An Integrated Approach to Managing Fly Pests in Dairy Calf Greenhouses

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Abstract

House flies, Musca domestica, and stable flies, Stomoxys calcitrans, are both extremely important dairy cattle pests in New York. House flies transmit diseases and are annoying, while stable flies inflict a painful bite causing weight loss and discomfort to animals. Both of these flies have the potential to move from the farm to neighboring homes creating legal challenges and extremely poor community relations.

Large, plastic covered, half-hoop structures, resembling greenhouses used for holding large numbers of calves are beginning to replace individual calf hutches on New York dairy farms. The benefits of using these structures are numerous (easier animal handling, healthier calves, and easier cleanup), however, there is also the potential for buildup of large numbers of fly pests. Until recently, we have not had the opportunity to critically evaluate the effectiveness of our dairy fly IPM program recommendations in these facilities. Additionally, this on-farm project enabled us to evaluate our fly management recommendations and provided us with a means to solicit grower feedback and suggestions in "real time."

Eight dairy farms with calf greenhouses were used in this study with three farms serving as control sites and five serving as IPM farms. Farms chosen for this study ranged in size from 200 to over 2,000 milking cows and were located in Tompkins, Cortland, Onondaga and Cayuga counties. Fly breeding areas were observed on every farm. Maternity and calf rearing facilities were the primary sources for breeding activity.

Producer perceptions on stable fly abundance appear to be closely reflected in calf leg counts. Sticky traps (75) removed 483,000 house flies and 77,000 stable flies from five dairies throughout the course of the study. IPM farms were less likely to use insecticides and when needed used more IPM-friendly materials than Control farms. As was expected, the sticky traps were not a "silver bullet" to fly management, but were an important component in an overall strategy. As observed in study year 1, cultural control continued to exert the single greatest impact on changes in fly populations. When producers (IPM and Control) disposed of refused water out-of-doors and cleaned wet areas below feed and water buckets, fly numbers dropped. During the 2001 study we incorporated an augmentative biological control program by releasing parasitoids on the five IPM farms. As of the publication of this report, parasitoid samples have not been fully identified and summarized.

This project was conducted over a two-year period. This abbreviated report will cover some of the results from the 2001 project. A complete report will be filed in the 2002 project report year.

Background and Justification

House flies, Musca domestica, and stable flies, Stomoxys calcitrans, are both extremely important dairy cattle pests in New York. House flies transmit diseases and are annoying, while stable flies inflict a painful bite causing weight loss and discomfort to animals. Both of these flies have the potential to move from the farm to neighboring homes creating legal challenges and extremely poor community relations.

Previous research has documented that calf areas, most often the calf hutches, are the greatest source of fly breeding on dairy farms. The reasons for this include; a small animal unable to crush developing fly larvae, manure and spilled grain mixing with spilled water and urine, management practices that utilize straw bedding rather than wood chips, and a 6 to 8 week period between animal introduction and bedding removal.

Large, plastic covered, half-hoop structures, resembling greenhouses used for holding large numbers of calves are beginning to replace individual calf hutches on New York dairy farms. Within these structures individual animals can be easily separated with fencing. The benefits of using these structures (greenhouses) are numerous (easier animal handling, healthier calves, and easier cleanup), however, there is also the potential for buildup of large numbers of fly pests. Farmers can spend thousands of dollars attempting to control flies in these facilities, usually with insecticides. However, chemical control is limited as house fly resistance to most of the currently registered materials has been documented on New York dairies in 1987 and again in 1999 (Scott et al. 1988; Kaufman, et al. 2001). Several farmers have reported that pest control operators are no longer willing to apply cyfluthrin, our most recently registered compound, because of house fly resistance. These control failures continue to increase even as the EPA and the chemical industry are beginning to cancel dairy insecticide registrations under the Food Quality Protection Act, FQPA.

