1985

Progress Toward Establishing a Pest Management Program for the Face Fly, Musca autumnalis DeGeer, in South Dakota

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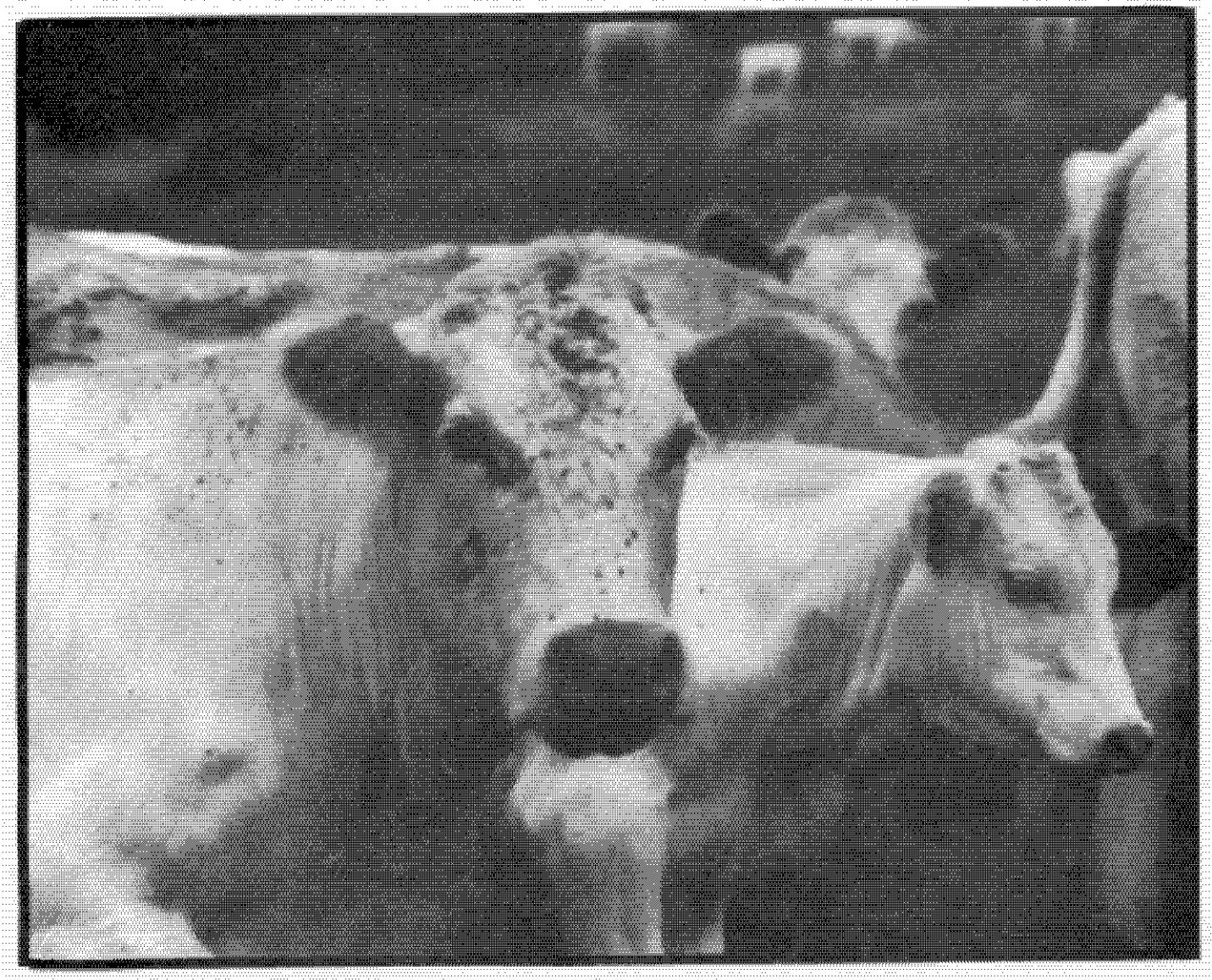
The Face Fly

Progress towards establishing an efficient pest management program.



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Progress Toward Establishing a Pest Management Program for the Face Fly, *Musca autumnalis* DeGeer, in South Dakota[1,3]

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JANUARY 1985

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INTRODUCTION AND LIFE HISTORY

The face fly is similar in appearance to the house fly (Figure 1) with a few minor differences. The female face fly is somewhat larger and darker. The large eyes of the male face fly nearly touch on the front of the head while the eyes of the house fly are further apart. The female face fly has a silvery stripe around the eyes whereas the stripe on the house fly is more golden. A dark spot between the eyes of the face fly is more rounded than that of the house fly and the abdomen of the face fly is darker and more slate-grey in color.

The face fly, which has been recently introduced into the North American continent, was first reported in Nova Scotia, Canada, in 1952. It has spread rapidly across the northern tier states of the USA and across southern portions of the provinces of Canada. In recent years the fly has been extending its range southward with only the states of Alaska, Arizona, Florida, Hawaii, New Mexico, and Texas being free of the insect.

The female fly does not have mouthparts capable of piercing the skin on its host so they are not normally blood feeders, however, annoyance can result while feeding on wounds or the moist mucous secretions of the face. Pinkeye, a bacterial disease, has been associated with the face fly. Shugart et al. (1979) in Nebraska demonstrated that just one or two face flies can transmit pinkeye. Untreated cases that become serious can lead to blindness of an animal.

The female face fly deposits her eggs in fresh cow patties where larval development takes place. When the larvae are mature they leave the pat, migrating to the surrounding soil to pupate. The adults emerge from grey pupae with the total cycle from egg to adult requiring 8 to 25 days. Continuous overlapping generations occur from June through September in South Dakota. The behavior of the male face fly differs significantly from the female because the males spend little time on cattle or feeding on fecal fluids.

