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SOUTH DAKOTA STATE COLLEGE ◆ BROOKINGS

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Many different kinds of flies cause important losses to South Dakota farmers and ranchers. Some are of importance as adults, some as larvae. Cattle grubs, screwworms, sheep head grubs, and wool maggots are all fly larvae. Sheep ticks (keds) are parasitic flies.

In addition to these flies affecting livestock, there are many fly larvae (maggots) that damage crops. This publication will concern only the flies that are found in considerable numbers on livestock and in buildings in which stock is kept.

Three species of such flies are common on farms of this State, and to control them effectively different methods and insecticides have to be used. The farm operator who can recognize the three most common pest flies at a glance and is familiar with their characteristics and habits will be better able to deal with them.

The choice of insecticides varies for the different species. Even where one insecticide, such as lindane or DDT, has wide applicability, the concentration to be used will be different in some situations than in others. Also, the method of application of insecticides or other control procedures will differ with the problem at hand.

The house fly is objectionable primarily because of its unsanitary habits. It breeds in almost any kind of decaying organic matter and is found in such places as homes, barns, milk houses, barnyards, privies, and city or town dumps. This fly cannot pierce the skin to suck blood and therefore is not greatly bothersome to cattle.

The stable fly is a blood sucker. On cattle, it feeds chiefly on the legs, but also on the sides and backs. It is commonly seen in barns and barnyards, resting on walls, ceilings, or fences, as well as on the animals themselves. These insects,

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however, do not rest on the animals for any length of time after blood has been taken. The stable fly breeds in wet, fermenting straw close to farm buildings or around feed bunks. It is not an important pest of range cattle. The stable fly is the same size and general shape as the house fly, though it can be distinguished from the latter by the pointed, forward projecting proboscis (mouth parts) on its head. This proboscis, which the stable fly uses for sucking blood, can be readily seen when the fly is at rest in a well-lighted location, as on the sunny, outside wall of a barn, or when resting indoors on a window.

The horn fly is also a blood sucker, but it is considerably smaller than the stable fly and is generally seen on the backs and withers of cattle. It spends most of its time on cattle, in contrast to the stable fly which visits animals only when feeding. The horn fly breeds in fresh cattle droppings and is a serious pest on the range as well as in pastures.

Resistance

In recent years considerable attention has been devoted to the problem of increased resistance of certain insects to insecticides that had previously been effective in their control. Of the three flies under consideration, only the house fly has been shown to have lost its susceptibility to many insecticides. No evidence is known that horn flies have become resistant, nor that stable flies (which have always been hard to kill) have any increased tolerance to insecticides.

As used here, resistance refers to a decrease in susceptability to an insecticide by a population of insects. It does not involve a change in individual insects but rather a selection and breeding of initially more resistant specimens. Initially resistant individuals must be present for such resistance to develop. This selection pattern has been established by research work at several entomological centers in the United States as well as in foreign countries.

House flies have developed resistance in the field, as well as in the laboratory, to practically all the common chlorinated organic insecticides. This list includes DDT, methoxychlor, lindane, chlordane, toxaphene, dieldrin, and heptachlor. The possibility of the development of resistance to other types of insecticides such as pyrethrum and organic phosphates (such as TEPP and parathion) has been demonstrated under laboratory conditions. The degree of such resistance, however, has been low, and it does not appear that any rapid change of susceptibility to these chemicals is likely to develop under field conditions.

As a population of house flies develops resistance to any particular insecticide it tends also to develop some resistance to related chemicals. Thus DDT resistant house flies are generally also somewhat resistant to methoxychlor and (though usually less so) to chlordane or lindane.

Once resistance has been stabilized in a fly population it is not likely to be lost quickly. Under laboratory conditions some strains show a decrease of resistance, whereas other strains remain unchanged. Field experience presents little hope that resistant house flies will become susceptible quickly enough to again permit use as standard procedure those chlorinated organic insecticides to which high resistance has developed.

