Bulletin No. 327 - Control Livestock Pests

University of Wyoming Agricultural Experiment Station

Follow this and additional works at: http://repository.uwyo.edu/ag_exp_stabulletins

Part of the Agriculture Commons

Publication Information
University of Wyoming Agricultural Experiment Station (1953). "Bulletin No. 327 - Control Livestock Pests." University of Wyoming Agricultural Experiment Station Bulletin 327, 1-56.
# CONTENTS

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>3</td>
</tr>
<tr>
<td>Insecticides</td>
<td></td>
</tr>
<tr>
<td>DDT</td>
<td>4</td>
</tr>
<tr>
<td>Methoxychlorin</td>
<td>6</td>
</tr>
<tr>
<td>Toxaphene</td>
<td>6</td>
</tr>
<tr>
<td>Chlordane</td>
<td>6</td>
</tr>
<tr>
<td>Dieldrin</td>
<td>8</td>
</tr>
<tr>
<td>Benzen Hexachloride</td>
<td>8</td>
</tr>
<tr>
<td>Lindane</td>
<td>9</td>
</tr>
<tr>
<td>Pyrethrum</td>
<td>9</td>
</tr>
<tr>
<td>Allethrin</td>
<td>9</td>
</tr>
<tr>
<td>Rotenone</td>
<td>9</td>
</tr>
<tr>
<td>Sulfur</td>
<td>9</td>
</tr>
<tr>
<td>Thanite and Lethane</td>
<td>10</td>
</tr>
<tr>
<td>Hazards in Using Insecticides on Livestock</td>
<td></td>
</tr>
<tr>
<td>General Parasites</td>
<td>11</td>
</tr>
<tr>
<td>House Flies</td>
<td>11</td>
</tr>
<tr>
<td>Mosquitoes</td>
<td>15</td>
</tr>
<tr>
<td>Black Flies</td>
<td>16</td>
</tr>
<tr>
<td>Fleas</td>
<td>17</td>
</tr>
<tr>
<td>Cattle Parasites</td>
<td>18</td>
</tr>
<tr>
<td>Cattle Lice</td>
<td>18</td>
</tr>
<tr>
<td>Cattle Grubs and Heel Flies</td>
<td>21</td>
</tr>
<tr>
<td>Horn Flies</td>
<td>26</td>
</tr>
<tr>
<td>The Stable Fly</td>
<td>27</td>
</tr>
<tr>
<td>Horse Flies and Deer Flies</td>
<td>29</td>
</tr>
<tr>
<td>Cattle Scab</td>
<td>30</td>
</tr>
<tr>
<td>Ticks</td>
<td>31</td>
</tr>
<tr>
<td>Winter Tick</td>
<td>32</td>
</tr>
<tr>
<td>Rocky Mountain Wood Tick</td>
<td>33</td>
</tr>
<tr>
<td>Ear Tick</td>
<td>35</td>
</tr>
<tr>
<td>Sheep Parasites</td>
<td>37</td>
</tr>
<tr>
<td>Sheep Ked (Sheep Tick)</td>
<td>37</td>
</tr>
<tr>
<td>Wool Maggots</td>
<td>40</td>
</tr>
<tr>
<td>Sheep Scab</td>
<td>42</td>
</tr>
<tr>
<td>Sheep Bot Fly</td>
<td>44</td>
</tr>
<tr>
<td>Horse Parasites</td>
<td>45</td>
</tr>
<tr>
<td>Horse Lice</td>
<td>45</td>
</tr>
<tr>
<td>Horse Bot Flies</td>
<td>45</td>
</tr>
<tr>
<td>Hog Parasites</td>
<td>48</td>
</tr>
<tr>
<td>Hog Louse</td>
<td>48</td>
</tr>
<tr>
<td>Hog Mange</td>
<td>49</td>
</tr>
<tr>
<td>Chicken Parasites</td>
<td>50</td>
</tr>
<tr>
<td>Chicken Lice</td>
<td>50</td>
</tr>
<tr>
<td>Mites of Chickens</td>
<td>52</td>
</tr>
<tr>
<td>Chicken Mite</td>
<td>52</td>
</tr>
<tr>
<td>Scaly-leg Mite</td>
<td>53</td>
</tr>
<tr>
<td>Depluming Mite</td>
<td>53</td>
</tr>
<tr>
<td>Northern Powl Mite</td>
<td>54</td>
</tr>
<tr>
<td>Scientific Names</td>
<td>55</td>
</tr>
</tbody>
</table>
CONTROL LIVESTOCK PESTS

By R. E. Pfadt, G. R. DeFoliart, and T. R. Robb*

Introduction

CONTROL OF INSECT PESTS of livestock is becoming more and more a regular management practice of ranchers in Wyoming. The greater adoption of insect control can be attributed to several facts: (1) wider recognition of benefits and profits resulting from control, (2) availability of more effective insecticides, (3) easier and faster methods of application, and (4) increased publicity and dissemination of control information. While modern insecticides and methods have proved to be efficient tools for the control of livestock pests, their variety has caused some confusion in the minds of ranchers. Purpose of this bulletin is to clear up some of the confusion and to provide the livestock grower with modern information and recommendations on controlling pests of livestock. Because the information is much condensed, including only the essentials, selected articles are referred to at the end of each discussion and these can be consulted for fuller treatment.

In general the arrangement of pests in this bulletin is based on the kind of domesticated animal attacked. A number of pests are injurious to more than one kind of animal but are treated only under the most important host. Each pest is discussed from the viewpoint of the kind and extent of injury which it causes, its life history, and finally its control. Some words of justification may be needed for including insect life histories. They are important because upon knowledge of them are based proper timing of treatments, successful methods of application, and control by sanitation and management practices.

Insecticides

Inasmuch as a number of different insecticides are used for livestock-pest control, the more important ones are briefly discussed in this bulletin to acquaint the livestock grower with several important facts. Most insecticides are not ready for use immediately after their manufacture. They must be combined with other chemicals or materials by a process called formulation, before they can be applied to control insects. The purpose of formulation is to put the chemicals in a physical form which permits uniform distribution of minute quantities over a large area. The common formulations of insecticides are: dusts, wettable powders, emulsifiable concentrates, oil solutions, and aerosol concentrates.

*Respectively: associate entomologist and assistant entomologist, Agricultural Experiment Station; entomologist, Agricultural Extension Service.
Dusts are usually purchased in a form and concentration ready for use. The percentage of the actual toxicant will vary according to the susceptibility of the insect to be poisoned; it usually ranges from 1 to 10 percent. Dusts can be applied by several kinds of equipment including quart jars with perforated lids, burlap bags, hand dusters, manual blower dusters, bellows dusters, and power dusters. Dusts are always meant to be applied as dusts; they are never designed for mixing with water and spraying.

Wettable powders on the other hand are designed to be mixed with water and used as washes, sprays, or dips. In the dry form in which they come they look like a dust, but in their manufacture they have been treated with chemicals which permit them to be mixed with water and to form suspensions of minute particles that will not settle out rapidly. The concentration of toxicant in wettable powders is greater than in dusts and often ranges from 25 to 75 percent. Before using a wettable powder it should always be mixed with enough water to yield the desired concentration of spray or dip. Table 1 provides information on quantities for mixing to make sprays or dips of 5, 25, or 100 gal. If other amounts are needed they can be easily calculated from the table.

Emulsifiable concentrates are solutions of toxicant in petroleum oils or other oily solvents to which has been added a chemical known as an emulsifier. This allows oils and water to mix and form emulsions. Emulsions are minute droplets of oil and insecticide distributed evenly throughout water. Emulsifiable concentrates are intended to be mixed with water before use. Amounts of toxicant in emulsifiable concentrates range from 18 to 75 percent and should be diluted with water, as indicated in Table 2, to yield desired spray concentrations.

Oil solutions are formulations in which the insecticide has been dissolved in oil. Usual concentrations of the toxicant vary from a fraction of 1 percent to 30 percent. Insecticidal oil solutions are used for space sprays, on the burlap of cable-type self applicators, in household residual sprays, and in aircraft application.

Finely divided particles of insecticide in air are referred to as aerosols; they are formed and propelled into the air in several ways. The instrument usually resorted to is the aerosol bomb. Pressing a button on the bomb releases a solution of insecticide in liquified gas through a small tube. Aerosol bombs are often used for producing space sprays in homes and restaurants to control house flies.

**DDT**

DDT (known chemically as dichlorodiphenyltrichloroethane), first to be discovered of a group of new and synthetic insecticides, is a widely used chemical in control of livestock pests. In its technical grade it is a white powder, insoluble in water. Relatively stable, it is degraded by cer-
### TABLE 1—Wettable Powder Amounts To Be Added To Water For A Desired Spray Concentration (After Howell)

<table>
<thead>
<tr>
<th></th>
<th>If the percentage of wettable powder is:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td>To make 100 gal. of spray use:</td>
<td></td>
</tr>
<tr>
<td>For 0.05% spray</td>
<td>7</td>
</tr>
<tr>
<td>For 0.5% spray</td>
<td>70</td>
</tr>
<tr>
<td>For 2.0% spray</td>
<td>280</td>
</tr>
<tr>
<td>To make 25 gal. of spray use:</td>
<td></td>
</tr>
<tr>
<td>For 0.05% spray</td>
<td>1.75</td>
</tr>
<tr>
<td>For 0.5% spray</td>
<td>17.5</td>
</tr>
<tr>
<td>For 2.0% spray</td>
<td>70</td>
</tr>
<tr>
<td>To make 5 gal. of spray use:</td>
<td></td>
</tr>
<tr>
<td>For 0.05% spray</td>
<td>.33</td>
</tr>
<tr>
<td>For 0.5% spray</td>
<td>3.5</td>
</tr>
<tr>
<td>For 2.0% spray</td>
<td>14</td>
</tr>
</tbody>
</table>
tain iron salts, alkaline substances, high temperatures, and at times ultra-
violet light. DDT is a slow-acting poison on insects, but it is outstanding
for its residual qualities, deposits of the material remaining effective for
several weeks. It has an undesirable quality in so far as it is absorbed by
livestock, stored in the fat for sometime, and excreted in milk. Neverthe-
less it is safe to use on livestock if label recommendations and those con-
tained in this bulletin are followed.

For control of livestock pests it has been found most effective against
house flies and horn flies.

The usual formulations of DDT for livestock-insect control are: (1) 50 percent wettable powder, (2) 75 percent wettable powder, (3) 25 per-
cent emulsifiable concentrate, and (4) oil solutions of varied concentra-
tions.

**METHOXYCHLOR**

Methoxychlor, closely related to DDT, has many similar character-
istics. It differs from DDT in that it shows little tendency to accumulate
in body fat and to be excreted in milk.

It is recommended for use on dairy animals against horn flies and
against house flies and stable flies in and around dairy barns. It is some-
what more costly than DDT, hence is not usually recommended for use on
beef animals except near slaughter time.

The usual formulations of methoxychlor are: (1) 50 percent wettable
powder, (2) 25 percent emulsifiable concentrate, and (3) oil solutions.

**TOXAPHENE**

Toxaphene or chlorinated camphene is another useful new insecticide.
It is an amber, waxy solid having a mild odor suggestive of camphor. It
is readily soluble in oils but insoluble in water.

Toxaphene is recommended for control of lice, ticks, and sheep keds
(sheep ticks). Formulations useful for needs of the livestock grower are:
(1) 40 percent wettable powder, (2) 60 percent emulsifiable concentrate
containing 6 lb. of actual toxicant per gallon, (3) 72 percent emulsifiable
concentrate containing 8 lb. of actual toxicant per gallon, and (4) 5 percent
dusts.

Toxaphene should not be used on dairy cattle.