Face flies have been reported feeding on several flower species in North Dakota (Peterson et al. 1980) and males frequent pasture margins, such as the wooded areas at pasture edges, and fence rows.

In October the fly enters farm houses, churches, and barns in South Dakota to overwinter and exhibits a true

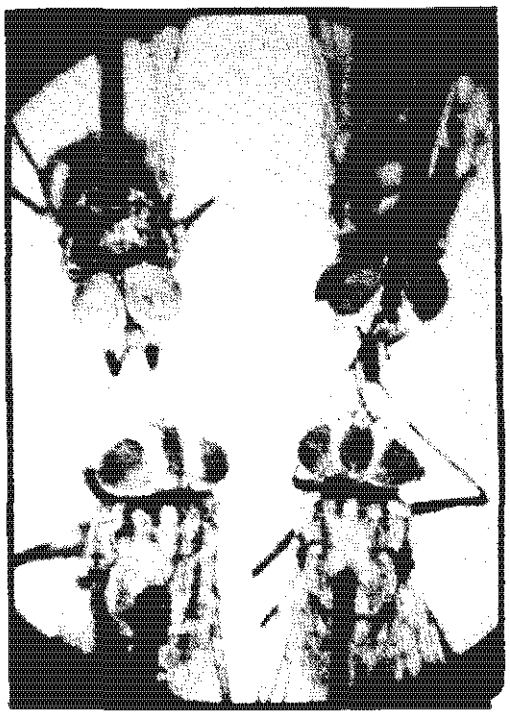

Fig. 1 Eyes of the male face fly (top left) almost touch while those of the male house fly (top right) are separated by a dark hairy patch. The females have a patch between the eyes and in the face fly (lower left) the patch is narrow and straight sided, while in the house fly (lower right) the patch is rounded.

diapause. In farm houses these flies appear on warm days during late autumn and early spring, often collecting in large numbers at windows or in rooms not used frequently, such as attics.

In homes these flies do no damage to home furnishings nor do they bite humans but their presence constitutes a nuisance. After the flies are cleaned up from a room, within a few days the same room may need to be cleaned again. The face fly enters the highest rooms of the home during the autumn months by forcing itself through various small cracks and openings, they hibernate between walls, in window casings, in closets, and behind furniture, etc. When the warm spring weather approaches many flies appear inside the home from wall voids, accumulating around windows in their attempt to get outside.

CONTROL TECHNOLOGIES

(1) Control Measures in Buildings.

Non-chemical - The control of face and other flies in buildings cannot be permanent until all openings are closed. Caulking compound or other suitable materials can be used to fill cracks and openings near windows, doors, vents, and any other possible entry sites. All holes, cracks, and splits in the siding of homes should be sealed. Tight fitting screens should be used, especially on the upstairs and attic windows.

Chemical - Before installing storm windows, an insecticide can be sprayed beneath the eaves out of doors. Flies inside the home can be killed with an aerosol spray of resmethrin or pyrethrum. Any dead, dying, or sluggish flies can be picked up with a vacuum cleaner or with a broom and dust pan. In tightly enclosed rooms where there is little air movement, resin strips impregnated with vapona (dichlorvos) can be used. One vapona strip should be used per 1,000 cubic feet of space because the strips emit vapors that reach cracks and inaccessible places in the room. Effectiveness can be up to four months but strips should not be used in nurseries or in rooms where the ill are confined. The strips should not be used in kitchens or restaurants where food is prepared.

When large numbers of face flies are killed in wall spaces, carpet beetles can be attracted to the odor and the beetles lay their eggs on the dead flies (Tyler, 1961). These beetles feed on the flies, develop, and eventually move into other rooms where they become a nuisance.

In a 1982 survey of 228 producers, from 27 counties in southeastern South Dakota (Easton and Au Yeung, 1983), 40 farmsteads reported having larder beetles in their homes (Table 10). By preventing the entry of face flies in farm houses, a reduction of larder beetles should occur.

(2) Biological Control

In many areas of the USA the nematode, Heterotylenchus autumnalis, inhabits the face fly rendering the females incapable of ovoposition, thus effectively removing them from the reproductive population. Kessler and Balsbaugh (1972) reported a low incidence (approximately 9% of the face flies examined) in eastern South Dakota pastures, along the Big Sioux floodplain. Attempts to rear and release this nematode have been carried out in some areas of the country but more research is needed in this aspect before this nematode can be effectively incorporated into a pest management program for the face fly.

Predatory staphylinid beetles in the Genus Hister have been manipulated for face fly control and Kessler and Balsbaugh (1972) in South Dakota as well as Wingo et al. (1974) in Missouri found Philonthus cruentatus to be an effective predator. Face fly pheromones have been isolated and identified by Sonnet et al. (1975) and Uebel et al. (1975) but further research is needed before these can be implemented into pest management programs.

(3) Insect Growth Regulators (I.G.R.)

such as diflubenzuron and methoprene can be fed to cattle at a relatively low rate (< 1 mg/kg body wt/day) and face fly development in the feces will be inhibited (Miller, 1974). Treatment of individual herds is not effective, however because immigrating adults will provide continuous

infestation pressures. In area wide control programs these compounds could be useful where the area was large enough to significantly reduce migration effects.

(4) Sanitation. It will unlikely play any role in the control of the face fly due to the habits of this fly in ovipositing in fresh manure that is voided in open pasture. When cattle are moved from the pasture to the feedlot or farm buildings, horn flies (Haematobia irritans), and face flies which normally are inhabitants of fresh cow manure are replaced by house flies (Musca domestica), and stable flies (Stomoxys calcitrans), that breed in decaying organic material other than fresh manure. When feed additives are utilized they work best in fresh manure situations, hence there is little control achieved with the larvae of house or stable flies that are not living in fresh manure.