House flies resistant to DDT and other insecticides were proven to exist in South Dakota in 1951. At the end of March of that year, attention was called to a serious infestation of house flies in the heated calf pens in one of the barns of the Dairy Department at South Dakota State College. These flies seemed highly tolerant to insecticides (chlordane and DDT) applied throughout the winter by the herdsmen. In previous years these premises had been sprayed with lindane, methoxychlor, dieldrin, and DDT. Laboratory tests to determine the extent and nature of the apparent tolerance of these flies were desirable, since no strains of insecticide-tolerant house flies had been previously investigated in South Dakota.

Tests were made with these flies against various insecticide residues on filter papers confined in glass petri dishes. Figure 1 shows a group of these dishes containing impregnated filter papers, flies, and pieces of apple to provide food and mois-

Figure 1. Tests for resistance in house flies. Each glass petri dish contains about 10 flies, a piece of filter paper impregnated with insecticide, and a piece of apple for food and nourishment.

ture. In July, 1951, tests were again made using flies collected in the same dairy barn. Table 1 shows the results of these tests as compared with tests performed under similar circumstances against a non-resistant strain and against a highly resistant strain. The high resistance of this strain of house flies is apparent from the data. It should be noted that these flies had never been previously exposed either to heptachlor or CS-645A. It should be added also that despite the increased resistance to lindane, that chemical was still effective in 1951 for practical control of these flies. Within a few years, however, lindane, too, became ineffective in this particular barn.

Since 1951 the house fly population of this same dairy barn has been studied by means of comparable residual laboratory tests. The results of these tests are shown in table 2. Of particular interest is the sharp change in the effectiveness of lindane between 1952 and 1953. While at least half of the flies tested were still susceptible to the insecticide in 1952, some (actually only a few) exceptionally resistant individuals were present in 1953.

A survey of the prevalence of insecticide-resistant flies was undertaken in eastern South Dakota during the summer of 1954. A total of 44 collections were made at random on farms in Beadle, Brookings, Deuel, Hand, Kingsbury, Minnehaha, and Moody Counties. All samples showed high DDT resistance. This tends to confirm field reports that house flies throughout South Dakota are now generally resistant to DDT. Samples from these same fly populations were also exposed to lindane and to Diazinon

Table 1. Residual Tests Showing Comparative 50 Percent and 100 Percent Knockdown Times in Minutes for Various Strains of House Flies; April and July, 1951

Compounds and Dosage Levels	Knockdown Time in Minutes for 50 Percent (KD_{50}) and 100 Percent (KD_{100}) of the Test Specimens			
	(California Data)		(Brookings, S. D. Data)	
	Non-Resistant*	Resistant*	April	July
DDT (100 mg./sq. ft.)				
KD_{50}	91	720	1,780	1,425
KD_{100}	152	2,880	2,800+	8,570
Methhoxychlor (100 mg./sq. ft.)				
KD_{50}	37	255	1,330	—
KD_{100}	67	360	2,800+	—
Heptachlor (10 mg./sq. ft.)				
KD_{50}	44	40	530	—
KD_{100}	51	52	1,700	—
CS-645A (Dilan) (100 mg./sq. ft.)				
KD_{50}	—	—	310	—
KD_{100}	—	—	2,800+	—
Lindane (10 mg./sq. ft.)				
KD_{50}	13	11	70	48—
KD_{100}	20	15	168	90

*The "non-resistant" and "resistant" data is from March and Metcalf, 1949, (Bull. Dept. Agr. Calif. 38:93-101) and represents the Citrus Experiment Station laboratory non-resistant strain and the 1949 Bellflower resistant strain of house flies, respectively.