**CHLORDANE**

Chlordane, another new synthetic insecticide, is a dark brown, viscous
liquid in its technical grade. Insoluble in water, it is relatively stable and
has good residual qualities although not quite as good as DDT.
### TABLE 2—Amount of Emulsifiable Concentrate Insecticides To Be Added To Water To Make Diluted Sprays for Fly Control (After Howell)

<table>
<thead>
<tr>
<th>Amount of Spray</th>
<th>18</th>
<th>20</th>
<th>25</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>To make 100 gal. of spray use:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 0.05% spray</td>
<td>1.1 qt.</td>
<td>1 qt.</td>
<td>1.6 pt.</td>
<td>1 pt.</td>
<td>13 oz.</td>
<td>10½ oz.</td>
<td>8½ oz.</td>
</tr>
<tr>
<td>For 0.5% spray</td>
<td>2½ gal.</td>
<td>2 gal.</td>
<td>10 pt.</td>
<td>1 gal.</td>
<td>6.6 pt.</td>
<td>5.3 pt.</td>
<td></td>
</tr>
<tr>
<td>For 2.0% spray</td>
<td>11 gal.</td>
<td>10 gal.</td>
<td>8 gal.</td>
<td>5 gal.</td>
<td>4 gal.</td>
<td>3.3 gal.</td>
<td>2.6 gal.</td>
</tr>
<tr>
<td>To make 25 gal. of spray use:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 0.05% spray</td>
<td>9 oz.</td>
<td>8 oz.</td>
<td>6.4 oz.</td>
<td>4 oz.</td>
<td>3.2 oz.</td>
<td>2.66 oz.</td>
<td>2.1 oz.</td>
</tr>
<tr>
<td>For 0.5% spray</td>
<td>2¼ qt.</td>
<td>2½ qt.</td>
<td>2 qt.</td>
<td>2½ pt.</td>
<td>1 qt.</td>
<td>1.6 pt.</td>
<td>1.3 pt.</td>
</tr>
<tr>
<td>For 2.0% spray</td>
<td>2½ gal.</td>
<td>2 gal.</td>
<td>1¾ gal.</td>
<td>1 gal.</td>
<td>3½ pt.</td>
<td>2½ gal.</td>
<td></td>
</tr>
<tr>
<td>To make 5 gal. of spray use:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 0.05% spray</td>
<td>1¾ oz.</td>
<td>1¾ oz.</td>
<td>1¾ oz.</td>
<td>5 tsp.</td>
<td>3½ tsp.</td>
<td>3½ tsp.</td>
<td>2.5 tsp.</td>
</tr>
<tr>
<td>For 0.5% spray</td>
<td>1 pt.</td>
<td>.8 pt.</td>
<td>½ pt.</td>
<td>.4 pt.</td>
<td>½ pt.</td>
<td>½ pt.</td>
<td>½ pt.</td>
</tr>
<tr>
<td>For 2.0% spray</td>
<td>4 pt.</td>
<td>3.2 pt.</td>
<td>2 pt.</td>
<td>1.6 pt.</td>
<td>1.3 pt.</td>
<td>1 pt.</td>
<td></td>
</tr>
<tr>
<td>To make 1 gal. of spray use:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 0.05% spray</td>
<td>2 tsp.</td>
<td>1¾ tsp.</td>
<td>1½ tsp.</td>
<td>1½ tsp.</td>
<td>1 tsp.</td>
<td>.6 tsp.</td>
<td>.5 tsp.</td>
</tr>
<tr>
<td>For 0.5% spray</td>
<td>3½ oz.</td>
<td>2½ oz.</td>
<td>2 oz.</td>
<td>1½ oz.</td>
<td>1 oz.</td>
<td>5 tsp.</td>
<td></td>
</tr>
<tr>
<td>For 2.0% spray</td>
<td>13½ oz.</td>
<td>12 oz.</td>
<td>10 oz.</td>
<td>8 oz.</td>
<td>6½ oz.</td>
<td>4 oz.</td>
<td>3½ oz.</td>
</tr>
</tbody>
</table>

Abbreviations used: pt.—pint; qt.—quart; gal.—gallon; tsp.—teaspoon; oz.—fluid ounce.
Chlordane is recommended for control of cattle lice and sheep keds. Formulations of chlordane in control of livestock pests are: (1) 40 percent wettable powder, (2) 50 percent wettable powder, (3) 45-48 percent emulsifiable concentrates containing 4 lb. of actual toxicant per gallon, and (4) 72-75 percent emulsifiable concentrates containing 8 lb. of actual toxicant per gallon.

Dairy cattle should not be treated with chlordane.

**DIELDRIN**

Dieldrin is a useful insecticide for residual applications to farm buildings and other structures in controlling injurious flies which use these places for resting. It is a white, crystalline solid, variously soluble in organic solvents and insoluble in water. It is a stable chemical and has prolonged residual effectiveness.

Useful formulations for the livestock grower are: (1) 25 percent wettable powder, (2) 18 percent emulsifiable concentrate containing 1.5 lb. of actual toxicant per gallon, and (3) 1 or 1.5 percent dust. To date dieldrin has not been approved for direct application to livestock, but it has proved to be effective against flies, mosquitoes, and ticks and is approved where there is no danger of contamination of human food.

**BENZENE HEXACHLORIDE**

Benzene-hexachloride, or simply BHC, a new synthetic insecticide developed in Britain and in France, has found wide use in the control of livestock pests. It is a white, crystalline solid composed of a mixture of five isomers. The term isomer refers to forms of a compound which have the same number of atoms composing the molecules but differing in the order in which the atoms are arranged. Isomers are named with letters of the Greek alphabet; the “gamma” isomer is the insecticidally active one of benzene hexachloride. Technical grade BHC contains amounts of the gamma isomer ranging from 12 to 36 percent. Because all recommendations are based on this fraction, all formulations indicate the percentage of the gamma isomer.

BHC is volatile and possesses fumigant properties, but it lacks the prolonged residual effectiveness of DDT. It also has a strong, musty odor which precludes its use where tainting of foods are likely. BHC is effective against lice, ticks, and mites. Formulations most useful to the livestock grower are wettable powders. These will vary in gamma isomer content from 6 to 12 percent or more. Dilution data for forming desired concentrations of washes, sprays, or dips can be obtained by finding the percentage of gamma-isomer content on the label and selecting the corresponding column in Table 1.
LINDANE

Lindane is the name given to purified preparations of benzene hexachloride which contain at least 99 percent of the gamma isomer. Lindane has the distinct advantage of lacking the musty odor of BHC. It can be purchased either as 25 percent wettable powder or 20 percent emulsifiable concentrate and is in general effective against the same insects as is BHC. It can be used for fly control in dairy barns but not on the dairy animals themselves.

PYRETHRUM

Pyrethrum, unlike the foregoing insecticides, is a plant derivative, most of the pyrethrum used in this country being imported from Africa. The compound is chemically unstable and will lose an appreciable percentage of its potency during prolonged storage or exposure to air or sunlight.

It is used mainly as a knockdown agent in fly sprays and is a common ingredient of household space and residual sprays.

Certain compounds known as synergists are capable of greatly extending the toxicity of pyrethrum. Piperonyl butoxide is the most frequently used pyrethrum synergist in livestock sprays, this combination being effective against several kinds of biting flies that annoy livestock. A sulphoxide/pyrethrum combination has also shown promise against certain biting flies. Pyrethrum is relatively non-toxic to warm-blooded animals and its use is safe on dairy cows.

ALLETHRIN

Allethrin is a synthetic compound closely related to pyrethrum. It is effective against house flies but has few other uses in the livestock field. For house flies it is used in the same way as pyrethrum.

ROtenone

The main sources of rotenone are the roots of cube (Lonchocarpus) and Derris plants which grow in certain tropical areas. These materials have been widely known and used as fish poisons. Rotenone is relatively non-toxic to warm-blooded animals and has wide application as an insecticide. It is the only satisfactory material for controlling cattle grubs and can be used effectively for control of various other livestock pests including those of dairy animals. It can be purchased as wettable powders, dusts, or emulsifiable concentrates.

SULFUR

Sulfur, in combination with rotenone, has been used extensively for control of cattle lice and grubs. The form used is wettable sulfur, which
is made by adding a small percentage of wetting agent to the sulfur. There is evidence that sulfur, when used in dipping vats, assists in preparing and maintaining an even suspension of the rotenone-containing powder, and that it increases the effective life of the dip.

Lime-sulfur, formed by action of lime on sulfur, was formerly used to control scab mites of sheep and cattle, but its use for that purpose has been largely supplanted by BHC and lindane.

**THANITE AND LETHANE**

Thanite, one of the organic thiocyanates, is a dark, aromatic liquid that is applied for direct knockdown of flies or as a synergist in combination with pyrethrum.

Lethane is the commercial name for other organic thiocyanates which are used mainly as knockdown agents in fly sprays.

**Hazards In Using Insecticides On Livestock**

All insecticides are more or less toxic to man and warm-blooded animals, and they should always be handled with care. Of the materials discussed above, pyrethrum, allethrin, and rotenone are comparatively non-toxic to man and animals. Of the chlorinated hydrocarbons, methoxychlor and DDT are of a relatively low order of mammalian toxicity, toxaphene and chlordane are intermediate, and dieldrin, BHC, and lindane more highly toxic to warm-blooded animals. The chlorinated hydrocarbons vary greatly, however, in their acute and chronic toxic levels and in their toxicity to different animals. For example, DDT has a very low acute toxicity, but it is eliminated from the body more slowly than are most other insecticides.

Certain precautions should be taken in handling and applying any insecticide:

1) Avoid breathing dust, spray mist, or vapors as much as possible.
2) Avoid spilling spray and liquid on the skin.
3) Wear protective clothing and change clothes as soon as you finish the job.
4) Wash face and hands thoroughly before eating.
5) Read all labels on packages and follow the directions explicitly.

Persons using insecticides should immediately stop work if any symptoms of poisoning appear and a physician should be called at once. Frequently the first symptoms are headache and nausea. While awaiting the arrival of a physician, the following measures may be applied:

If the poison has been inhaled, remove the patient to open air and give artificial respiration if needed.
If the poison has been spilled on the skin, wash immediately with large amounts of warm, soapy water. Drops or particles in the eyes should be removed by flushing with water.

If the poison has been swallowed, empty the stomach as soon as possible. This can be done by giving an emetic of warm salt solution or ground mustard and water (1 teaspoonful in a glass of warm water). Vomiting may also be induced by sticking a finger down the throat. If poisoning is by BHC, lindane, chlordane, toxaphene, or DDT, give hot tea or coffee and one ounce of epsom salts after the stomach has been emptied. The physician may administer phenobarbitol. If poisoning is by dieldrin, have victim lie down and remain quiet until arrival of physician. Medical authorities advise administering phenobarbitol immediately and repeating as often as symptoms require.

Symptoms of poisoning are in general similar for all the chlorinated hydrocarbons. As observed for sheep and cattle, they include nervousness, excited stare, tremors, diarrhea, anorexia and weight loss, paralysis, and convulsions.

Before using any insecticide, the instructions on the label should be carefully read and complied with. Dosages used should absolutely not exceed those recommended on the label. The theory "If a little is good, more is better" is not advisable when one is dealing with poisonous substances.

**General Parasites**

**HOUSE FLIES**

The house fly has been called one of the world's most dangerous insects, because of its ability to carry and transmit many kinds of disease agents—bacteria, viruses, protozoa, and parasitic worms. The fly is known to carry the causative organisms of infectious keratitis (pink eye), mastitis, anthrax, typhoid fever, bacillary and amoebic dysentery, cholera, poliomyelitis, tuberculosis, and many other diseases. The exact role the house fly plays in the transmission of diseases is known in a few cases only, but sufficient research information is available to incriminate the fly as a most important vector of several human and livestock diseases.

**Life History**

Adult house flies live for about 30 days during the summer and somewhat longer during cooler periods. They feed upon many kinds of food ranging from fecal wastes and garbage to carefully prepared dishes and may pass back and forth between these foods. Liquids are sucked directly into the digestive tract, but solids must first be dissolved by regurgitated salivary juices before they can be ingested. These juices leave light-colored spots, called vomit spots, on feeding surfaces. During feeding the fly may also pass fecal matter which forms dark-colored spots called fly specks.
Mating of house flies takes place in 2 to 12 days after the adults emerge. The female will lay 3 to 4 batches of eggs, ranging from 100 to 150 per batch, during her life time. Females prefer to lay their eggs in horse manure but they also lay eggs in human excrement, in the dung of cattle, hogs, poultry, and in a wide variety of decaying plant and animal matter. Under favorable conditions eggs will hatch within 8 to 24 hr., although this period may be prolonged by low temperatures. The young larvae develop rapidly and grow to full size in 5 to 14 days, when they cease feeding and crawl to the edge of the manure pile or to the edge of other breeding media and enter the pupal stage, which lasts from 3 to 6 days. The entire life cycle from deposition of eggs to emergence of adults requires from 8 to 20 days depending on environmental conditions such as food, moisture, and temperature. In temperate regions several generations of flies are produced each growing season. During winter the house fly either hibernates or continues development in heated barns or other kinds of buildings where breeding materials are available.