(5) Traps. New or better sampling techniques are a key to an understanding of this pest. Passive trapping techniques to evaluate adult populations have been used by Peterson and Meyer (1978) as well as Pickens et al. (1977).

Peterson's trap (on the Sheyenne National Grassland area of southeastern North Dakota) employed 18 cm diameter screen disks stapled to the tops of fence posts and sprayed with Tanglefoot®. White disks trapped more flies (37.6%) than disks painted yellow, green, black, or red and since the male face fly spends most of its time on fence lines, these traps caught mostly male flies.

The Pickens trap is a glossy white pyramid coated with cellophane plastic and Tack Trap® adhesive and placed 1 meter above the ground in the vicinity of grazing dairy cattle.

(6) Insecticides. Chemical control methods are not adequate to manage this pest. Currently used technologies include a number of self treatment devices such as dust bags and oilers of various designs. Feed-through insecticides and sprays are used with limited success and perhaps the insecticide impregnated ear tags provide the best chemical control available today at a nominal cost.

RESULTS AND DISCUSSION

Sampling Face Fly Populations

Face fly estimates are based on flies counted on the faces of cattle and are subject to a lot of variation, therefore, better sampling techniques are necessary.

Variations occur with time of day and with prevailing climatic conditions. Fly counts should not be taken during excessive rain or wind because the face fly will rest on vegetation instead of on animals. If the morning is quite cool, counts will not be reliable because the flies have not yet left the concealment of the pasture.

Variation also occurs regarding the breed or age of the animal, whether the animal is in sunlight, or whether the animal is in the shade.

Facial counts of 15 animals in a herd during morning hours using binoculars, has been a commonly used practice for estimating female face fly abundance. Numbers over 10 flies/face are considered heavy. Shugart et al. (1979) reported that even one fly/face/month on the average can produce eye damage to the conjunctivae of the eye. An economic threshold of 5 flies/head is probably more realistic.

The distribution of the face fly in South Dakota was determined by facial counts of flies from a vehicle using binoculars, during early morning hours along highway transets in eastern and western South Dakota from June through August. During September and October the cooler nights necessitated making facial counts later in the morning (10:00-11:00 a.m.). Numbers of face flies were counted from 10 animals/herds at each site.

Observations throughout the summer seasons of 1977 and 1978 revealed that the face fly occurs predominantly east of the Missouri River in north and central

South Dakota (Fig. 2). In the south-central portion of the state, on the other hand, face flies were observed on cattle in Gregory, Tripp, and southeastern Todd counties (all west of the Missouri River).

Flies were not observed in Washabaugh, Mellette, Bennett, Washington, and Shannon counties in southwestern South Dakota, as earlier reported, but they were found in the Black Hills area which includes most of Lawrence County, the extreme southwestern part of Meade, and only the western portions of Pennington, Custer, and Fall River counties.

The higher numbers of face flies generally found east of the Missouri River in South Dakota are believed to be due to a combination of factors. Soil moisture is 0.18-0.22 inches/year in the upper 8 inches of eastern soil as opposed to 0.10-0.16 in the west. Rainfall is 20-30 inches/year in the east and 13-15 inches/year in the west. There are also more shaded habitats in the east that are less desiccating to cattle manure and larval face flies (Easton 1979).

The greatest density of face flies observed in South Dakota is believed to occur along the Big Sioux River floodplain (Ben Kantack, personal communication) in southern Brookings and northern Moody counties. Because of an overstory of cottonwood trees; greater soil moisture, associated sloughs, and appreciable shade is supplied.

In pastures around northern Brookings county, tree cover is less dense and during the summer fly numbers average 3 to 7/head while in the southern area of the county these numbers average from 7 to 20 flies/head. Some individual animals have been observed with 30 to 50 flies on their faces.

The absence of the face fly in 1977 and in 1978 in areas that were formerly occupied, according to cooperative insect reports, may have been due to the ease of confusing the face fly with the house fly. The house fly is a well known farmyard and feedlot pest. Cattle maintained close to farm buildings or in feed lots during the summer months can be expected to suffer