Table 2. Residual Tests Showing Comparative 50 Percent and 100 Percent Knockdown Times in Minutes for Various Population Samplings of the Brookings (SDSC Dairy) Resistant Strain of House Flies

Compounds and Dosage Levels	Knockdown Time in Minutes for 50 Percent (KD_{50}) and 100 Percent (KD_{100}) of the Test Specimens				
	April, 1951	July, 1951	June, 1952	July, 1953	July, 1954
DDT (100 mg./sq. ft.)					
KD_{50}	1,780	1,425	2,016	2,171	2,936
KD_{100}	2,800+	8,570	11,880	13,020	12,645
Heptachlor (10 mg./sq. ft.)					
KD_{50}	530	—	84	—	—
KD_{100}	1,700	—	5,040	—	—
Lindane (10 mg./sq. ft.)					
KD_{50}	70	48—	44	44	27
KD_{100}	168	90	120	2,400	1,725
Diazinon (10 mg./sq. ft.)					
KD_{50}	—	—	—	—	14
KD_{100}	—	—	—	—	30

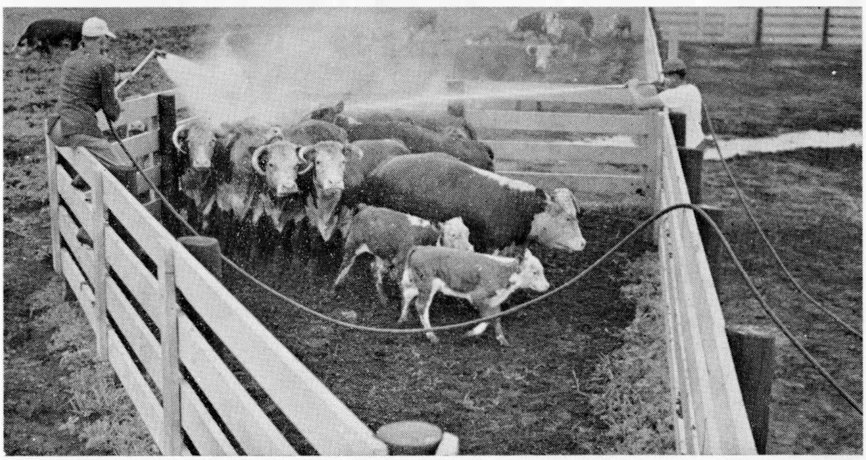
without obvious evidence of resistance. This does not confirm frequent reports of widespread house fly resistance to lindane.

Whether or not house flies throughout the State are now generally resistant to lindane is of no great importance in the light of general experience elsewhere. It is apparent that these flies are able to build a high tolerance to this chemical just as they have succeeded in becoming able to withstand DDT. If they are not already resistant, it is reasonably sure they soon will be.

Control of Flies on Stock

The control of flies on stock may be fairly easy if the infestation is limited to horn flies. If it includes any large number of stable flies, discouraging results are not unusual.

Figure 2. Spraying cattle for flies.



Horn Flies. Horn flies, partly because of their habit of resting on cattle whether they are drawing blood or not, and partly because of general susceptibility to insecticides, are easy to manage. No proven cases of insecticide resistance in horn flies have yet been reported. Any one of the common insecticides, such as DDT, toxaphene, TDE, methoxychlor, the synergized (activated) pyrethrums, or the thiocyanates should prove effective. The last three are the materials recommended for use on dairy cattle or beef cattle being finished for slaughter. Recommended concentrations are shown in table 3.

The method of application will vary with the local situation. Power sprayers, at low or high pressures, are effective. Cable-type backrubbers (described in bulletin 418), are effective, inexpensive, and easier to use than sprayers. When backrubbers are properly located and when serviced every few weeks, horn fly control is easily accomplished. Excellent control of these flies was obtained by this method even on a herd of dairy calves confined to a shelterbelt during the summer of 1953. Thus, the fact that there are trees or other places to rub does not necessarily mean cattle will not use these devices.

Some custom-built backrubbers or oilers have a place but only when so constructed that over-treatment is impossible. In general, they tend to be expensive, though some of them require little maintenance. In any event, whether farm-built or custom-built backrubbers are used, lubricating oils, new or waste, are not recommended. Fuel or diesel oils are widely used as solvents for DDT or methoxychlor (either of which should be used at 5 percent strength).