In 1999, we investigated the use of a newly released giant sticky ribbon, the Spider Web™, with the manufacturer, Atlantic Paste and Glue Co., Inc. in 6 New York calf greenhouses. The traps collected large numbers of house flies and stable flies and producers were very pleased with the effectiveness of the trap in reducing fly numbers. An added benefit of using the sticky trap as an "insecticide application" is the protection of the natural enemy complex.

The benefits of hymenopterous parasitoids for the control of filth flies have long been recognized (Patterson and Rutz 1986, Rutz and Patterson 1990). Geden et al. (1992) documented increased parasitoid activity on New York and Maryland dairies where parasitoids were released. Fly populations on dairy farms using IPM methods were found to be approximately 50% of those on conventional farm, and fly reduction was achieved with 80% fewer insecticide treatments (Lazarus et al. 1989).

Calf greenhouses are fairly new to New York and, until recently, we have not had the opportunity to critically evaluate the effectiveness of our dairy fly IPM program recommendations in these facilities. Additionally, this project will enable us to evaluate our fly management IPM recommendations under actual farm conditions and provide a means to solicit grower feedback and suggestions in "real time." The results obtained in this study will be used in our extension training programs. Herein we report a portion of the results of the second year of a two-year study. Following the completion of specimen and data handling, a complete report will be published in the *2002 NYS Livestock and Field Crops Project Reports Relating to IPM*. NYS IPM Pub. #322.

Objectives

Year 1 - (2000)

1. Determine if fly densities in calf greenhouses can be influenced using manure management and other cultural controls.
2. Evaluate the change in fly densities in the calf greenhouse following the application of Spider Web™ traps.
3. Compare dairy producer opinions of fly densities to that of established fly treatment thresholds.

Year 2 - (2001)

1. Address areas shown to be in need of improvement from Year 1 and deal with challenges, such as outside breeding areas and emigrating flies.
2. Incorporate augmentative release of biological control agents (parasitoids) into the IPM program when needed.
3. Compare the dairy producer's opinion of fly densities to that of established fly treatment thresholds.

Materials and Methods

Eight dairy farms with calf greenhouses were used in this study with three farms serving as control sites and five serving as IPM farms. Farms chosen for this study ranged in size from 200 to over 2,000 milking cows and were located in Tompkins, Cortland, Onondaga and Cayuga counties. Due to bio-security issues, one farm (H) decided against participation in the second year and was replaced with a similarly sized operation (I) in the same county. Greenhouses were all of similar construction, however, four had concrete aisles (B, C, F and I). Newborn calves were held in individual pens, while older calves were held singly or in larger group pens. Bedding used by producers was either straw or wood chips and additional bedding was added as needed. All bedding was removed following removal of the calf. All animals were watered and fed in side by side buckets with water/milk replacer changed daily.

The study began on June 05 and concluded on September 25, 2001. House fly and stable fly densities were monitored weekly with 10 spot cards, 3 x 5 inch white index cards placed equidistantly apart in the rafters of the greenhouse. Cards were positioned approximately 8 ft. above the floor. Additionally, calf-level spot cards were placed on 15 x 10-inch steel plates attached 36 inches above the ground to the calf pen. The numbers of spots per card were determined weekly. Stable flies were monitored directly on calves by counting flies on the legs of 15 calves per farm per week (Campbell et al. 2001). Due to a lack of effectiveness in 2000, sticky cards were not utilized in 2001.

At the start of the study (June 05, 2001), and every fourth week thereafter, a sanitation survey was performed on each farm. This allowed for the identification of breeding sites both in the greenhouse and around the remainder of the farm. Additionally, a weekly "viewpoint survey" was provided to producers allowing them to regularly assess their perception of the effectiveness of fly management efforts. They answered two questions in this regard: (1) "Have fly densities a) decreased; b) increased; or c) stayed about the same?" and (2) "Are fly numbers present high enough to warrant treatment?" This information was used to compare grower perceptions against spot card and calf leg count results and current IPM guidelines for fly management. To determine if producers observed increasing or decreasing fly densities as recorded by the objective fly measurements (spot cards and fly counts), we transformed their answers into numerical data. At each week, an answer of "decreased" was scored as a "-1", while "increased" was scored as a "+1" and "about the same" was assigned a value of zero. We then averaged both the weekly scores and objective fly measurements (spot cards and leg counts) across farms. To determine if our spot card data reflect producer perceptions of necessary additional fly management practices, we plotted the weekly average spot card data from each farm against the categorical "yes/no" response to the second question. Producers were also asked to rate the fly annoyance levels (animal and human) on a scale of 1 to 5 with a value of 5 being "constantly annoyed." These results were compared to those recorded by the Cornell University representative.