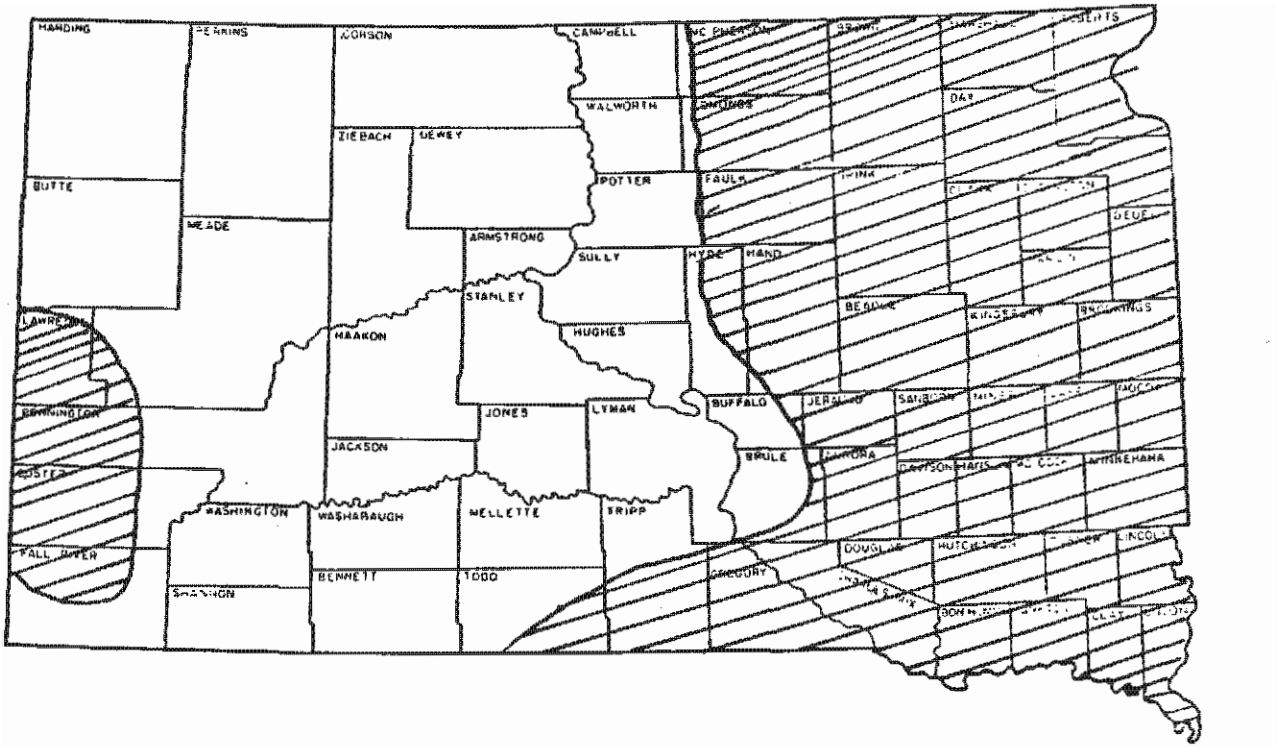

Fig. 2 Distribution of the face fly, Musca autumnalis in South Dakota.

annoyance from house flies. For a discussion of the impact of the house fly in feedlots in Nebraska, see Campbell et al. (1981).

Trap Construction

Sticky pyramid traps similar in design to the model by Pickens et al. (1977) were constructed from three 2-cm thick triangular sheets of plywood 29.5 m base x 13.4 in, and painted white. The pyramids were nailed to wooden posts (2 x 2 x 35 in) that were previously sharpened on one end and driven into the ground with a post driver (Fig. 3). Transparent plastic was applied to the pyramids with cellophane tape and painted with adhesive Tack Trap®. Traps were placed where they would receive full exposure to the sun and as close as possible to areas where cattle routinely loafed. Three traps each were placed on 2 farms near Brookings and on 3 farms south of town in areas along the Big Sioux River where face fly numbers were reported to be high.

Traps were placed on three farms where pastures along the Big Sioux River are bordered by a deciduous forest consisting of elm (Ulmus americana L.), Green Ash (Fraxinus pennsylvanicus), and plains Cottonwood (Populus deltoides Bartr) (Choates and Spencer Jr. 1969). Soil types are Lamoure silt loam and Sioux loam while predominate grass species include smooth brome (Bromus inermis Leyss), western wheatgrass (Agropyron smithii Rrdb.), Kentucky bluegrass (Poa pratensis L.), and timothy (Phleum pratense L.).

Fly counts were made from faces of animals and were also removed from traps at 3 day intervals. Generally the plastic and adhesive was replaced twice weekly to prevent the large number of other insects caught from reducing available surface area. Because the pyramid traps attracted house flies also, it was not possible to differentiate the two species on the trap under field conditions. Flies were removed and placed in non-leaded gasoline for 12 hours to remove the adhesive residue. The species identification and the sex of the flies could then be determined.

During a period from May through October of 1980, cylinder traps (constructed of 3 lb coffee tins painted with white Sears Weatherbeater® latex exterior enamel) were compared with the pyramid models to monitor face fly population in fields along the Big Sioux River in southern Brookings and in northern Moody counties of South Dakota.

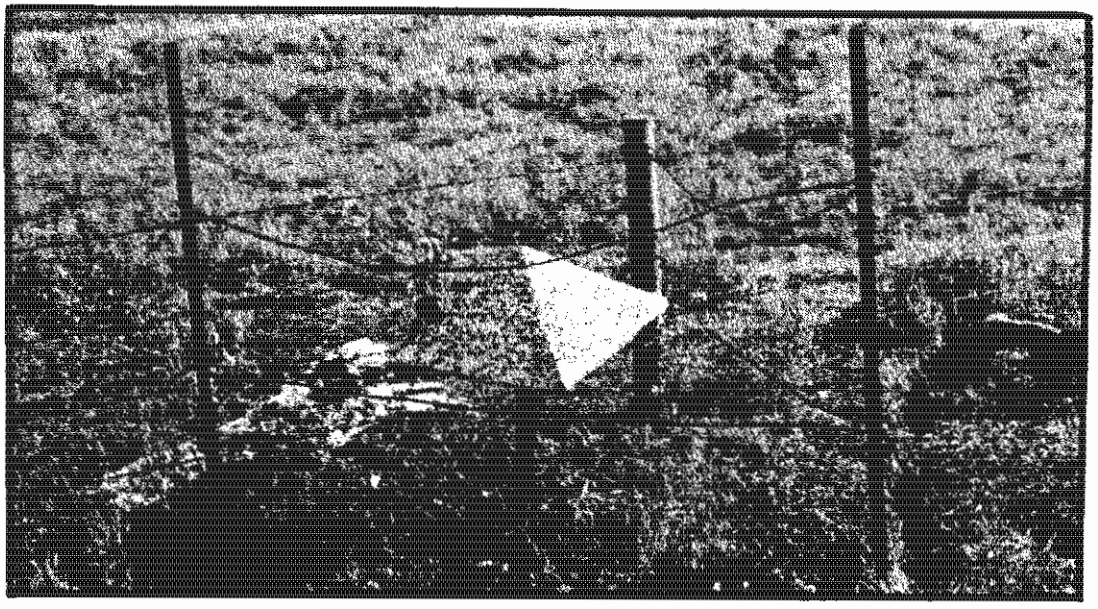

Fig. 3 Pyramid sticky trap inside enclosure of barbed wire near beef cattle along the Big Sioux River. Additional reinforcement with rabbit wire mesh was necessary to prevent licking by calves.