Stable Flies. If the infestation of flies on stock includes significant numbers of stable flies, the problem is much more complicated than for horn flies alone. Stable flies feed for a relatively short time and then leave the animals. This characteristic, plus their natural resistance to chemicals, makes stable fly control

Table 3. Sprays on Stock for Fly Control

Stock	Insecticide	Method of Mixing 100 Gals. of Spray*	Concentration of Finished Spray Percent
Dairy cattle and beef being finished for slaughter	methoxychlor	50% W.P.,† 8 lbs.;25% E.C.,‡ 2 gals.	0.5
	synergized pyrethrum	as directed on label	—
	thiocyanates	as directed on label	—
Beef cattle	Same as dairy cattle or:		
	DDT	50% W.P., 8 lbs.; 25% E.C., 2 gals.	0.5
	TDE	50% W.P., 8 lbs.; 25% E.C., 2 gals.	0.5
	toxaphene	50% W.P., 8 lbs.; 45% E.C., 1 gal.	0.5
	chlordane	50% W.P., 8 lbs.; 45% E.C., 1 gal.	0.5

*One pound of a wettable powder to 100 gallons of water is equal to ½ ounce to 3 gallons of water.
One gallon of an emulsifiable concentrate to 100 gallons of water is equal to 2½ tablespoons to the gallon of water.

†W.P.=wettable powder.

‡E.C.=emulsifiable concentrate.

difficult in some situations, and virtually impossible in others.

Synergized (activated) pyrethrums and the thiocyanates, with or without the addition of repellents, seem to provide the best control. Unfortunately these chemicals are of comparatively short residual duration and their use involves frequent re-treatment. Such re-treatment is usually impractical in beef herds unless automatic spraying equipment, such as the treadle-type sprayer, is available. These sprayers are operated by the cattle as they step on a platform in a chute through which they must pass.

Experiments with cable - type backrubbers have shown that these devices are as effective as sprayers in applying residual insecticides such as DDT. While some relief was afforded, neither of these procedures could be regarded as satisfactory in the face of moderate to heavy infestations. Repellants applied by means of the cable-type backrubber were ineffective.

Removal of breeding areas, in this case the removal of spilled feed and old straw bottoms, may provide considerable reduction of stable flies under some circumstances. In many cases, however, the elimination of breeding areas may be impractical.

House Flies. The importance of house flies on stock is relatively small since these flies do not suck blood. To keep them off cattle for purposes of over-all sanitation in milk handling establishments, they are best controlled by treatment of premises rather than stock.

Control in and Around Buildings

Fly infestations requiring control in and around buildings consist primarily of house flies, stable flies, or

Figure 3. A cable type backrubber in use.

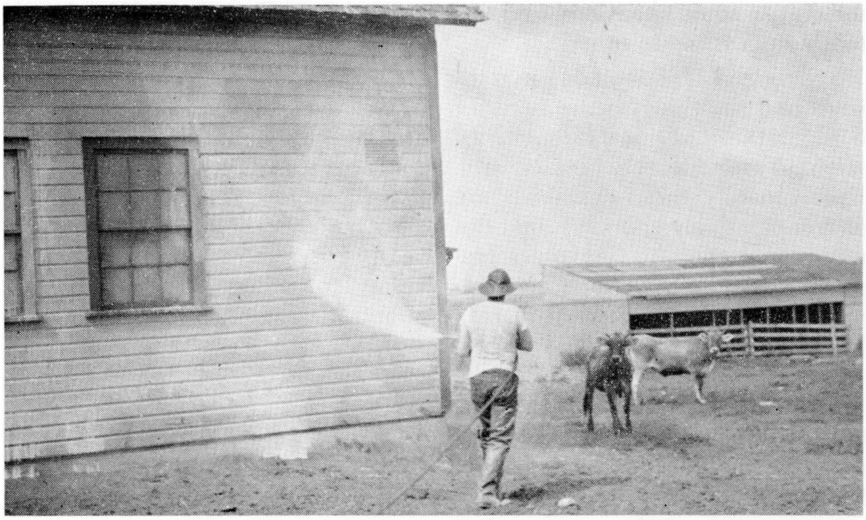


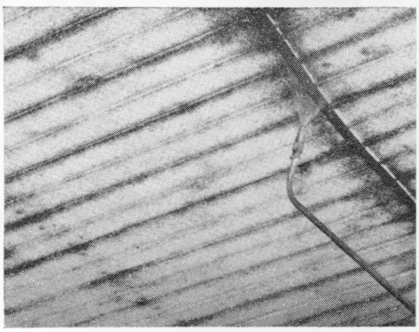
Figure 4. Residual spraying of the exterior of a barn.

both. The first essential to successful control of these infestations is sanitation: the elimination of breeding areas and the reduction in quantity of materials attractive to flies for feeding or breeding purposes.