Producers at the IPM farms were instructed on the proper pest management guidelines to be followed including; pouring refused water outside the building, removal of dead animals and bedding promptly and using a nozzle on the end of the watering hose. Producers documented their management actions, need for additional action, perceived fly densities and change in densities (increased/decreased/same) on the weekly survey. If densities were perceived to be too high by the producer, the producer carried out a management action. Actions included identification and removal of breeding areas and/or a treatment action for adult flies such as the use of an insecticide. Cornell University personnel installed or replaced additional Spider Web™ traps if increases in the numbers of flies were observed to necessitate the action. IPM producers who felt that flies were too abundant were advised to apply pyrethrin-based insecticides, fly baits or pour-on pyrethroid insecticides (stable fly). These methods of insecticide applications are the least damaging to the natural enemy complex.

When used, Spider Web™ traps were positioned horizontally and attached to the rafters, 8 ft above the ground in all greenhouses. The number of traps placed in each greenhouse was determined based on the estimation of fly densities and size of the facility. Traps were stretched to 10 ft because longer distances were not stable. Traps were examined weekly and when the surface was covered with flies or debris, the original exposure was rolled and a second 10-ft exposure was revealed. When the second exposure was determined to be ineffective, the trap was removed and held for fly enumeration. In the laboratory, trap exposures were measured to determine the exact length presented. To estimate the numbers of flies on a trap, transparent acetates (3 x 11 in) were positioned on opposite sides of the trap and flies observed through the acetate were identified and counted. Acetates were positioned randomly with five areas counted on each trap. For each fly species, the numbers of flies per side of each trap were determined by multiplying the length of each trap (in) by the mean number of flies per inch per respective side. The two sides were summed to give the total number of flies per trap.

All producers recorded their fly management actions including the use of all insecticides, physical controls, manure management tactics and use of beneficial organisms. Fly management actions taken by the Control farm producer were the producer's usual methods; i.e. Cornell University personnel did not provide fly management recommendations (so as not to bias normal fly management at the farm).

Sentinel fly pupae were placed on all farms to gather parasitoid prevalence, distribution and effectiveness prior to, during and after the release of parasitoids. Sentinel pupae (30 live house fly pupae) were placed into window screen bags. Each week, 10 sentinel bags were placed on each farm (IPM and Control) and replaced the following week with a fresh bag. Pupae from exposed bags were placed in gelatin capsules and held for parasitoid emergence and subsequent identification.

The parasitoid species Muscidifurax raptor was purchased from IPM Laboratories, Inc., Locke NY. Parasitoids were picked up on Monday and released the following day. Parastioid releases were conducted weekly from July 03 through August 28, 2001 on the 5 IPM farms. The numbers of parasitoid colonies (10,000 parasitoids per colony) released each week were based on the average number of calves present in each facility during the prerelease period. The release level targeted was 500 parasitized pupae per calf. The calculated number of colonies placed at each facility was rounded up to the next whole colony number. Each week, Farms A and C both received 4 colonies, Farms D and E both received 3 colonies and Farm B received 1 colony.

Parasitoid releases were accomplished by placing an individual bag (10,000 pupae) at a protected location in the greenhouse. These were generally under calf feed/water buckets or in between larger group pens. Sites were chosen to allow for multiple-week releases at the same locations (placed near young calves or by more permanent group pens). Locations were marked with colored wooden stakes and producers were notified of these locations and advised not to "scrape" the areas clean. Locations were chosen to allow for as wide a distribution as possible while meeting the previously described criteria. Sentinel pupae described above were not placed within two calf pens of the release site to ensure that released parasitoids had to disperse from the release site to encounter the sentinel pupae.