Trap Results

In earlier studies (Easton 1979) on 2 farms near Brookings and from the experiments on the Wicks, Ahern, and Kahler farms. Pyramid sticky traps caught mostly male flies. Traps were primarily set along fences where the male face fly spent more of its time and the time spent by the cattle near the trap was probably minor, relative to other loafing areas in the pastures. Similar results occurred in 1980 (Table 1). Since the female sex of the face fly is a major pest and male flies are rarely observed on a host, passive sampling methods were altered in an effort to sample the female sex more effectively.

Comparison of pyramids to square panels for sampling:

In order to determine the abundance of female face flies from May to July of 1981, sampling surfaces constructed of 1/4" exterior grade Douglas fir plywood (1506 sq. in. sampling surface) in a pyramid shape were compared to 12" plywood squares (1288 sq. in.). The triangles and squares were painted using high gloss white Sears Weatherbeater® latex exterior enamel. The squares were nailed to wooden stakes (2 x 2 x 35 in) that were driven into the ground. Plastic bags coated with Tack Trap® were placed over the traps. The traps oriented vertically, in an east-west plane, one meter above the ground. Other traps placed under similar conditions were oriented horizontally.

Transparent plastic was applied to the pyramids with the aid of cellophane tape and plastic was painted with adhesive Tack Trap®. Other adhesives such as Stickem Special® were found to be less satisfactory. Due to the latter's consistency it was harder to apply with a paint brush. When exposed to rainy color resulting in difficulties when determining the number of face flies caught.

The foot square panels, although easily constructed, were found to be less effective in the capture of face flies (Table 2). The surface area for trapping

Table 1. Number of face flies caught near cattle along fence lines on 2 farms near the Big Sioux River, Brookings and Moody Counties of South Dakota.

	Wicks Pyramid Traps		Aherns Pyramid Traps	
	1978	1980	1978	1980
May	--	313[b]	--	524
June	35[a]	2,200	56	2,402
July	897	4,215	239	1,681
August	247	5,122	311	1,478
September	986	1,372	1,207	1,242
October	254[c]	152	412	183
November	8	10	11	9
	2,433	13,383	2,250	7,519

[a]First flies noticed around June 16, 1978.

[b]First flies noticed around May 23, 1980.

[c]After October 7, 1980, few flies observed in field.

flies on the pyramid trap was 5 times that of the square foot panel. Twenty-one flies were caught on two farms with the square foot trap compared to 148 flies captured with the pyramid model.

Fig. 4 Cow-faced sticky panel trap.

Comparison of sticky pyramid to cow faced sticky traps:

Sampling surfaces for the cow-shaped traps were constructed of 1/4 inch plywood sheets (length 19 inches). They were rounded at both ends with the top end 13 inches wide and the bottom end 8 inches wide, to simulate the outline of the head of a cow (Fig. 4). The faces were fastened obliquely 40 inches above the ground to wooden stakes. Three traps were compared to 3 pyramid models formerly described.

A total of 1,663 face flies (178 females) were collected by pyramid sticky traps on the Wicks farm, compared to 500 flies (201 females) sampled on cow-faced panels.

On Wheeler's farm during the same period 1,348 face flies (155 females) were attracted to the sticky pyramid traps compared to 335 flies (140 female) collected on the cow-faced model (Table 4).

Pyrethroid insecticide-containing ear tags were used on cattle from the Wicks and Wheeler farms. On the Collins farm (Table 5) where insecticidal control devices were not in place, a total of

Table 2. Comparison of sticky pyramid and foot sq. (1) panels for sampling face flies on 2 South Dakota farms, summer, 1981.

Period	Wicks		Ahern		Center	
	Pyr.	Panel	Pyr.	Panel	Pyr.	Panel
16 June	11*	3	7	1	2	0
19 June	35	5	10	0	2	0
23 June	34	3	11,3[a]	3	12,3[a]	0
26 June	15,1[a]	4,2[a]	6	2	3	0
Totals	95,1[a]	15,2[a]	34,3[a]	6	19,3[a]	0

* = Male fly

[a] = Female fly

1,108 face flies (560 females) were attracted to sticky pyramid models and 385 (178 females) were caught on the cow face design during the month of August. More flies were caught on the Collins farm than on the Wicks farm (Table 6) or the Wheeler farm where control devices had been used for a number of seasons. Several miles separate each farm so that it is unlikely that populations of face flies on these farms are contiguous.

The combination of the sticky traps with the synthetic pyrethroid ear tags used each season since 1981 could be credited with the reduction of fly numbers on both the Wicks and Wheeler farms.

Table 3. Comparison of sticky pyramid and cylinder traps for sampling male face flies on 2 South Dakota farms, summer 1980. (3 traps of each type on each farm.)

	Wicks		Ahern	
Period	Pyramid	Cylinder	Pyramid	Cylinder
June	1670*	196	2439	511
July	3831	759	1996	354
August	5059	1229	1417	202
September	1273	222	1241	291
Totals	11,833	2,406	7,093	1,358

* = No. of male flies caught.