Control

The most important practice in control of house flies is the elimination of breeding sites. Four groups of materials are of special concern: (1) garbage, (2) animal manure, (3) spilled feeds, and (4) human feces. Where house flies are a problem on farms or ranches, the source of the pests is most often on the individual farms or ranches themselves, since few flies drift or migrate in from surrounding areas. Hence the solution is to find where flies are breeding on the ranch and to eliminate those sites.
Garbage can become an important source of flies on the farm or ranch, if it is not disposed of properly. It should not be dumped in some out-of-the-way place and left exposed to flies but should be either burned completely or buried under at least 24 inches of earth. For convenience garbage can be wrapped in paper and stored in tight metal containers for a few days before disposal.

Getting rid of animal excrement to prevent fly breeding is probably the most difficult problem on the farm because of the man hours needed during the busy season to do the job adequately. Ideally, accumulated manure should be spread on the fields daily, but twice weekly is fairly successful. If this recommendation is not practicable, the next best practice is to store manure in a box or a concrete pit. Wooden or metal doors close the pit from above and will keep flies out when fitted tightly. Fly breeding can also be reduced by piling manure where it will dry quickly and form a hard crust on the surface, thus making it unattractive for egg laying. Piling manure where it is exposed to soaking by surface water should be strictly avoided.

Manure can also be treated chemically with hellebore or with a mixture of calcium cyanamid and superphosphate, or with several other chemicals, to kill the eggs and maggots. A recommendation for use of calcium cyanamid and superphosphate follows: to manure added each day, sprinkle a 1:1 mixture of these two materials at the rate of 1 lb. to each bushel of manure. Watering after treatment spreads the chemicals more thoroughly and provides better control. By adding this mixture to manure, its value as fertilizer is enhanced, and fly breeding is prevented. Care should be exercised in keeping barns clean and free of accumulated manure, straw, and spilled feeds. Also, small accumulations of manure in spreaders can provide breeding sites and so should be guarded against.

Finely ground stock feeds when they become wet, form highly attractive and nutritious breeding media for house flies. For this reason special attention should be given to safe and dry storage. Any spilled feeds should be swept up and returned to the bin or, if they have become wet, they should be spread out and dried or disposed of in some sanitary way. In feed lots spilled feeds should not be left to accumulate on the ground.

Because outside toilets may also become a source of fly breeding, they should be constructed to exclude flies. Doors should fit tight, windows and ventilators should be screened, and the junction of pit and siding should be banked with earth. During the fly season the repository should be treated every other day with powdered borax or calcium chloride.

Although sanitation will greatly reduce fly numbers, some breeding will no doubt occur and necessitate using other methods to bring the pests under control. These methods include insecticidal sprays, screens, baits, traps, and swatters. The value of screen to exclude flies from barns and houses and of swatters to kill flies entering the home is well known. The use of sprays and baits is discussed below.
Two types of sprays are used in controlling house flies, namely, space sprays and residual sprays. Space sprays are those which are designed to be suspended in the air as minute droplets or mists. They are used either in enclosed places such as barns, homes, and restaurants, where they are most effective, or outdoors. They are not meant for direct application to animals. For applying space sprays in buildings a hand sprayer or a small electric sprayer can be employed. Space sprays usually consist of pyrethrum in deodorized kerosene and often contain organic thiocyanates, synergists, and DDT or methoxychlor. Fly sprays are sometimes graded on their insecticidal value as B, A, and AA, the last being the strongest. Since there are many kinds of space sprays, one should use each spray according to recommendations on the label.

Residual sprays are those which are sprayed onto surfaces such as walls, ceilings, and fences, and which kill insects when they alight on the coated surfaces and absorb some of the toxicant. These spray deposits remain effective for several weeks and have been highly successful in controlling house flies.

Because the Federal Food and Drug Administration limits the kind of residual insecticides to be used in dairy barns, control recommendations may differ from those for other buildings. The walls and ceiling of dairy barns should be sprayed with 2 percent methoxychlor (3.2 lb. of 50 percent wettable powder in 10 gal. of water) when house flies begin to appear in spring. In warm summer weather a change from methoxychlor to 0.5 percent lindane (1½ lb. of 25 percent wettable powder in 10 gal. of water) may be necessary for continued satisfactory control. Enough spray should be applied to wet the surface but not so much as to cause much run-off. A single residual spraying should last several weeks. Whenever control is not obtained, the cause may be resistance of house flies to the insecticide. Development of resistance by house flies and by several other insects to the new insecticides has become a grave problem for which a permanent solution has yet to be found. Space sprays applied two or three times a week will usually bring a resistant population under control. Recent research has also shown that an emulsion of lindane plus synergist applied as a mist spray twice each week to dairy barns and adjacent grounds provides satisfactory control.

In farm buildings and sheds other than dairy, several insecticides in addition to methoxychlor and lindane can be used for residual spray applications. Dieldrin at 0.5 percent (1 gal. of emulsifiable concentrate containing 1.5 lb. actual dieldrin per 35 gal. of water) has been found to be effective. Recent research has shown that malathion, one of the newer phosphate insecticides, has given good kills against resistant flies under field conditions. This insecticide has been approved for use as a residual spray on barns, sheds, fences, etc. but not in dairy barns or on the animals themselves. Follow label directions in using this material. Where resistance is not a problem, 2 percent DDT is effective.
In the use of all residual-type sprays, resistance of house flies to the insecticide must be carefully watched for. Reports of new research and new recommendations will appear from time to time; and a successful program of fly control may be carried out based on latest information.

Poison baits can be used to reduce house fly numbers. A safe and effective bait can be made by adding 3 tablespoons of commercial formalin and a small amount of brown sugar to 1 pt. of milk. One method of exposing the bait is to put some in a drinking glass, place a saucer containing blotting paper upside down on the top of the glass, invert the whole, and insert a piece of matchstick under the edge of the glass.

**Selected References**


**MOSQUITOES**

Mosquitoes constitute a severe nuisance to both man and animals in many areas. The problem is largely, although not entirely, rural in nature. Annoyance to livestock most often results in refusal of the animals to graze normally. Instead, they tend to bunch together on high ground or mill around in circles. Handling may be very difficult under such circumstances. The mosquito nuisance to human beings, especially in mountain recreational areas and in some irrigated areas, is so thoroughly familiar to most people that it needs no description. Although they are annoying mainly through their vicious bites, mosquitoes are also important as transmitters of encephalitis in Wyoming, as well as many other diseases in other parts of the world.

**Life History**

Most of the pest mosquitoes of Wyoming belong to the genus *Aedes*. In common with all other mosquitoes, these breed in water. Breeding places include permanent and semipermanent ponds, river flood-plain pools, irrigated meadows, snow-melt pools, marshes, and bogs.

*Aedes* mosquitoes do not lay their eggs directly in water. The eggs are deposited singly in depressions that are subject to inundation. The egg is the overwintering stage, and the larvae appear after the eggs have been flooded. The rate of development depends on the temperature, but at least a week is required for completion of the larval (wriggler) and pupal (tumbler) stages, and several weeks are required at cooler temperatures.

The number of generations per year varies with species and with environmental conditions, but most Wyoming species of *Aedes* have only one generation per year. Adults usually appear in May or June and may persist throughout the summer. They are capable of distant migrations, some species being known to fly from 5 to 20 miles from their breeding grounds.
Mosquitoes can be controlled in several ways. Methods include:
(1) elimination of breeding areas, (2) chemical destruction of larvae, and
(3) chemical destruction of adults. Although the first two methods are
cheapest and most effective in the long run, community action is generally
necessary for their success.

Chemical destruction of adult mosquitoes by means of residual sprays
is frequently more practical when the problem is to be dealt with on an
individual basis. Annoyance can be greatly reduced by spraying with DDT
building surfaces and the surrounding vegetation where the mosquitoes
rest. A hand-operated, garden-type sprayer is suitable for making such
applications. DDT should be used at a concentration of 2.5 percent and
applied at a rate of 2 to 3 lb. per acre. To make a 2.5 percent spray, use
(1) 4 lb. of DDT 50 percent wettable powder in 10 gal. of water; (2) 1
gal. of DDT 25 percent emulsifiable concentrate in 9 gal. of water. Such
treatments should provide relief during daylight hours for at least one
week.

Temporary relief from mosquitoes during picnics or in the evening
hours can be obtained by use of an aerosol bomb, but this gives no lasting
effect. Repellents applied to exposed parts of the body and sprayed lightly
on the clothing will also give temporary relief. Repellent 612, dimethyl
phthalate and indalone, or mixtures of these can be used.

As yet there is no material that can be applied directly to livestock
that will effectively protect them from mosquitoes.

Selected References
Anon. 1952. Protection against mosquitoes in mountain recreational camps. U. S. D.

BLACK FLIES
Black flies are small, bloodsucking flies which in some areas may be-
come exceedingly annoying to man or animals. They are sometimes called
buffalo gnats because of their peculiar humped thorax. The immature
stages, i.e., egg, larva, and pupa, are always found in running water; swift
mountain streams or the rapids of large rivers are ideal places for their
development. Large-area control may be accomplished by treating with
DDT the streams which act as breeding places, but such an undertaking
should be under direct supervision of a qualified entomologist. Otherwise,
harm to fish or other aquatic life may result.

For individuals such as fishermen, campers, or laborers who may be
subjected to blackfly bites, several repellents will give some relief. In field
tests 612 has generally given the best protection, but indalone, dimethyl phthalate, or a mixture of these with 612, are nearly as good. None of the repellents will last for more than a few hours, so frequent applications on all exposed areas are necessary for complete protection. Blue clothing is particularly attractive to black flies and should be avoided in areas where they are annoying.

Selected Reference

FLEAS

Fleas are small, dark brown in color, and wingless; unlike any other insects mentioned in this bulletin, they are compressed laterally or from side to side. Blood is the only food of the adult fleas, although they can live for a long period without feeding. In this area they are primarily tormentors of dogs and cats and only infrequently do they become numerous enough to rank as household pests. From the standpoint of the public health, fleas are of great potential importance as transmitters of bubonic plague.

Life History

In their development, fleas pass through four stages. The small, glintening, white eggs are deposited loosely on the host and readily fall off during movements of the animal. The slender, white larvae have chewing mouth parts and subsist entirely on organic matter, including the feces of adult fleas. After the larvae have become full grown, they spin a cocoon and pupate. The entire cycle is greatly influenced by moisture and temperature and may vary in length from only 2 or 3 weeks under favorable to many months under unfavorable conditions.

Control

For direct application to dogs, dusts containing 10 percent of DDT or 2 to 5 percent of chlordane are effective when about 1 tablespoonful is
dusted thoroughly in the hair along the back from head to tail. DDT kills the fleas slowly and causes a short period of greatly increased flea activity (consequently dog activity) immediately after treatment. Neither DDT nor chlordane should be used on cats, because during the process of cleaning themselves, they are likely to ingest enough poison to cause death. On these animals, flea powders whose active principle is either pyrethrum or rotenone are satisfactory. Particular attention should always be given to mats and areas where pets sleep. Either an insecticidal dust or a household spray is suitable.

To rid a house of flea infestation a 5 percent DDT solution is recommended. Household sprays that are formulated with DDT or chlordane in highly refined oils can be purchased for treating flea-infested floors, rugs, overstuffed furniture, and basements. Applications can be made with small hand sprayers; 1 qt. of spray will cover about 1,000 sq. ft. of surface.

When a flea buildup has occurred under a house or in the yard, a 2 percent DDT or chlordane water suspension will give good control. A 2 percent spray can be made by adding 4 lb. of 50 percent wettable DDT or chlordane to 12.5 gal. of water. A 10 percent DDT dust will also give good results.

![Adult Flea; Enlarged](After Gibson and Twinn)

**Cattle Parasites**

**CATTLE LICE**

Four species of lice infest cattle in Wyoming. Three of these, the short-nosed louse, the long-nosed louse, and the little blue louse have sucking mouth parts with which they puncture the skin of the host and suck blood. The short-nosed louse is the largest of the three and is gray in color, while the others are blue. The fourth species found on cattle is the biting louse, easily distinguished from the sucking species by its reddish-brown
color and chewing mouth parts. Biting lice do not suck blood, but when numerous they are as injurious as the sucking lice. Although nearly all untreated cattle harbor lice to some extent, the heaviest infestations are generally found on a few especially susceptible individuals. The reason why some animals are more susceptible to infestation than others is not known.