Prior to each release, five sub-samples of 30 pupae each were removed from each farms' allotment and held in the laboratory for emergence. These samples allowed for species identification and a determination of the actual number of parasitoids released from each weekly allotment. A field-release bag containing 30 parasitized pupae from each allotment was placed on each of the farms at the site of the parasitoid release. This allowed for the determination of field-based mortality.

Following the full assimilation of 2001 data, full statistical analyses will be performed.

Results

A full analysis of this project had not been completed as of the publication of this report. A complete report of this project will appear in the 2002 report.

Insecticide use on the farms is presented in Table 1. Insecticides were not used on four of the five IPM farms. Farm B (IPM), which had extremely high house fly numbers during 2000, once again utilized only pyrethrins during 2001. Similar numbers of Control-farm applications were made in 2001 (20) as were made in 2000 (19). The facility using permethrin (farm F), saw little relief as this compound is ineffective against house flies (Kaufman et al. 2001). Farm G, which had used permethrin in 2000, did not use the material in 2001. During 2000 the operator of farm G noted that cyfluthrin was effective for less than one week, while in the past applications were only needed every few weeks. This producer used cyfluthrin only once during 2001. In studies by Kaufman et al. (2001), cyfluthrin was found to kill only 70% of wild-source flies, as compared to 100% of laboratory-susceptible flies.

Producer viewpoint data are preliminary and are presented only to show the current trends in the study. In general, producers determined that the fly numbers were greater each week through the first week in August (week 7 in 2000; week 9 in 2001) followed by a decline in the fly population. The general patterns observed in these graphs suggest that stable fly leg counts were moderately effective in mimicking producer viewpoints in fly abundance (Figure 1). The mean numbers of stable flies on IPM and Control farms are presented (Figure 2). Similar numbers of stable flies were observed on calves from both treatments until week 11 (mid-August). From weeks 11 through 15 fewer stable flies were observed on calves housed at IPM farms.

Spider Web™ traps were first placed on two IPM farms in June and the remaining three farms in July (Table 2). Farm A required the most traps (23), while Farm D used the fewest (10). Spider Web™ capture data from 2000 and 2001 are presented for comparative purposes (Figure 3 and 4). As would be expected, Farm A captured the most stable flies (33,000) and house flies (200,000) (Figures 3 and 4). Farm B was most efficient at capturing both stable flies (1,600/trap) and house flies (9,700/trap). In total, 77,000 stable flies and 483,000 house flies were removed from the five farms using 75 traps. The house fly is a more prolific breeder and its immatures can develop in more substrates than stable flies, making it more common on dairies. This is possibly the reason the sticky traps captured six times more house flies than stable flies. However, given the large numbers of stable flies captured on the IPM farms (77,000) and their painful bite and annoyance factors the removal of these flies certainly provided relief from this pest for the calves as well as the producers.

The total numbers of flies captured on farms was generally higher in 2001 than in 2000 (Figures 3 and 4). However, Farm C, which had extremely high numbers of flies in 2000 witnessed a drastic drop in fly capture. This was in large part due to improved cultural control practices performed at this farm in 2001 and documents that through these practices dramatic results can be achieved. In 2001, the manure pack at this farm was much drier than in previous years. Since we do not yet have parasitoid data analyzed, it is also possible that parasitism was also higher on this farm. Conversely, the manager of Farm A decided in early July, for labor purposes, to empty refused water onto the calf bedding. This management practice continued until a resultant fly outbreak convinced the producer that cultural control and water management were crucial components to successful fly management. Unfortunately, much of July and August was spent trying to reduce fly abundance using additional Spider Web™ traps thereby resulting in the drastic increase in fly captures for 2001. As presented in the Year 1 report (Rutz et al. 2001), Farm B again had a large fly population despite having limited on-farm breeding. We remain convinced that the flies observed on this farm are produced off-farm.