Pearson Correlation Coefficients/Prob R Under HO RHO=0 / N = 45

	WP	WC	AP	AC
WP	1.00000 0.0000	0.90952 0.0001	0.48325 0.0008	0.30354 0.0427
WC	0.90952 0.0001	1.00000 0.0000	0.27309 0.0695	0.09863 0.5192
AP	0.48325 0.0008	0.27309 0.0695	1.00000 0.0000	0.76412 0.0001
AC	0.30354 0.0427	0.09863 0.5192	0.76412 0.0001	1.00000 0.0000

Table 4. Comparison of 2 sticky traps for sampling face flies on the Wheeler farm in southern Brookings County, 1983.

	Pyramid Traps						Cow Face Traps					
	1		2		3		1		2		3	
	m	f	m	f	m	f	m	f	m	f	m	f
JUN	146	13	14	11	98	22						
JUL	51	8	40	9	18	9	13	5	9	9	10	6
AUG	234	40	361	30	231	13	53	27	46	30	64	33
TOT	431	61	415	50	347	44	66	62	55	39	74	39

m f = male and female flies, respectively.

Table 5. Comparison of sticky pyramid and cow face traps for sampling face flies from 3 farms in southern Brookings County, August 1983.

	Wicks Farm				Collins Farm				Wheeler's Farm			
	Pyramid		Cow face		Pyramid		Cow face		Pyramid		Cow face	
Date	m	f	m	f	m	f	m	f	m	f	m	f
7	30a	3	3	2	64	149	35	57	12	1	5	2
14	38	3	6	2	146	158	49	41	30	3	5	2
21	58	8	11	7	158	159	67	45	58	5	10	6
28	113	4	21	8	180	94	56	35	110	6	10	3
Total	239	18	41	19	548	560	207	178	210	15	30	13

a = the mean of 3 replicates or traps.

m f = male and female flies, respectively.

Table 6. Comparison of 2 sticky traps for sampling face flies on the Wicks farm in southern Brookings County, 1983.

	Pyramid Traps						Cow Face Traps					
	1		2		3		1		2		3	
	m	f	m	f	m	f	m	f	m	f	m	f
JUN	150	14	107	26	117	30	23	11	19	12	23	14
JUL	42	9	68	9	67	4	38	32	29	20	31	11
AUG	288	31	413	36	233	19	42	27	50	37	44	37
TOT	480	54	588	71	417	53	103	70	98	69	98	62

m f = male and female flies, respectively.

Survey of Face Fly Incidence on 228 Farms in Southeastern SD in 1982.

A survey of beef cattle pests was conducted in the summer of 1982 and face flies were considered the most important external pest in this area.

The information was obtained from a questionnaire sent to a sample of cattle owners in 27 counties. The accumulated data was analyzed through the SPSS computer package. Control devices found to be commonly employed included pour-on applications of systemic insecticides, employment of insect growth regulators, and oral larvacides in mineral mixes. Various methods of applying conventional insecticides such as sprays, back rubbers, dustbags, rubbing devices (Dr. Scratch® and Sittner Oiler®), and the employment of insecticide impregnated ear tags were used.

The face fly received the number one ranking, as a livestock insect pest (28.6%). The insecticide impregnated ear tag received the number one ranking control device available. Larvacides in feeds, animal sprays, facial dust bags, and back rubbers ranked 2nd, 3rd, 4th, and 5th, in order of importance.

According to the 228 stockgrowers interviewed, flies were found clustering on the outsides of 134 farmhouses during the fall while only 74 farm owners reported fly clusters in late spring. No clustering was reported on 94 homes in the fall or on 154 houses in the spring. Since both the house fly and the cluster fly are known to overwinter in attics and between walls of farmhouses in the northern United States, we can assume that a portion of flies reported are the face fly.

In the Sheyenne National Grassland of southeastern North Dakota (H. Meyer, personal communication) and in other states, observations suggest that white farmhouses and buildings are more attractive to overwintering face flies than houses painted other colors (Strickland et al. 1970).

In this study we wanted to see what relationship may exist between white farmhouses and the presence of the face fly. A total of 135 homes (59.2%) were found to be white in southeastern South Dakota. Farmers reported that 58.5% of these had flies clustered on their sides in the fall. Houses painted yellow or gold were the next frequently found (11.0%). Sixty-eight percent of these houses were reported to have flies clustering on their sides. Houses painted green or some combination of green and white comprised 7.9% of the total and 27.8% of these houses had flies clustered on their sides in the fall. The remaining houses, consisting of all other colors combined amounted to 22% (Table 7).

In living quarters flies were found to be a nuisance largely in the late summer and early fall (Table 8) with late summer first in importance (29.8%) and early fall second (24.6%). Some flies were reported to be in living quarters throughout the year with the smallest numbers reported in early winter, late winter, and early spring. The 15.4% of flies found in homes in early summer and the 3.9% in late spring, is lower than expected, assuming that the face fly emerges from its overwintering site in late winter and comes into heated rooms before leaving in the spring.

Domestic flies are most abundant around farmhouses and barns during June, July, August, and September.

Since churches in the Sheyenne National Grassland study of southeastern North Dakota were often found to contain face flies, there was an interest in determining if they were overwintering in churches in South Dakota. The frequency of flies in churches, which is not as high as in farmhouses, extended into October (Table 9). This is when the face fly is believed to congregate on the sides of farmhouses and churches in anticipation of entering its overwintering site.

Larder beetles may be attracted to the odor of flies overwintering in attics or in wall spaces of farmhouses and these beetles may feed, develop, and eventually move into rooms to become pests. Question 5 in the survey concerned the presence of larder beetles. The location of beetles reported in this survey are included in Table 10.

Table 7. The frequency and percentage of different colored farmhouses in southeastern South Dakota in 1982.