The use of insecticides has been complicated by the widespread development of resistance to chlorinated organic insecticides in house flies. Where such resistance is established, certain organic phosphate insecticides may be used. Several of these materials have shown great promise.

Three organic phosphate insecticides now recommended for use in South Dakota are malathion, Diazinon, and Bayer L 13/59 (Dipterex). Of these insecticides, malathion appears to be considerably less toxic to man and livestock than many of the chlorinated insecticides such as DDT, toxaphene, or chlordane. The other two insecticides, Diazinon and Bayer L 13/59, are in essentially the same range of acute mammalian toxicity as DDT, toxaphene, and chlordane. These chemicals must be treated with respect, but with reasonable precautions no difficulties to the spray operator or stock in the vicinity are to be expected.

Figure 5. Applying spray to fly resting places along cable and cracks in the ceiling of a heavily infested barn.



Experience with these three new organic phosphates during the summers of 1953 and 1954 has demonstrated their effectiveness even against house flies otherwise highly resistant to insecticides. Diazinon has been applied successfully as a general residual spray. It has also been employed successfully as a dry bait sprinkled on clean floors. Bayer L 13/59 has been used successfully as a sprinkled dry bait and as a syrup bait applied with a paint brush as a spot treatment and permitted to dry in place.

The most successful use of malathion and of Bayer L 13/59 during the summer of 1954 was in the form of syrup-baited, spot applications. This procedure involved the use of a 3-gallon cylindrical sprayer fitted with an especially long wand with the nozzle at the end. It was easy to apply the spray to the fly resting places.

These resting places are generally on the edges of beams or supports, junctions between boards or sheathing, wires, or the edges of windows or doors. They are easily identified by the large masses of black excreta which accumulate on these locations. Repeated sprayings at 2- to 3-week intervals were neither expensive nor particularly laborious, and the degree of control was excellent.

Insecticides available for use in and around farm buildings are summarized in table 4.

Fly Control Methods Must Be Adapted to Particular Problem

The procedures available for fly control on the farm must be adapted to the particular problem at hand. Control of flies on stock is easy if the infestation is one of horn flies but difficult if stable flies occur in significant numbers. Fly control in and around buildings generally requires a combination of many types of treatment. Removal of breeding places is always important. Residual sprays, bait application, or both also are usually needed depending on the size of the infestation and degree of resistance present. Fly control practices should be established before infestations become too large and should be continued as a routine management practice throughout the fly breeding season.

Table 4. Treatments for Premises for Fly Control

Location	Insecticide	Method of Mixing 100 Gals. of Spray Using Available Formulations	Concentration of Finished Spray Percent
Dairy buildings	methoxychlor	50% W.P., 40 lbs.; 25% E.C., 10 gals.	2.5
	lindane	25% W.P., 10 lbs.; 20% E.C., 5 qts.	0.3
	malathion	.... 50% E.C., 2 gals.	1.0
	Bayer L 13/59 (Dipterex)	follow directions on label	0.3
Other buildings	Same as for dairy, or:		
	DDT	50% W.P., 40 lbs.; 25% E.C., 10 gals.	2.5
	toxaphene	50% W.P., 32 lbs.; 45% E.C., 4 gals.	2.0
	chlordane	50% W.P., 32 lbs.; 45% E.C., 4 gals.	2.0
	TDE	50% W.P., 40 lbs.; 25% E.C., 10 gals.	2.5
	Diazinon	25% W.P., 32 lbs.	1.0