Fly breeding areas were observed on every farm. Maternity and calf rearing facilities were the primary sources for breeding activity. Breeding areas around bunk silos and feed bunks were also common. At the time of this report, the parasitoids that have emerged from sentinel pupae have not been identified.

Producers were very generous with their time and were positive in their attitude toward this project. Fly management in their facilities was a major concern and they were willing to try new practices. As was expected, the sticky traps were not a "silver bullet" to fly management, but were an important component in an overall strategy. Cultural control continues to exert the single greatest impact on fly populations. When producers (IPM and Control) disposed of refused water out-of-doors and cleaned wet areas below feed and water buckets, fly numbers dropped.

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Table 1. Insecticide treatment records from eight New York dairy farms during 2001.

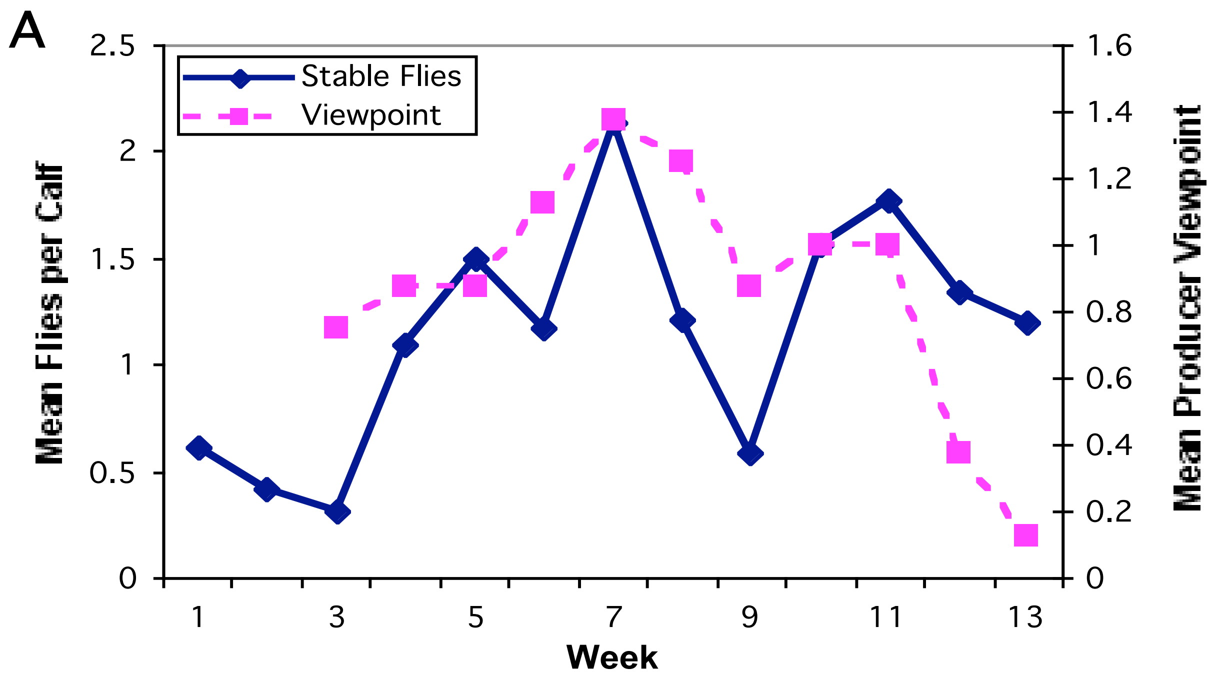
	IPM					Control		
Week	A	B	C	D	E	F	G	I
June 12	--	--	--	--	--	PER	--	--
June 19	--	PYR	--	--	--	--	PYR	--
June 26	--	PYR	--	--	--	PER	--	--
July 3	--	PYR	--	--	--	--	--	DIM
July 10	--	--	--	--	--	PER/MET	--	
July 17	--	--	--	--	--	PER	--	--
July 24	--	PYR	--	--	--	--	PYR	--
July 31	--	PYR	--	--	--	MET	CYF-S	DIM
Aug 7	--	PYR	--	--	--	MET	PYR	--
Aug 14	--	PYR	--	--	--	MET	PYR	--
Aug 21	--	PYR	--	--	--	PER	--	--
Aug 28	--	PYR	--	--	--	PER	--	DIM
Sept 4	--	PYR	--	--	--	PER	--	--
Sept 11	--	PYR	--	--	--	--	--	--
Sept 18	--	--	--	--	--	--	--	--
Sept 25	--	--	--	--	--	--	--	DIM