Color of Farmhouse	Frequency	Percent
White or brick and white combination	135	59.2
Yellow or gold	25	11.0
Light green, green, green and white	18	7.9
Brown, brown and white, tan, natural cedar	15	6.6
Beige, fawn, cream or peach	13	5.7
Gray or galvanized	10	4.4
Blue	6	2.6
Red	4	1.7
Orange or redish-brown	2	0.9
Total	228	100.0

Table 8. A ranking according to importance from 1 through 8 of attic fly occurrence in the living quarters of 228 farmhouses in southeastern South Dakota in 1982.

Rank	Time	Percent
1	early fall	30.4
2	late summer	27.8
3	early summer	18.3
4	late fall	13.9
5	late spring	5.4
6	early spring	2.1
7	late winter	1.8
8	early winter	0.3
	Total	100.0

Forty farmhouses in our survey were reported to have beetles. Eighty percent of the insects were reported active in the home during the summer season and twenty percent of the beetles were observed at other times. In order to demonstrate a relationship of the beetles with the face fly our analysis revealed that 62.5% of the farmhouses reporting the presence of larder beetles also reported domestic flies clustering on the external walls during the fall. These beetles may become more active indoors during the summer when there is an absence of food between wall spaces or in attics when domestic flies have left their overwintering sites.

Manure Quality

As fly counts on animals as well as on the surfaces of sticky traps differ from one pasture to another, and from one region to another, a study of manure quality was undertaken in three cool-season pastures along the Big Sioux River (on the farms of Ahern, Wicks, and Wheeler) to see if the quality of the manure could account for some of the differences. Several coprophagous fly species such as the horn fly and the bush fly, Musca vetustissima, have been known to be sensitive to changes in manure quality in Texas and Australia, but it was not known if the face fly in South Dakota

Table 9. The seasonal importance of domestic flies in 35 country churches found in southeastern South Dakota.

Month	Yes		No	
	Frequency	Percent	Frequency	Percent
January	5*	2.2	223	97.8
February	5	2.2	223	97.8
March	5	2.2	223	97.8
April	5	2.2	223	97.8
May	9	3.9	219	96.1
June	21	9.2	207	90.8
July	25	11.0	203	89.0
August	26	11.4	202	88.6
September	18	7.9	210	92.1
October	10	4.4	218	95.6
November	5	2.2	223	97.8
December	4	1.8	224	98.2

* Musca domestica (house fly) and Musca autumnalis (face fly)

responded to such changes.

Fresh cattle manure was collected weekly from the pastures traditionally associated with high numbers of the face fly during the summer of 1981 (Lysyk 1982). For a description of the pasture see page 7. Five manure samples collected from each site were returned to the laboratory, mixed thoroughly, and sub-sampled to determine both the percent of moisture and the percent of nitrogen.

Moisture content was discovered to be highest at the end of June in all three pastures. Moisture content in Ahern's pasture declined slightly until Sept. when a greater decline occurred. In Wicks' pasture the moisture content was lowest in late June to early July, and in Wheeler's pasture moisture content was high in June and in August.

Nitrogen content in Ahern's pasture was highest in late spring, declining until late July and rising again until August. In Wick's pasture nitrogen content was highest in the spring, declining until early June and rising again through August before another decline. In Wheeler's pasture, changes in manure nitrogen were more pronounced than in the other pastures with nitrogen at a higher level in late spring and lowest in early July and rising again until August when it remained steady until the end of the month before slowly declining in September.

It is believed that the nitrogen content of manure affects the fecundity of the face fly over a season, constitutes one of the reasons why differences in face fly numbers occur between pastures, and why a large body size is probably necessary for this fly to successfully overwinter (Lysyk et al. 1985). The size of flies have been shown to be correlated with their reproductive potential, and various nutrient levels can determine the size of fly larvae which ultimately determines the number of ovarioles in the adult fly.

Table 10. The location of larder beetles (Coleoptera:Dermestidae) from 40 farmhouses in southeastern South Dakota.

Rank	Where	Frequency	Percent
1	Kitchen near drains, sinks or cupboards containing food.	16	32.0
2	Floor, wall, window sills, or in light fixtures.	10	20.0
3	Basement	7	14.0
4	Bathroom cupboards or near drains or tubs.	5	10.0
5	Attic or from light fixtures in the attic	5	10.0
6	Bedroom or clothing	3	6.0
7	Porch or sidewalk	3	6.0
8	Living room	1	2.0
Total		50*	100.0

* This number is higher as larder beetles were reported in more than 1 location.

This study indicates that processes which alter the quality of manure could be developed and used as an advantage in the development of a more effective control method for the face fly.

Progress Towards a Pest Management Scheme

Field tests in southeastern South Dakota during the summer season of 1983 involved four fly control devices; the 8% Fenvalerate (yellow) ear tag (Table 1), the 10% permethrin (green) tag, the ear tapes (fire orange, 0.9 g), and the 10% permectrin strips that were inserted in cattle ears in a similar manner as the conventional numbered ear tags.

Four to 5 months of 88-95% horn fly control as well as 40-60% of face fly reduction was received through the employment of the devices. Some of the devices however were lost resulting in complete lack of control on those animals later in the summer. Of two cattle herds treated with permectrin strips in late May of 1983, only one animal (of ten tagged) retained its strip until the end of that fly season in September. Fifty percent of the ear tapes (when attached with 2 strips/head in one herd and 1 strip/head in another) were also lost by September.

The loss of certain tagging devices to the cattle at this time suggests that producers should use only those devices that remain on the cattle for the entire summer season.

The Ectrin eartag (containing Fenvalerate) was originally developed by the Diamond Shamrock Corporation while Atroban (containing Permethrin) was developed by the Burroughs Wellcome Company.

In 1983 the presence of Ectrin tags sold by the Ralston Purina or Moorman companies was due to Diamond Shamrock selling their rights of the tags to other marketing agencies under a private labeling. Agencies who purchased these tags then marketed them with their own brand name.

Other companies have purchased the technical synthetic pyrethroid material and have incorporated it into their own tags using their own brand names.

The prices of any of the above tags ranged from $1.10 to $1.50/tag (in 1984) depending on where purchased; local feed store, supermarket, or veterinarian.

Sticky pyramid traps have been employed to sample face flies on 3 farms since 1977. In 1982 and 1983 traps placed in areas where cattle spent most of their time caught more female flies/trap than in previous years when traps were placed along fence rows used less frequently by cattle.

Higher numbers of face flies appeared on farms in 1983 that were lower in numbers in previous years, which suggests that insecticide ear tags are expressing a repellent activity. It is unsure at this time, if fly reduction that has taken place on some farms is due to ear tags and traps or if the flies are moving from formerly treated herds to untreated herds.

Even though chemical controls are currently inadequate to manage the face fly, some fly reduction can be received with insecticidal ear tags or dust bags using a forced use regimen.

In general, each ear of an adult cow needs to be tagged. Also put 1 tag on each calf, since face flies (as opposed to the horn fly) often build up to higher numbers on the immature animals. Application of insecticidal ear tags can be undertaken with the use of a chute with a headgate during the spring before cattle are moved to summer pastures. At this time one tag can be applied in horn fly areas (Kohler and Blome, 1982a,b) and 2 tags applied in face fly areas (Easton 1983).

In the fall, when cattle are again moved from the summer pasture, tags can be easily removed with hand wire cutters. If the tag is not eliminated at this time, it can be easily cut during the following season and a fresh tag applied using the same opening or hole previously made. Tags will often become brittle over the winter season and break off by spring leaving only the button in the ear.

Most pyrethroid containing materials will provide 4 to 5 months of good horn fly control, however, there is evidence of

resistance in the southern states of Florida, Louisiana, Kansas, Oklahoma, and Texas. Recent evidence of pyrethroid resistance in horn flies near the Clay Center area of eastern Nebraska indicates that resistant flies could develop this year or next in South Dakota. In general, resistance is showing up in areas where there has been intensive use of pyrethroid insecticidal ear tags for 3 years or more.

If a producer should notice appreciable numbers of horn flies on an animal that has been treated with insecticidal ear tags, resistance should be suspected and the extension entomologist at South Dakota State University should be notified for further instructions. Recommendations to prevent resistance from occurring include the following:

1. Tag animals only according to the labeled directions. (1 tag/animal for horn flies and 2 tags/animal for face flies)

2. Tag animals at or near the beginning of the fly season if at all possible. The practice of many local producers has been to allow the tags to overwinter on the animals. Since a sublethal dose may be present in the old tags that have overwintered the previous season, these sublethal doses could increase the likelihood of resistant horn fly populations developing (cut out the old tag with a wire cutter before retagging).

3. Use alternate treatment methods with non-pyrethroid materials near the end of the fly season to avoid the development of sublethal doses of material.

4. If resistance is suspected, do not re-treat with any brand of pyrethroid ear tag since cross resistance is very likely. The RABON tag containing organophosphate insecticide can be used or cattle can be treated with an alternate control method (dust bag or cable back rubber under the forced use regimen), or do not treat at all so that the resistant population of horn flies does not develop further and spread to other areas of the state. If resistance has occurred the pyrethroid ear tags should not be used for at least 1 year, and organo-phosphates should be used exclusively during that year. The following year pyrethroids may then be effective.

5. Industry is currently developing new chemical entities and/or chemicals that will control resistant horn fly populations.

If resistance by the horn fly to synthetic pyrethroid develops in South Dakota, face fly control will be affected. It is unlikely that the pyrethroid containing ear tags could be marketed effectively when resistant horn fly populations are present and success has not yet been totally achieved for complete control of the face fly.

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Table II. Insecticide impregnated ear application devices available for horn fly and face control in the United States in 1984.

Product Name	Marketing Agency	Shape/Color	Application
	Fenvalerate (8%) Ear Tags		
Ectrin	Diamond Shamrock Corp.	 /Yellow	Allflex Tagger
Insecta-Shield	Ralston Purina Co.	 /Yellow	Allflex Tagger
Ear Tag Plus	Moorman Mfg. Co.	 /Yellow	Allflex Tagger
Starbar	Thuron Industries, Inc.	 /Green	Temple Tagger
Vet Shack	Parker Livestock/Great Plains Chemical Co.	 /Yellow	Allflex Tagger
	Permethrin (10%) Ear Tags		
Atroban	Burroughs Wellcome Co. (Cooper)	 /Green	Allflex Tagger
Insecta-Gard	Ralston Purina Co.	/Green	Allflex Tagger
Gard Star	Y-Tex Corp.	 /Fire orange	Y-Tex Tagger
Fearing DuFLEX	Fearing Mgf. Co.	 /Burnt orange	DuFLEX Tagger
*Gen-Sal (Wellcome Tag)	Burroughs Wellcome Corp. (Cooper)	/Fire orange	Allflex Tagger
Permectrin (tags/strips)	Anchor Laboratories, Inc.	 /Clear	Allflex Tagger/ or by hand using cable tie around existing ear tag
	TAPE (1.2 grams of Permethrin)		
Ectiban Tape	ICI Americas, Inc.	 /Fire orange	By hand around existing ear tag
	Flucythrinate (7.5%) Ear Tags		
Guardian	American Cyanamid Co.	 /Burnt orange	Allflex Tagger
	Rabon (13.7%) Ear Tags		
Rabon	Diamond Shamrock	 /White	Allflex Tagger

* For distribution to and sale by licensed veterinarians only. Table adopted from K.H. Holscher, Iowa State University Insect Weed and Plant Disease Newsletter, April 29, 1983. p. 38.

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