Heavy louse infestation may result in lowered milk production, loss of flesh, or stunted growth, general un thriftiness, and anemia. Occasionally in heavy infestations, lice may contribute to death. It has been reported that treated cattle make gains of $\frac{1}{3}$ to $\frac{1}{2}$ lb. more per day over similarly managed louse-infested cattle.

**Life History**

Cattle lice spend their entire life on cattle, and under Wyoming winter conditions quickly succumb if removed from the host. Similarly, the eggs will usually not hatch if they become detached from the hairs and fall to the ground, unless the weather is unusually warm. In this event the young lice must find a suitable host within 2 or 3 days or they will die. Cattle lice are never found on other animals, and lice from other animals cannot live on cattle.

Normally the oval-elongate eggs, which are either blue or opaque white, depending on the species, are glued singly to the hairs and hatch in 1 to 2 or more weeks. The young lice or nymphs are similar to the adults except for their smaller size and lighter color. The nymphs molt three times after hatching and become adult in 2 or 3 weeks. The life cycle, or period from egg to egg representing one complete generation, lasts approximately 1 month for each of the species. This fact simplifies control procedures, since measures effective for one species are also effective against the others.

Lice infestations fluctuate greatly during the season and vary from animal to animal. They are normally so low during the summer as to be indiscernible, but they begin to increase with approach of cool weather during fall and reach maximum numbers in late winter and early spring. When the weather becomes warm and cattle are again on green pastures, the number of lice declines rapidly. Seasonal fluctuations are probably influenced by temperature variations. During spring and summer the skin temperature of a cow may go well over $100^\circ$ F., which is above the maximum temperature at which lice can live and produce eggs. Light intensity, host-diet, length of hair, and other factors probably also play a role in regulating populations.

**Control**

It is best to treat for lice in October or November before the onset of cold weather, but lice should be controlled whenever they are found to be numerous. Treatment in the fall prevents heavy winter infestation.
No insecticide now in use can be counted on to give one-treatment control in Wyoming. For complete clean-up, two treatments at an interval of 14 to 18 days are necessary. Since most insecticides will not destroy the eggs, the second application is necessary to kill lice which hatched from eggs that were present at time of the first treatment. Even with those that are ovicidal, a second application is generally necessary to insure that every animal has been covered thoroughly. If any lice are left, the herd will again be generally infested within a few months.

A number of materials can be used for cattle-lice control. They may be applied as sprays, dips, washes, or dusts, although dusts are generally less effective. Two applications of any of the following formulations as sprays, dips, or washes will give good control.

1. 0.25 percent chlordane (4 lb. of chlordane 50 percent wettable powder in 100 gal. of water).
2. 0.5 percent DDT (8 lb. of DDT 50 percent wettable powder in 100 gal. of water).
3. 0.5 percent methoxychlor (8 lb. of methoxychlor 50 percent wettable powder in 100 gal. of water).
4. 0.05 percent benzene hexachloride (7 lb. of benzene hexachloride wettable powder, 6 percent gamma isomer, in 100 gal. of water).
5. 0.05 percent lindane (1.5 lb. of lindane 25 percent wettable powder in 100 gal. of water).
(6) 0.5 percent toxaphene (10 lb. of toxaphene 40 percent wettable powder in 100 gal. of water).

(7) 1 lb. of cube or derris (containing 5 percent rotenone) in 100 gal. of water.

A spreader such as soap chips, detergents, or commercially available products made for this purpose should be added to each of the formulations. Each of the insecticides listed above can be obtained and used as emulsions after the proper amount of water has been added. Emulsions should be used at the same concentrations as suspensions made from wettable powders. For use in dipping vats, wettable powders are safer than emulsions since the latter may sometimes break in certain types of water. If rotenone dip is used, wettable sulfur should be added in the ratio of 10 lb. of sulfur to 1 lb. of rotenone.

If a power sprayer is used, the spray should be applied at 200 to 400 lb. per square inch nozzle pressure and at a rate of about 2 gal. per animal, or whatever amount is necessary to soak the animal completely. The spray stream should be directed to every part of the body with particular attention to the head and underline. Not more than 7 or 8 cows should be enclosed in the spraying pen at one time since more than this make it difficult to do a thorough job on each one.

Benzene hexachloride and lindane should not be used on calves less than 2 or 3 months of age and none of the above insecticides, except methoxychlor and rotenone, should be used on dairy cows, since small amounts are excreted in the milk.

Selected References

CATTLE GRUBS AND HEEL FLIES

Cattle grubs and heel flies are among the most destructive insect pests that attack cattle. Grubs, or warbles, which are commonly found in cysts on the backs of cattle from December to July in Wyoming, are the larval or immature stage of heel flies. Both larvae and adults injure cattle. Grubs in the backs of cattle cause much irritation and allow the secondary invasion of bacteria which produce large amounts of pus and poison. Sometimes the grubs, in migrating through the animal’s body, enter the spinal canal, injure the nerve cord, and thereby cause paralysis. Besides the losses sustained on live animals due to grubs, losses are also encountered when animals are slaughtered. Hides of grubby cattle are peppered with holes, and hides having five or more grub holes are classed as No. 2 and are dis-
counted 1c per pound. Another slaughter loss results from the fact that the backs of grubby carcasses require trimming, 12,000,000 lb. of the choicest meat being lost annually.

Much injury is also caused by the adult stage. Heel flies in attempting to lay their eggs on the hairs of cattle produce an uncontrolled fear which causes animals to run wildly. Cattle constantly attacked by heel flies do not graze and feed properly, but lose weight. Many times animals will injure themselves in their mad attempts to escape the attacks of flies. Animals being chased have a characteristic way of holding their tails high in the air as they run. During the heel-fly season, herding cattle becomes impossible except in the early morning or in the evening, when the flies are inactive.

Cattle of all breeds are the normal hosts of cattle grubs.

There are two kinds of cattle grubs—the common cattle grub and the northern cattle grub. The former is found widely in the United States and in Canada, but the latter is found only in northern sections of the United States and in Canada. Both kinds occur in Wyoming.

Heel flies are true flies, that is, they belong to the insect order Diptera. They look more like small bumble bees, however, than flies. They are hairy and are colored black with yellow or orange bands. The grubs are tiny and white when they emerge from the eggs. They do not have any legs, nor do they have a noticeable head. When full grown, grubs are about 1 in. long and are black in color.

Life History

The life histories of the two species are similar, although there are some important differences. The common heel fly appears earlier in the season than the northern species, emerging and becoming active in April and May. Individual flies live for only a short time, usually less than a week. During this time the females lay eggs on the hairs of the flanks.
and legs of cattle. Although no injury or pain is caused during oviposition, cattle become frightened and try to escape when the flies advance to lay eggs. The eggs of the common heel fly are laid in groups of about seven and are arranged neatly in a row along the hair. The eggs hatch in three to six days and the minute larvae bore through the skin. Underneath the skin the grubs migrate in several directions, but eventually, after a period of eight months, all that survive reach the back. As soon as the grubs arrive at this site, they cut the skin to make a hole through which they obtain air and later make their exit. In Wyoming, time of arrival of grubs in the backs of cattle varies with altitude: the higher the elevation, the later the grubs appear. At altitudes of around 5,000 ft. larvae reach the back in December. The larvae develop rapidly within the cyst formed under the skin and become full grown in approximately 55 days. On reaching full growth, they crawl through the holes and drop to the ground, where they take shelter in ground litter and form a pupal case or puparium within a day or two. The pupal stage lasts 40 to 50 days. Flies emerge from the puparia in April and May and are ready to seek out cattle for the purpose of laying eggs. These eggs are the beginning of the next generation.

The northern cattle grub appears later in the season than does the common cattle grub. The first northern cattle grubs appear in the backs of cattle in February at altitudes around 5,000 ft. Other grubs arrive later, resulting in the presence of northern cattle grubs in the backs for a period of approximately 150 days. This extends the period of the presence of grubs in the backs to the middle of July.

Control

Control of cattle grubs is directed against the larval stages present in the backs of cattle. Attempts to control the adult flies and the eggs so far have failed. Some research is now being conducted to find a drug which
will kill the young grubs upon injection or oral administration to the host, but to date no such drug has been found which is safe enough to use.

The most effective insecticide in controlling grubs is cube or derris powder. These powders are formulated and used as dusts, washes, or sprays. Dusts are applied with a shaker and rubbed by hand into the cysts. Washes are likewise applied by hand, but usually a stiff brush is used to work the liquid into the cysts. Where large numbers of cattle need treatment, sprays are best to use. They are applied with power sprayers at pressures of 400 to 450 lb. per square inch. Cattle are most conveniently run into chutes, for the operator can then stand on a platform built at the side and direct the spray at close quarters onto the backs of the infested animals. The spray gun should deliver a solid stream and should be held at no greater distance than 12 in. from the backs. Disc openings should be 4/64 in. on multiple-nozzle guns and 5/64 in. on single- or double-nozzle guns. About 1 gal. of spray is required per head.

Formulas which have proved effective are the following:

1. Formulas for dusts
   (a) 1 part cube or derris powder (5 percent rotenone content)
       2 parts pyrophyllite or tripoli earth.
   (b) 1 part cube or derris powder (5 percent rotenone content)
       1 part sulfur.

2. Formula for a wash
   12 oz. cube or derris powder (5 percent rotenone content)
   1/2 oz. wetting agent (optional)
   1 gal. water.

3. Formula for a spray
   7 1/2 lb. cube or derris powder (5 percent rotenone content)
   1 lb. polyphosphate or other wetting agent (optional)
   100 gal. of water.

Because cube and derris powders often vary in rotenone content from the usually recommended 5-percent quality, Table 3 is included to show

<table>
<thead>
<tr>
<th>Percentage of rotenone</th>
<th>Amount of powder per 100 gal. of water</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.15</td>
<td>7 lb. 5 oz.</td>
</tr>
<tr>
<td>5.10</td>
<td>7 lb. 6 oz.</td>
</tr>
<tr>
<td>5.05</td>
<td>7 lb. 7 oz.</td>
</tr>
<tr>
<td>5.00</td>
<td>7 lb. 8 oz.</td>
</tr>
<tr>
<td>4.95</td>
<td>7 lb. 9 oz.</td>
</tr>
<tr>
<td>4.90</td>
<td>7 lb. 10 oz.</td>
</tr>
<tr>
<td>4.85</td>
<td>7 lb. 12 oz.</td>
</tr>
<tr>
<td>4.80</td>
<td>7 lb. 13 oz.</td>
</tr>
<tr>
<td>4.75</td>
<td>7 lb. 14 oz.</td>
</tr>
</tbody>
</table>
several strengths of these materials and the amounts to be mixed with 100 gal. of water. In mixing cube or derris powders with water a slurry should first be made by adding only a small amount of water; the slurry should then be added slowly to the balance of water in the spray tank while the agitator is in operation.

![TREAT 1 TREAT 2 TREAT 3 TREAT 4]

<table>
<thead>
<tr>
<th>COMMON GRUB</th>
<th>COMMON GRUB</th>
<th>NORTHERN GRUB</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEC</td>
<td>JAN</td>
<td>FEB</td>
</tr>
</tbody>
</table>

FIG. 1—Seasonal Occurrence of Cattle Grubs in the Backs of Wyoming Cattle At Altitude of Approximately 5,000 Ft. Rise in Lines Indicates Peak Numbers; Arrows Suggest Timing of Treatments

Proper timing of treatments is essential in getting satisfactory results and should be based upon a knowledge of the seasonal occurrence of grubs in the backs of cattle. From research conducted in the Rocky Mountain Region on the life cycle of cattle grubs, a schedule of four insecticidal applications is recommended. The first treatment should be given 45 days after the first appearance of grubs, the second 30 days later, the third 45 days later, and the fourth 30 to 45 days later if grubs are still present. Another recommended schedule spaces all the intervals at 40 days. In either case small variations in timing will have to be expected because of interference from periods of stormy or extremely cold weather. To follow this schedule of treatment, ranchers will need to examine their cattle regularly to establish the date of first appearance of grubs in the backs. When a grub first arrives in the back it makes a small hole in the skin of the host, causing a small amount of serum to exude. This serum hardens and can be detected by running one's hands slowly over the back. Within a few days the cysts enlarge and can be felt as small bumps. Proper timing of treatments is illustrated for the Wheatland area (elev. 4,735 ft.) in Figure 1. The importance of the late treatments cannot be overemphasized, since they are designed to control the northern grub, which is a more injurious pest than the common grub. Errors in both recommendations and in actual control practices have been made in Wyoming during past campaigns because two or sometimes three applications were advised and carried out early in the cattle-grub season, while late applications were neglected. The early treatments resulted in satisfactory control of the common grub but gave practically no control of the northern grub.