-- = no insecticides applied; PYR = pyrethrins (spray); CYF-P= cyfluthrin (pour-on); MET = methomyl (bait); PER = permethrin (spray); CYF-S = cyfluthrin (spray); DIM = dimethoate (spray).

Table 2. Use of Spider Web™ traps on five New York dairy farms during 2001.

Farm	Date 1st Trap Placed	Week	Number Traps Used[1]	Days in Place[2]
A	July 3	5	23	13
B	July 3	5	12	14
C	June 19	3	19	14
D	June 19	3	11	19
E	July 3	5	10	16

[1]Number of Spider Web™ traps placed in greenhouse over course of study. Each trap contained two 10-foot lengths.
[2]Mean number of days one length of trap was exposed for fly capture.



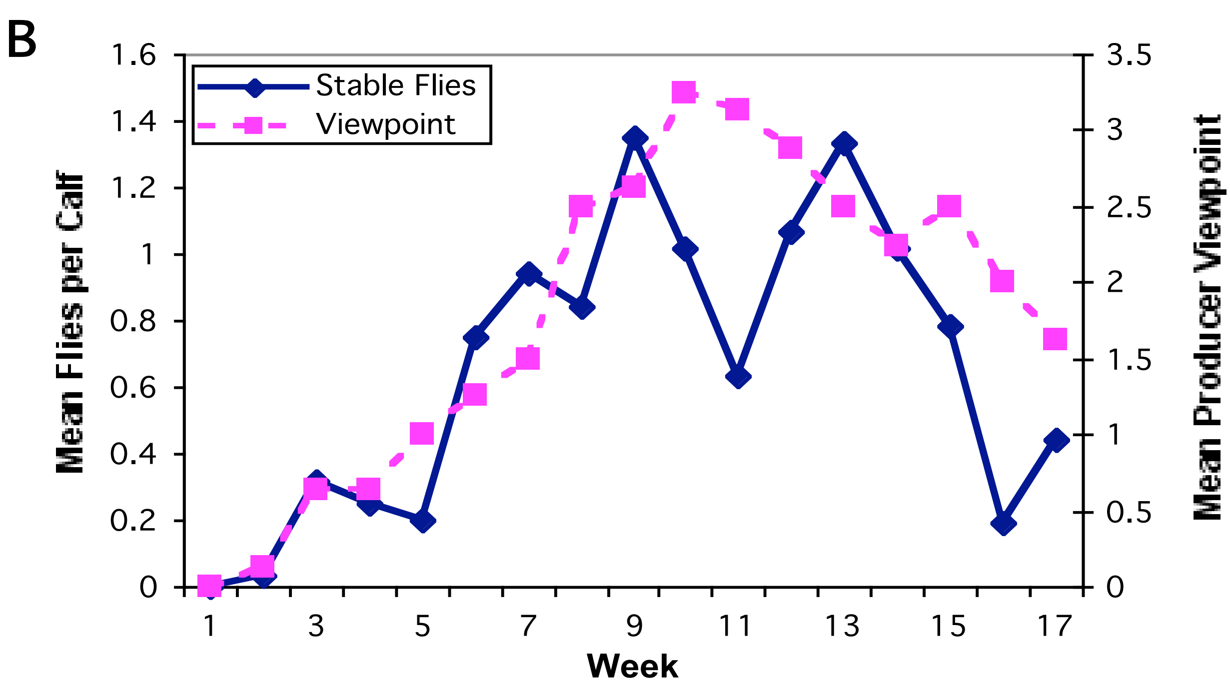


Figure 1. