidiosis is present.

CONCLUSIONS

1. The spraying of toxite on litter once each week has controlled poultry coccidiosis of various types under conditions of poor sanitation and deliberate contamination.

2. In the absence of cleaning, toxite protected a flock against coccidiosis for four weeks but not for five. Regular weekly application of toxite, supplemented by cleaning and removal of litter at least every three weeks, is recommended to control coccidiosis successfully.

3. A water-borne mixture of toxite base of the same chemical strength as toxite had apparently no value in controlling coccidiosis.

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* While it has been shown that the flock was protected for *four* weeks without cleaning, it is felt that in order to give a reasonable margin of safety, the intervals between cleaning and litter replacement should not be greater than *three* weeks.