To reduce significantly the grub population for the following year, community or area control must be undertaken. It is suggested that the size of a control area should be no smaller than a township and that all cattle within the area be treated. Consideration should also be given to the existence of natural barriers such as rivers, mountain ranges, and cul-
tivated lands in selecting control areas. Barriers such as these will aid in the protection of treated cattle from reinfectionation by impeding immigration of heel flies arising from untreated cattle.

**Selected References**


**HORN FLIES**

Horn flies cause a great deal of worry to cattle during the summer months. Like most other flies on cattle, they are blood suckers. When the flies are numerous, cattle may spend much of their time fighting the flies and consequently do not make normal weight gains. Studies made in nearby states have shown that cattle treated for horn flies may gain an average of 15 to 50 lb. more per head during the grazing season than untreated cattle.

**Life History**

Despite their misleading name, horn flies are not often found on the horns but rather on the backs or bellies of cattle. The adult flies remain always on the host, except when depositing their eggs on fresh cattle droppings. Oviposition lasts only a few minutes, after which the flies hurry back to the host.

During warm weather, the life cycle is very short. The eggs hatch in less than 24 hrs. and the larvae complete their development in the droppings in 4 to 5 days. Pupation occurs usually in the ground, and the pupal period lasts about 5 days. When the weather is unusually cool or dry, the cycle from egg to adult may be somewhat longer.

**Control**

Control of horn flies has become much easier since introduction of DDT and other new insecticides. During the fly season four spray applications at 3- to 4-week intervals will generally keep infestations at a low level.

**Horn Flies on Back of Hereford**
To spray for horn flies, as many cattle as possible should be crowded into a small pen. Spraying the backs only will give as long a period of protection as spraying the animals completely. In the case of horn flies, complete coverage is not only unnecessary but is wasteful of time and material.

Several of the chlorinated hydrocarbon insecticides will give more or less satisfactory control, but apparently none gives better control than DDT. About $1\frac{1}{2}$ to 2 qt. of a 1.0 percent DDT water suspension should be applied to the backs, or, if it is more convenient to apply a small amount per animal, such as only a pint or two, the concentration of DDT should be increased to 1.5 percent. A 1.0 percent suspension of DDT is made by adding 16 lb. of a 50 percent DDT wettable powder to 100 gal. of water. The wettable powder is generally superior to an emulsifiable concentrate for horn-fly control. A slightly shorter period of protection is obtained by using toxaphene, but this insecticide costs less than DDT.

DDT and most other chlorinated hydrocarbons should not be used on dairy cows, since small amounts are excreted in the milk. Methoxychlor, however, can be used and gives nearly as good control as DDT. It can be purchased as a 50-percent wettable powder and should be used in the same way as DDT.

Automatic applicators or back-rubbers, when properly placed, will give satisfactory control of horn flies. If the cattle have definite loafing areas, the applicators should be placed nearby; otherwise they probably will not be used. 5.0 percent DDT or toxaphene in No. 2 fuel oil, or furnace oil, or light mineral oil—these are effective formulations for use in such units.

**Selected References**


**THE STABLE FLY**

The stable fly is a serious pest of livestock. It is usually found annoying cattle on the lower parts of the legs. The severe pain produced by the flies biting or piercing of the skin causes cattle to stamp their feet incessantly. The stable fly looks somewhat like a robust house fly but can be distinguished easily by the proboscis, which is held forward bayonet-like when the fly is at rest, and by the seven dorsal spots on the abdomen.

The stable fly reaches highest and most damaging numbers in the central section of the United States. The fly, however, is troublesome in Wyoming around barns and sheds where livestock gather and where straw
accumulates in the yards and corrals. The fly is usually not a problem on the open ranges.

Flies injure cattle by their painful bites, consumption of blood, and annoyance. Animals which are attacked by large numbers of stable flies do not feed properly, and as a result they fail to gain or may even lose weight. The fly can be a factor in disease transmission, although actual proof of this has been obtained in the case of a few diseases only.

Life History

Stable flies overwinter as larvae and pupae in straw and manure piles. In spring the adult flies emerge and begin a succession of generations which lasts until cold weather in autumn. The adult flies spend most of their time at rest on the sides of buildings and on fences, visiting the host only long enough to feed. Flies feed by puncturing the skin and withdrawing blood. An engorgement takes approximately five minutes to complete, but a fly may puncture the skin several times before drawing blood. Mating occurs at the resting sites. The females lay eggs in irregular masses, although occasionally they lay single eggs. Preferred sites for egg laying are wet straw piles and manure mixed with straw. Pure cow manure is unattractive to the female fly and is unfavorable for development of the larvae. Eggs hatch in about two days, and the larvae complete development in about 7 days. Upon reaching full growth, the larvae enter the pupal stage, which lasts about 7 days. The adults have a life span of approximately 21 days.

Control

Control of the stable fly depends largely upon elimination of breeding sites. Manure should be hauled away from barns and stables and scattered over the fields every three or four days. Precautions should be taken to prevent straw piles from becoming soggy and wet. This means that the straw should be stacked properly on dry ground. If straw piles become soggy, they should be scattered like manure or plowed under.

Residual sprays have been found effective against stable flies, and sprays suggested for controlling house flies can be used. Since stable flies generally remain outdoors and rest on fences and on the sides of barns and sheds, such places should be sprayed.

On dairy farms the same insecticides and concentrations suggested for control of house flies can be used for stable flies. On buildings other than dairy, 0.5 percent dieldrin or 2.5 percent DDT is suggested.

When stable flies become particularly bad, protection of animals can be attained with an insecticidal mixture containing pyrethrum and piperonyl butoxide. Either emulsifiable concentrates or wettable powders diluted in water can be sprayed on at the rate of approximately 1 qt. per animal, with special attention to wetting of the legs. Treatments should be made twice weekly. The exact dilutions of the insecticide should be obtained from the label.
Selected References


Adult Horse Fly; Enlarged
(USDA BEPQ)

HORSE FLIES AND DEER FLIES

More than 300 species of horse flies and deer flies (family Tabanidae) have been recorded from North America. Several dozen occur in Wyoming. Only the females suck blood, and they are among the most annoying of livestock pests. They take large amounts of blood from their hosts, inflict punctures that worry the animals to the extent that grazing time is materially reduced, and leave wounds whereby other undesirable organisms may enter.

It has been shown that horseflies consume more than their own weight at each feeding. Thus when the flies are abundant the daily blood loss may amount to 100 to 300 cc., not including the blood which exudes from the bite after the fly leaves. In addition horseflies are known or suspected of transmitting several diseases of livestock, including anthrax and anaplasmosis. Cases of tularemia due to the bites of a deer fly, Chrysops discalis, have been reported from Wyoming and other western states. Deer flies more commonly attack man than do the horseflies.

The adults are generally robust, compact-looking flies with large, brightly colored eyes and antennae composed of three parts, the third being long and having several rings plus a thumblike projection at its base. They are active on warm, sunlit days when the temperature is above 70° F. On dark, cloudy, or rainy days, or when it is windy, they seek shelter in woods or other secluded places. The adults are on the wing from June to Sep-

— 29 —
tember, the peak population of the various species occurring early and then tapering off gradually.

Life History

Each female lays several hundred eggs in a wedge-shaped mass protected by a gluey, waterproof material. Since the larvae develop in an aquatic or semiaquatic environment, the eggs of most species are deposited on foliage or other objects projecting over water or moist ground. The eggs usually hatch within a week, and the larvae immediately burrow into the ground beneath. The larvae, which are mostly carnivorous and canibalistic, grow to maturity in slightly less than a year, although a few species require two years or more. The mature larvae measure up to about 2 in. in some species, are tapered at both ends, and have a fleshy ring on each body segment. After reaching maturity the larvae pupate, and the adults emerge 1 to 2 weeks later.

Control

At present there is no satisfactory control for horseflies, this being particularly true under the conditions pertaining in Wyoming. Some degree of repellency can be obtained for two or three days after applying a spray mixture of 0.1 percent pyrethrins and 1 percent piperonyl butoxide. Use of this mixture may benefit dairymen or other small-herd owners in areas of heavy local infestation. There is no known material that will repel the insects for a longer period.

If the horseflies in an area are developing around one or only a few ponds, removal of all plants and other projecting objects occurring in or within approximately 10 ft. of the water will appreciably reduce the number of flies, since removal of these sites prevents egg-laying.

Selected Reference


CATTLE SCAB

Scab or mange of cattle is a contagious skin disease caused by minute parasitic mites. Four kinds of mites attack cattle. These vary in habits and in the ways in which they cause injury; however, symptoms of the diseases are somewhat similar in that the first signs appear as small, raised areas, about the size of a pinhead, on the surface of the skin. As the infestation progresses, the raised areas coalesce and form large lesions which become denuded of hair and covered with yellow or gray-colored crusts or scabs. Because symptoms of mange can be confused with symptoms of ringworm, louse infestation, X disease, and several other skin diseases, positive diagnosis is made by taking deep skin scrapings and examining these for presence of mites. This is best done by a competent veterinarian.
Cattle mange is most serious and evident in winter. After cattle are placed on green pasture in spring, the symptoms of mange usually disappear without treatment. Nevertheless the infestation remains dormant over the summer and the disease will appear again next winter.

Control

Cattle mange is controlled by spraying or dipping of infested herds with lime-sulfur, nicotine, or crude petroleum. Recent research has discovered the effectiveness of BHC or lindane for controlling it, and since these insecticides are generally easier and safer to apply and are readily available, directions for their use are given. Dilute one of the following quantities of wettable powders with 100 gal. of water:

1. 8 lb. of 6 percent gamma BHC wettable powder, or
2. 5 lb. of 10 percent gamma BHC wettable powder, or
3. 4 lb. of 12 percent gamma BHC wettable powder, or
4. 2 lb. of 25 percent lindane wettable powder.

Two sprayings or two dippings are suggested at an interval of 10 to 12 days between treatments. Thoroughness of application is important and, if animals are sprayed, at least 2 gal. of spray should be applied per animal at pressures of at least 350 lb. per square inch. Every part of the animal's body including the face should be wetted with the spray.

Selected References


Ticks

Fourteen or more kinds of ticks inhabit Wyoming, but only three are of direct importance to the health of livestock. These are the winter tick, the Rocky Mountain wood tick, and the ear tick. Ticks are eight-legged animals with complex life cycles. All agree in having four developmental stages: (1) the egg, (2) the six-legged seed or larval stage, (3) the eight-legged nymphal stage, and (4) the eight-legged adult stage. Variations in life cycle frequently result from the marked host preferences of ticks. Some species in all their developmental stages attack only certain large wild or domestic animals, while others in the larval or nymphal stages attack small mammals such as rabbits and ground squirrels and in the adult stage attack large mammals such as cattle and elk.
WINTER TICK

As the name implies, this tick is found on its hosts mainly during the winter. It is seldom found on hosts in fall earlier than September or in spring later than June. Preferred hosts are horses, elk, and moose, but cattle and deer are often infested. Injury from this tick is caused by its feeding and withdrawing large amounts of blood. One of the chief factors of mortality in moose and elk is gross infestation by the winter tick, combined with feed shortages in late winter and early spring. Colts are especially vulnerable to attack, succumbing to heavy infestations. Although definite proof is lacking, this tick is considered to be a potential vector of anaplasmosis of cattle.

Adult Female of the Winter Tick;
Enlarged (USDA BEPQ)

Life History

The winter tick has a comparatively simple life history, for it is a one-host tick. An individual tick will complete its larval and nymphal development and become an adult on one and the same host. During late fall, winter, and spring adult females become engorged and swollen with blood, mate, and drop from the host to the ground. Egg-laying commences in spring, about 4,000 eggs being produced and deposited by each female in a single mass over a period of several weeks. The eggs hatch in about six weeks into larval ticks, which remain bunched together and in a torpid state during summer. Upon advent of cold weather in fall the larval ticks became active. They crawl high on vegetation, assume a characteristic waiting position, and when a host brushes by they attach themselves. Each young tick remains on the host for 6 to 8 weeks, feeding on blood and growing up to an adult.

Control

Thoroughly spraying infested animals with 0.5 percent toxaphene and 0.025 percent lindane provides good control. A single treatment is usually sufficient, but if ticks are numerous two treatments at intervals of 6 to 8
weeks may be required. Also, if the first treatment is made early in the season, reinfestation may occur, necessitating a second treatment. Because horses are frequently frightened by spraying, it is advisable to sponge them with the spray material.

To obtain 0.5 percent toxaphene spray use one of the following quantities in 100 gal. of water:

1. 2 qt. of 80 percent emulsifiable concentrate toxaphene, or
2. 3 qt. of 60 percent emulsifiable concentrate toxaphene, or
3. 4 qt. of 45 percent emulsifiable concentrate toxaphene, or
4. 10 lb. of 40 percent wettable powder toxaphene, or
5. 16 lb. of 25 percent wettable powder toxaphene.

In addition to toxaphene, lindane may be added to enhance the effectiveness of the spray in one of the following quantities per 100 gal. of water.

1. 0.8 pt. of 25 percent emulsifiable concentrate lindane, or
2. 1 pt. of 20 percent emulsifiable concentrate lindane, or
3. 13 oz. of 25 percent wettable powder lindane.

If this is done, the finished spray will contain 0.5 percent toxaphene and 0.025 percent lindane (or gamma isomer). Benzene hexachloride may be used in place of lindane at the same concentration of gamma isomer and has the advantage of being much cheaper. Use 3.5 lb. of 6 percent gamma BHC to 100 gal. of water.

**ROCKY MOUNTAIN WOOD TICK**

This tick is found on domestic livestock in spring and is of economic importance both because of its heavy feeding on the blood of the host and also its transmission of several disease agents. Rocky Mountain spotted fever, tick paralysis, tularemia, Q-fever, and anaplasmosis are some of the diseases with which the Rocky Mountain wood tick has been incriminated.

**Life History**

The Rocky Mountain wood tick has a complex life cycle, since it is a three-host tick. Adults infest large mammals such as cattle, horses, sheep, and deer during spring and early summer. Females which are fully engorged with blood and mated drop to the ground from these large hosts and lay eggs 2 to 4 weeks later in some protected place. About 6,000 eggs are laid by each female in one mass over a period of a month. After 1 to 2 months of incubation the eggs hatch into small larval ticks. These infest small rodents, upon which they are particularly numerous during July. After becoming engorged with blood in about a week, the larval ticks drop to the ground and enter a quiescent period of 1 to 4 weeks. Thereupon they molt to the nymphal stage and go into a dormant state that lasts until the following spring.
In spring the nymphs become active, climb up vegetation, and assume waiting positions for hosts. The hosts of nymphal ticks also are rodents, upon which they engorge with blood for about a week before dropping to the ground. The nymphs go into a quiescent period of 6 to 10 weeks before molting to the adult stage. Ticks become adult in summer to early fall and enter dormancy, remaining in this state until the following spring.

During the first warm days of spring the adult ticks become active, crawl high on vegetation, and wait for a large host to which they can attach. Mating takes place on the host, to which the female ticks remain attached from 1 to 2 weeks before becoming fully engorged with blood. If unsuccessful in finding a host early in the season, the adult ticks wait until June, but hot summer weather causes the still unsuccessful individuals to take shelter. Unfed adults live up to 4 years and are able to repeat the process of waiting for a host for several seasons.

Control

Insecticides recommended above to be used against the winter tick are effective also against the Rocky Mountain wood tick. The time of treatment however, should be in spring, when livestock become infested, rather than in fall or winter.
The ear tick lives in the ears of cattle, horses, sheep, dogs, a number of wild mammals, and, occasionally, man. The original distribution of this tick was probably confined to the Southwestern States and Mexico, but sale and movement of cattle have resulted in its spread to other areas. Injury is caused by the tick puncturing the tender skin within the ear and sucking blood. The wounds may become infested with bacteria, which give rise to a condition known as "ear canker." Plugs formed by accumulation of ticks, their excretions, and ear wax may close the ear passage completely. In this condition an infested animal shakes its head and repeatedly turns it from side to side. When irritation is more intense on one side, the animal often turns its head toward that side, and the more seriously affected ear is held lower than the other. A tendency for the animal to rub and scratch affected ears may result in extensive lacerations.

**Life History**

The adult ear tick lives on the ground away from the host. Only during the larval and nymphal stages does this species inhabit the ears. Larval ticks which catch a host crawl to the ears, where they attach themselves to the tender inner skin. After engorging with blood for 5 to 10 days, they enter a quiescent state for 1 to 5 weeks. The larval ticks then molt to the nymphal stage. Within the ear the nymphs engorge themselves with blood for 2 or more months. When they become completely engorged, they drop to the ground and rapidly seek cover under litter for the final molt. The adults mate on the ground; soon afterward females commence to lay eggs. These are laid in about 6 separate masses of approximately 1,400 by each female.

**Control**

The sprays recommended for the winter tick can be used successfully against the ear tick. They should be applied both inside and outside the
ears and on the head and neck of the animal at low pressures of 30 to 50 lb. per square inch.

Another method of controlling this tick is to squirt a small amount (½ oz.) of insecticidal solution into the infested ear with a spring-bottom oil can. The following insecticidal formula is recommended:

5 parts benzene hexachloride (12 percent gamma isomer)
10 parts xylene
85 parts steam-distilled pine oil.

The solution is available commercially, but it can be prepared at home. It is made by mixing benzene hexachloride in xylene at 120°F. with frequent stirring. When the BHC is largely dissolved, the material is removed from the source of heat, and to it is added the pine oil with repeated stirring. Since xylene is inflammable, it should be kept away from an open flame. The solution should be prepared in a well-ventilated room, or preferably out of doors.

An ordinary metal spring-bottom (press bottom) oiler of about 1 pint capacity is the most suitable instrument. The spout should be cut off so that it will be only 2 in. long, thereby forming a spout opening about three-eighths in. in diameter. A piece of flexible soft-rubber tubing 2½ in. long and with a three-eighths in. inside diameter should be slipped over the oiler spout. The tubing will guard against injury to the delicate inner lining of the ear by the sharp edges of the metal spout tip, while the oiler spout is being inserted.

The following method of applying the medicament is suggested. Grasp the ear with the left hand, insert the oiler spout into the opening of the ear canal, and inject ½ oz. into each ear. While the injection is being made, the ear should be manipulated with the left hand so as to spread the solution over the entire inner surface. Then hold the ear in an upright position for a few seconds, to allow the fluid to settle into the canal.

One treatment of either the spray or the solution is usually enough to control an infestation, but animals should be examined and the treatment repeated when necessary.

**Selected References**

The sheep ked, often called sheep tick, is a common pest of sheep in Wyoming. Although many observations have been made on the damage caused by this insect, few exact studies have been carried out. At the Torrington Agricultural Substation the writers have investigated the effect of keds on weight gains of feeder lambs. The results indicated that no significant difference in gains occurred between ked-infested and ked-controlled lambs and that the number of keds infesting the untreated lambs markedly decreased during the period of feeding. Evidently lambs on a fattening diet can in some way control ked infestations themselves. On the other hand, sheep grazed through the year on our ranges acquire heavy infestations during the winter and early spring months. Damage should be most evident at these times and may result from consumption of blood by the keds and from irritation caused by the bites. Also, injury may occur after transfer of large numbers of keds from ewes to new-born lambs.

**Life History**

The sheep ked is a wingless fly which has a remarkable way of reproducing. Eggs hatch within the uterus of the female ked, and the young larvae develop to maturity on food material secreted by nutritive glands of the mother. Only a single larva develops at a time, the full-grown larva being born after 8 days of feeding and growing in the uterus. The larva is cemented to the sheep’s wool and forms the red-barrel-shaped puparium which is sometimes confused with eggs or nits. The pupal period lasts an average of 22 days, after which the young keds emerge. Females live for about 100 days and produce 15 or more larvae during a lifetime. Males live
for about 80 days. The entire life of a ked is spent on the host. Keds that fall off the host usually survive less than a week and present little danger of infestation to a flock. With regard to numbers, keds have an annual cycle, for they build up to large populations during winter and decline during summer.

**Control**

The sheep ked can be controlled by three methods: spraying, dipping, or dusting. Spraying and dipping can be effectively done from spring after shearing to early fall; dusting is effective only in spring immediately after shearing. Advantages of the latter method lie in the safeness, ease, and speed of application and in the fact that sheep are not wetted.

Sprays can be applied at either high (300-350 lb. per square inch) or low pressures (50-75 lb. per square inch), although, when the wool is long, penetration is more satisfactory at high pressures. Sheep should be thoroughly wetted all over with the spray. Depending on length of wool, from 2 to 8 qt. of spray is required per head. Adding a pound of household detergent (Vel, Tide, and others) to each 100 gal. of spray will aid penetration and wetting and thereby enhance the effectiveness of the insecticide. Either 0.5 percent chlordane or 0.5 percent toxaphene spray is suggested. The following quantities provide these concentrations when diluted with 100 gal. of water:

**Chlordane**

1. 10 lb. of 40 percent wettable powder, or
2. 4 qt. of 45 percent emulsifiable concentrate, or
3. 2 qt. of 75 percent emulsifiable concentrate.

**Toxaphene**

1. 10 lb. of 40 percent wettable powder, or
2. 16 lb. of 25 percent wettable powder, or
3. 2 qt. of 80 percent emulsifiable concentrate, or
4. 3 qt. of 60 percent emulsifiable concentrate, or
5. 4 qt. of 45 percent emulsifiable concentrate.

Dipping has proved to be a most effective method in the eradication of sheep keds. A highly successful yet inexpensive material for a dip is ground cube or derris root. It is used at the rate of 8 oz. of powder (5 percent rotenone content) to each 100 gal. of water. The dry powder should be converted to a paste in a small amount of water before adding to the water in the vat. After the vat is filled with water and insecticide, the contents should be mixed well. A good method of stirring is to take a 5-gal. pail, punch holes near the top, insert a wire for a bail, allow the can to fill and partially sink, then drag it with a dipping fork rapidly from one
end of the vat to the other. Repeat the process several times. Adding a
detergent or wetting agent to the dip assists in penetration of the fleece.

A 0.25 percent toxaphene dip can also be recommended for effectiveness and cost. Wettable powders of this insecticide are safest to use in dip vats and should be added in the following quantities for each 100 gal. of water in the vat.

1. 5 lb. of 40 percent wettable powder, or
2. 8 lb. of 25 percent wettable powder.

Sheep are most conveniently dipped in spring after shearing, or in fall at the time of making up the winter bands. If sheep are dipped in spring, at least 10 days should be allowed after shearing for wounds to heal. Also, ewes and lambs should not be dipped together, as the danger of drowning some lambs is greater than when they are dipped separately.

Ranchers who plan to dip should obtain a copy of USDA Farmers’ Bulletin 2057 for complete instructions.

Among sheep growers in Wyoming, power dusting has proved to be the most popular method of controlling the sheep ked. Several reasons are given: (1) Dusting fits well into management practices in spring. After the sheep are shorn they are branded and then run through the dust as they are turned out on the range. (2) Dusting is rapid, for 2,000 to 3,000 can be treated per hour. (3) Dusting is safe, as sheep are not wetted and exposed in vulnerable condition to storms and cold nights, nor is any lost by drowning or poisoning. (4) Cost is low, amounting to 1c to 2c per head for the insecticidal dust.

Dusting for Control of the Sheep Ked (Sheep Tick)
Usually a Howry-Berg* duster is used (see page 39), although other makes of heavy-duty dusters can be converted to sheep-dusting requirements. The duster and steel dusting chute are set up at the end of a sheep chute. Sheep are then ready to be driven from a holding corral through the sheep chute and through the dust as fast as they will run. The most effective dusts are 1 percent dieldrin, 5 percent toxaphene, or 5 percent chlordane, although 0.5 percent rotenone, which has been extensively used, has given nearly equal kills. Dusts should contain 2 percent of No. 10 motor oil to reduce fluffiness. The proper time to dust is in spring after shearing, when the wool is short. For eradication of keds, sheep should be dusted twice with toxaphene, chlordane, or dieldrin at intervals of 2 to 4 weeks between treatments. Rate of application of dust should be 2.5 to 3 lb. per minute. If a Howry-Berg sheep duster is used, this rate can be approximately obtained by opening the two dust-outlet holes five-sixteenths of an inch. Make sure all sheep are dusted both times. For further information on sheep dusting see Mimeograph Circular 23 of the Wyoming Agricultural Experiment Station.

Selected References

Wool Maggot; Enlarged
(USDA BEPQ)

WOOL MAGGOTS

In spring and early summer, sheep are frequently found to be infested with great masses of maggots, the larvae of certain species of blowflies. The infestations begin most often in the crutch area or where neglected wounds exude offensive discharges, and literally thousands of maggots may be found on a single sheep. After hatching from the eggs, the maggots spread extensively over the body, where they feed on the skin surface and cause severe irritation. Badly infested sheep, if untreated, become weak and sometimes die; but if they recover, they often remain in unthrifty condition for a long time.

*Howry-Berg Steel and Iron Works, Denver, Colorado.
Life History

The female blowflies are attracted to sheep by smells associated with moisture, especially that accompanying decay. Wetness alone, however, without accompanying bacterial action may be enough to induce "strike," a term meaning deposition of eggs by blowflies and development of the larvae in the skin and tissues of the host.

Each female fly is capable of laying from several hundred to several thousand eggs. The eggs hatch in a few hours, and the maggots reach full growth usually within 3 to 10 days. They then drop to the ground, where they form a pupa. It is during the pupal stage that the transformation from maggot to adult fly takes place. The pupal stage in the ground is the method of overwintering.

Control

A new smear, EQ-335 screw-worm remedy, has recently been developed by U. S. Department of Agriculture entomologists for use as a wound treatment for controlling screw-worms on livestock. The new treatment replaces smears 62 and 82, and, although developed primarily for use against screw-worms, it is equally effective against wool maggots on sheep. The active ingredients are lindane and pine oil. An emulsifier is added so that the material may be mixed with water.

For use against wool maggots, EQ-335 should be diluted 1 part to 9 parts of water. For preparing one pint, place 3 tablespoonfuls of EQ-335 in approximately 3 tablespoonfuls of water, mix thoroughly, and then add the remainder of the water and shake well before using. Such emulsions should not be prepared too far in advance of their use.
The infestation should be completely encircled with the material, covering an area extending several inches outside of the infestation. The infested area need not be sheared.

A simpler formulation that will give equally good results is a 0.5 percent gamma isomer concentration of BHC wettable powder, which can be made by adding 11 oz. of the 6 percent gamma powder to 1 gal. of water. This treatment prevents restrike at least long enough to permit complete healing.

Selected Reference

Sheep Scab Mite, Female; Greatly Enlarged (USDA BEPQ)

SHEEP SCAB

Common or psoroptic scab is a highly contagious and serious skin disease caused by the sheep-scab mite. Although this disease is no longer present in Wyoming, new information on control of the mite may prove useful in event that infected sheep are introduced despite present stringent regulations. Sheep scab has prevailed in the United States principally in certain farming areas, but in recent years western range areas have again shown infestation.

Positive diagnosis of scab is made by examination of the sheep for the scab mite. Lesions are scraped with a knife; the scrapings are then placed on a black cloth, warmed, and observed for presence of mites. These are small, about one-fortieth of an inch long, but they can be seen by the unaided eye. The body is white or light yellow and the legs are brownish.
Indications of the disease are usually first noticed by the disturbed appearance of the wool. At spots where mites are active the wool looks uneven, picked, and thin.

**Life History**

The sheep-scab mite has four life stages, all of which are confined to the host. They include the egg, larva, nymph, and adult stages. The sexes are separate, that is, both males and females occur. Mites live close to the skin of sheep and feed by puncturing the epidermis and sucking up skin juices. Adult females live for 30 to 40 days and lay about 90 eggs during this time. The eggs are laid on the skin at the edges of lesions and normally hatch in 1 to 3 days. The larval stage lasts 2 to 3 days, the nymphal stage 3 to 4 days. Adult males live up to 34 days.

**Control**

Dipping of sheep in water mixtures of lime-sulfur or nicotine sulphate at dip temperatures of 95° to 105° F. has been the usual method of controlling scab. Two dippings are required, with an interval of 10 to 14 days between treatments. Recent tests have shown that only one dipping is necessary when benzene hexachloride or lindane is used. These materials have another advantage in that the dip can be used at ordinary water temperatures, no heating being needed; in fact the temperature of the dip should not exceed 80° F.

**TABLE 4—Benzene Hexachloride or Lindane-wettable-powder Dilution Rate for Each 100 Gallons Water in Vat**

<table>
<thead>
<tr>
<th>Percentage of gamma isomer in powder</th>
<th>5</th>
<th>6</th>
<th>10</th>
<th>12</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds of wettable powder</td>
<td>6.3</td>
<td>8.3</td>
<td>5</td>
<td>4.2</td>
<td>2</td>
</tr>
</tbody>
</table>

The recommended concentration of the dip is 0.06 percent of the gamma isomer, which is the active ingredient in BHC or lindane. Only wettable powder formulations are advised, for these have been found safer to use than emulsifiable concentrates. The gamma-isomer content of wettable powders varies so that in making up dips this fact must be taken into consideration. Table 4 shows the number of pounds of wettable powder to use for each 100 gal. of water in the dipping vat.

When replenishing the vat contents for the dip that has been carried out in the wool of the sheep, a somewhat stronger mixture has been suggested. Table 5 shows the increased rates.

**TABLE 5—Replenishment of Lost Dip. Benzene Hexachloride or Lindane-wettable-powder Dilution Rate per 100 Gallons of Water**

<table>
<thead>
<tr>
<th>Percentage of gamma isomer in powder</th>
<th>5</th>
<th>6</th>
<th>10</th>
<th>12</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds of wettable powder</td>
<td>11</td>
<td>9</td>
<td>5.5</td>
<td>4.6</td>
<td>2.2</td>
</tr>
</tbody>
</table>

**Selected References**

In some parts of the country, notably Southwestern United States, more than 90 percent of the sheep may be infested with the larvae or grubs of the sheep bot fly. Goats are equally subject to infestation. The grubs are found in nearly all parts of the world where sheep are raised.

The grubs do not cause considerable death loss but are detrimental to health, and the persistency of the fly in depositing the larvae in the nostrils interferes with the proper handling and grazing of the animals. Presence of a fly is indicated by the excited condition of the sheep, which shake their heads, keep their noses against each other or next to the ground, and in other ways indicate that they are trying to escape something trying to enter the nostrils. The grubs irritate the membranes lining the head cavities, which they inhabit, causing an excess flow of mucus commonly referred to as “snotty nose.” The mucus may be flecked with blood and become viscous, making it difficult for the animal to breathe properly. Under such conditions older or weak sheep may die.

**Life History**

The very small, first-stage larvae are deposited in the nostrils by the female flies, each of which is capable of producing up to 500 larvae. These small larvae remain in the nasal passages for a time, and then migrate to the frontal sinuses for further development. After reaching full growth in the sinuses the larvae, which are over 1 in. long, work their way out of the nostrils and drop to the ground, where they bury themselves and pupate within a few hours. The pupal period lasts about one month. The majority
of the grubs overwinter as larvae, having a larval period of 8 to 10 months, but in warm climates where there are two generations, the developmental cycle of the first generation may be completed in only 2 to 3 months.

**Control**

Sheep should be treated as soon as possible when cold weather has caused cessation of fly activity for the season, since the small larvae are easier to kill before they migrate to the sinuses. Treatment consists of spraying into each nostril 1 fluid oz. of 3 percent saponified cresol (lysol) at an air pressure of about 40 lb. During treatment, the animal should be held on its back with the muzzle slightly elevated. Inexperienced persons should consult a veterinarian rather than administer treatment themselves, since there is some danger of strangling unless treatment is administered quickly and the animals released promptly.

Repellent materials such as pine tar applied to the noses of sheep usually are not very successful in preventing larviposition by the female flies.

**Selected References**


**Horse Parasites**

**HORSE LICE**

Horses occasionally are infested with two species of lice, the horse-sucking louse and the horse-biting louse. Horse lice may be controlled by spraying, washing, or dusting with DDT, methoxychlor, or rotenone as recommended for cattle-louse control.

**HORSE BOT FLIES**

Three different kinds of bot flies infest horses in Wyoming. Two of them have received common names with regard to the egg-laying habits of the female flies. The nose bot fly lays its eggs on the hairs of the lips, while the throat bot fly lays the majority of eggs under the lower jaw. The third species is called simply the horse bot fly. It is less specific in laying eggs on any particular area of the horse, but the hairs of the legs usually bear most of them.

Horse bots cause injury in several ways. The flies in laying eggs annoy and terrorize horses and cause them to mill and run around, thus interfering with work or grazing. Because of this annoyance horses may lose weight and become reduced in vitality. Young larvae penetrate and
irritate tender tissues of the inner lip, mouth, and tongue and induce horses to rub the mouth on hard objects with resulting production of sores. The older larvae in attaching to the lining of the stomach and intestines cause inflammation of these organs. Heavy infestations seriously hinder passage of food through the alimentary canal.

**Life History**

Although there are several important differences in the life cycles of the three species of bot flies they are, in general, similar, and only the life cycle of the horse bot fly is considered here. Females of this species lay eggs most often on the hairs of the front legs, but many are also laid on the hairs of other parts of the animal. About 550 eggs are laid per female. Upon stimulation from being rubbed and licked by the horse, hatching of eggs takes place usually 9 to 11 days after deposition. The young larvae are taken into the mouth, where they burrow into the surface of the tongue or into the mucosa between the teeth. There they develop for 3 or 4 weeks. They then pass to the stomach, where they attach themselves and remain for about 10 months. Upon attaining full growth they pass out with the dung. Pupation takes place in the soil or ground litter, the pupal period lasting from 40 to 60 days. Individual adult flies live for about 3 weeks, but because larvae continue to drop from the host over a long period of time, flies can be found annoying horses from June through September. As the mouth parts of adult flies are nonfunctional, no feeding is done in this stage.

Larvae of the Throat Bot and Horse Bot Fly; Enlarged (USDA BEPQ)
Control

Control is directed against the larvae attached to the lining of the stomach and intestines and against the adults. Mechanical devices to protect the horse from egg-laying females are suggested. These devices consist of some fabric or leather to cover the lips and the area of the lower jaw for protection against two of the species, the nose bot fly and the throat bot fly. A piece of leather 4 to 6 in. wide and long enough to cover the entire lips, suspended beneath the mouth from the bit rings, will protect and calm a horse from attack of the nose bot fly. Canvas or burlap suspended beneath the jaw from the throat latch to the bit rings affords a great deal of protection from the throat bot fly. No mechanical protection is feasible against the horse bot fly, which lays its eggs rather widely on the animal.

To kill the larvae infesting the alimentary canal, carbon bisulfide in capsules is administered to horses. The dose is computed on the basis of weight of the horse at the rate of 1.5 fluid drams for each 250 lb. Horses should be fasted for 18 hr. before being given the capsules and withheld from feed and water for 3 hr. after treatment. Only veterinarians or ranchers experienced with the use of a balling gun should administer the drug. If a capsule is not sent down the throat but happens to fall in the mouth, the horse may break it by biting. The escaping gas will kill the horse in a few minutes.

The best time to treat is in December, as all larvae are then present in the stomach or intestines and are subject to treatment. For most effective control, all horses, mules, and donkeys in an area should receive treatment. In this way, great reduction of bot flies is brought about the following summer.

Selected Reference

Hog Parasites

HOG LOUSE

The hog louse is the largest louse affecting domestic animals; it is found wherever hogs are raised. It feeds on the blood of the host and causes irritation and itching in gross infestations, for each louse makes a new puncture in the skin every time it feeds. The constant rubbing of the hog to relieve the irritation results in additional injury to the skin, and the restlessness results in failure of the animals to make normal weight gains. Hogs infested with large numbers of lice suffer a lowering of vitality and general unthrifty condition, which renders them more susceptible to attacks by other parasites and diseases.

Normally hog lice are found only on hogs. The lice spread readily from one animal to another because of the hogs' habit of remaining close together.

Female Hog Louse; Enlarged (USDA BEPQ)

Life Cycle

The life cycle is similar to that of the cattle lice. The eggs usually hatch in 12 to 14 days and the females reach maturity and begin laying eggs about 12 days later. The duration of the life cycle from egg to egg is 24 to 32 days. They are most abundant during cold weather.

Control

The same insecticides and concentrations recommended for cattle-lice control are effective for controlling hog lice. Generally, one thorough treatment by spraying or dipping will give good control. If a second treatment is necessary, it should be made 14 to 16 days after the first treatment.

Benzene hexachloride should not be used when treated animals are to be slaughtered within 30 days, since the flavor of the meat may be affected.

Selected References

**HOG MANGE**

Hogs are susceptible to infestation by two kinds of mange mites—the itch mite, which is by far the most common, and the hog follicle mite. The itch mite is a small (1/50 of an inch), whitish, round-bodied parasite. It lives for the most part in tunnels that it makes in the skin of hogs, though adult females and newly hatched larvae regularly leave the burrows to move over the body and spread the disease. Eggs are laid in the tunnels and hatch in 3 to 10 days. The young mites pass through larval and nymphal instars and require 10 to 12 days to reach the adult stage after hatching.

The burrowing and feeding of the mites cause intense itching, irritation, inflammation, and swelling in the affected areas. The early stages of the disease begin around the eyes, ears, and nose and can be recognized by the nodules and vesicles which the mites cause. These nodules and vesicles eventually rupture and ooze serum, which hardens to form gray or yellow scabs. Hair often falls out in the affected areas. In advanced cases the skin becomes thickened and wrinkled. Transmission is usually by direct contact with infected animals or with objects that infected animals have rubbed against. Mange spreads slowly during summer but rapidly during winter.

**Control**

Accurate diagnosis of hog mange is made by examination of deep skin scrapings and discovery and identification of itch mites. Either BHC or lindane spray at 0.05 percent of the gamma isomer is effective in controlling this pest. The following amounts diluted in 100 gal. of water are suggested:

1. 7 lb. BHC wettable powder (6 percent gamma), or
2. 1.5 lb. lindane 25 percent wettable powder.

Spraying should be thorough and about 2 qt. of spray should be used for each hog of 200 lb. or larger. A nozzle pressure of at least 350 lb. per square inch is desirable. Until sprayed animals become dry they should be protected from cold to prevent chilling and from sunlight to prevent blistering. Do not treat animals within 30 days of slaughter.

Since mites can live in infested quarters, particularly in moist bedding for 4 to 6 weeks, control measures must include thorough cleaning of shelters and houses and, spraying of the floors and walls with the same spray recommended for direct application to hogs.

**Selected References**


Chicken Parasites

CHICKEN LICE

Chickens are hosts to several kinds of biting lice in North America, two of the most important being the chicken body louse and the chicken head louse. Other lice which infest chickens include the shaft louse, wing louse, fluff louse, large chicken louse, and brown chicken louse. In Wyoming the body louse is perhaps more commonly seen than any other. In heavily infested birds parting of the feathers will reveal small, yellow-colored insects which run rapidly over the skin to seek protection. A favored position of body lice is the region below the vent. Feathers in this area often bear clusters of louse eggs near the base of the shaft.

The effect of the body louse on mature chickens has recently been studied at the Alabama Agricultural Experiment Station. Moderate infestations of this louse over an 11-month period depressed egg-laying by 11 percent. In terms of net income this represented a monetary loss of 30 to 40 percent or, at present prices, 75c to 85c per louse-infected bird. Mortality was slightly greater and body weights less among infested birds.

Life History

Although life histories of chicken lice have not been extensively studied, some information concerning them is available. Eggs of the chicken body louse hatch in about a week, and the young nymphs take about two
weeks to reach the adult stage. All stages are confined to the chicken and cannot long survive away from the host.

**Control**

Several methods are employed to control lice on chickens and other poultry. The birds themselves can be dusted or dipped, or the chicken house can be treated with dusts, sprays, or paints. An old remedy—one which has not been surpassed for effectiveness—is sodium fluoride. Commercial grade is recommended because of its availability and low cost. When it is used as a dust, the pinch method of application is suggested, for the reason that one person can hold the bird and apply the dust. This method consists of placing a small pinch (an amount conveniently held between index finger and thumb) of powder next to the skin in 11 places over the body: 2 along the back, 1 on the neck, 1 on each wing when spread, 1 on the head, 1 on the breast, 1 below the vent, 1 on each thigh, and 1 on the tail. One pound of sodium fluoride applied by the pinch method will treat about 100 chickens. Because of difference in size, grown turkeys should receive 15 pinches and pigeons no more than 5. Since sodium fluoride is an irritant to nose and throat, one should wear a respirator or wet cloth over nose and mouth.

Sodium fluoride can also be used as a dip. This method has the advantage of being faster than dusting, but it must be carried out on a mild, sunny day or in a warm house and must be done early enough to allow the birds to dry off before roosting time. The dip is prepared by adding 1 oz. (rounded tablespoonful) of sodium fluoride to each gal. of lukewarm water measured into a tub. An ounce of soap or detergent can be added to aid in wetting. The tub should be located on a box at convenient height for dipping. The birds are held in one hand by the wings and plunged into the dip. The head should not be submerged. With the other hand, the feathers beneath the solution are raised to allow the skin to become uniformly wet; then the head is submerged once or twice, after which the bird is withdrawn and held up to drain for a few seconds before being released. The actual dipping of a fowl requires 20 to 30 seconds.

A much faster method of controlling chicken lice than either dusting or dipping is the painting of roosts and accessory structures with benzene hexachloride or with lindane. BHC is much cheaper than lindane, but it has a pronounced musty odor which may prove objectionable. Recent tests have shown, however, that BHC used at recommended dosages does not taint the eggs or the meat of chickens. The following amounts diluted in one gal. of water can be employed as paints:

1. 1.5 lb. benzene hexachloride wettable powder of 5-6 percent gamma, or
2. 12 oz. benzene hexachloride wettable powder 10-12 percent gamma, or
3. 5 oz. lindane wettable powder 25 percent gamma, or
4. 0.5 pt. of 20 percent emulsifiable concentrate lindane.
After mixing one of these materials in a gallon of water, the insecticide is painted on roosts, nest boxes, and other structures which can be used by chickens for roosting. Since lice are killed through fumigation action of the insecticide, and since fumes are greatest immediately after application, the best time to paint is shortly before the birds go to roost.

Lindane has also been found effective against lice when used as a spray at 0.5 percent concentration. The floor, walls, roosts, and nests should be thoroughly wetted. This method is most successful when the chicken house is cleaned before applying the spray. The following amounts of lindane mixed in 10 gal. of water will yield the suggested concentration:

1. 1.5 lb. of 25 percent wettable powder, or
2. 1 qt. of 20 percent emulsifiable concentrate.

Selected References


MITES OF CHICKENS

Although many different kinds of mites infest poultry, there are only four of importance in the West, namely, the chicken mite, the northern fowl mite, the scaly-leg mite, and the depluming mite. The habits of these mites vary as well as the nature of the injuries which they cause. The one most commonly infesting poultry in Wyoming is the chicken mite. Scaly-leg mite is present in smaller numbers compared with infestations of former years, the reduced incidence perhaps being due to the current management practice of retaining only young hens and selling the old. Neither the northern fowl mite nor the depluming mite has been encountered in the state to date, but both could well be present, for little effort has been made to find them.

Chicken Mite

The chicken mite is small, being no more than 1/32 in. in length. They are somewhat pear-shaped and are gray in color when unfed and red when engorged with blood.

Chicken mites inhabit crevices, cracks, and spaces between boards in the chicken house and infest chickens only for a blood meal. The mites feed mainly at night, but in heavy infestations mites can be found on birds during the day. Each female lays from 25 to 35 eggs during her lifetime and deposits them singly in hiding places in the chicken house. In warm weather the eggs hatch in 24 hours, and the young mites develop rapidly, passing through one larval and two nymphal stages in about a week.
Control

Chicken mites are controlled by spraying the floor, walls, roosts, nests, etc., with one of the carbolineums or with BHC or lindane. The first thing which should be done, however, is a thorough house cleaning. All loose boards and boxes should be removed. The carbolineums can be diluted with an equal amount of kerosene for ease of spraying or if a sprayer is not available, the undiluted carbolineum can be painted on the roosts, nest boxes, and other places where mites are found. The same formulas of BHC or lindane suggested for control of chicken lice can be used against chicken mites.

Scaly-leg Mite

The scaly-leg mite is a microscopic burrowing parasite which attacks the legs of poultry and causes the scales to lift and the legs and feet to swell. Scaly-leg is easily transmitted from bird to bird and therefore all infested birds should be segregated.

Control

This mite is controlled by dipping feet and legs of infested birds in crude petroleum. The oil should not be splashed on the upper part of the legs or on the feathers. Usually one treatment is sufficient, but a second treatment 30 days later may be necessary in bad cases.

Depluming Mite

This mite is closely related to the scaly-leg mite, but it burrows into the skin at the base of feathers instead of the scales of the legs. The mites
produce an irritation and itching which cause the infested bird to pluck its feathers.

**Control**

Applying an ointment of sulfur or dipping in sulfur effectively controls this mite. A dip can be made by mixing 2 oz. of wettable sulfur per gal. of water. A tub is satisfactory for holding the mixture and dipping the birds. Where only a few birds are infected, an ointment is conveniently applied by rubbing it into the skin of affected areas. The ointment can be made at home by thoroughly mixing one part of flowers of sulfur with four parts of vaseline or lard.

**Northern Fowl Mite**

Northern fowl mites commonly spend their entire life on chickens and other birds. They prefer the region of the vent and accumulate on a few feathers which become matted and grey or black. When infestations are heavy, the mites spread to all parts of the body.

**Control**

Recent tests conducted in California have shown that northern fowl mites can be controlled by spraying birds with 1 percent Sulphenone or 1 percent Neotran. The spray may be used at approximately 50 lb. of pressure, using a nozzle producing coarse droplets, and at a rate not exceeding 35 birds per gallon. Application with hand sprayers is also effective. Addition of a small amount of wetting agent assists in wetting the feathers. For making the desired spray concentrations, add one of the following to 10 gal. of water:

1. 2 lb. of 40 percent wettable powder Neotran, or
2. 1.5 lb. of 50 percent wettable powder Sulphenone.

Hand dusting or pinch dusting with 10 percent Neotran dust provides effective control and good residual protection against reinfestation.

**Selected Reference**

Scientific Names

The common and scientific names of parasites discussed in this bulletin are as follows:

1. House fly—*Musca domestica* L.
4. Fleas—*Ctenocephalides* spp.
5. Short-nosed cattle louse—*Haematopinus eurysternus* (Nitz.)
6. Long-nosed cattle louse—*Linognathus vituli* (L.)
7. Little blue cattle louse—*Solenopotes capillatus* Enderl.
8. Cattle biting louse—*Bovicola bovis* (L.)
9. Common cattle grub—*Hypoderma lineatum* (De Vill.)
10. Northern cattle grub—*Hypoderma bovis* (L.)
11. Horn fly—*Siphona irritans* (L.)
12. Stable fly—*Stomoxys calcitrans* (L.)
13. Horse flies—*Tabanus* spp.
15. Winter tick—*Dermacentor albipictus* (Pack.)
16. Rocky Mountain wood tick—*Dermacentor andersoni* Stiles
17. Ear tick—*Otobius megnini* (Duges)
18. Sheep ked—*Melophagus ovinus* (L.)
19. Wool maggots—*Phormia regina* (Meig.)
   *Protophormia terra-novae* (R.-D.)
20. Sheep scab mite—*Psoroptes equi* var. ovis (Her.)
21. Sheep bot fly—*Oestrus ovis* L.
22. Horse sucking louse—*Haematopinus asini* (L.)
23. Horse biting louse—*Bovicola equi* (L.)
24. Nose bot fly—*Gasterophilus haemorrhoidalis* (L.)
25. Throat bot fly—*Gasterophilus nasalis* (L.)
26. Horse bot fly—*Gasterophilus intestinalis* (Deg.)
27. Hog louse—*Haematopinus adventicu*s Neum.
28. Hog itch mite—*Sarcoptes scabiei* var. suis Ger.
29. Hog follicle mite—*Demodex phylloides* Csokor
30. Chicken body louse—*Eomenacanthus stramineus* (Nitz.)
31. Chicken head louse—*Cnemidocoptes heterographus* (Nitz.)
32. Shaft louse—*Menopon gallinae* (L.)
33. Wing louse—*Lipeurus caponis* (L.)
34. Fluff louse—*Goniocotes hologaster* Nitz.
35. Large chicken louse—*Goniodes gigas* (Tasch.)
37. Chicken mite—*Dermanyssus gallinae* (Deg.)
38. Scaly-leg mite—*Cnemidocoptes mutans* (R. & L.)
39. Depluming mite—*Cnemidocoptes gallinae* (Raill.)
40. Northern fowl mite—*Liponissus sylviarum* (C. & F.)
Wyoming Agricultural Experiment Station

Main Station
Substation
Field Station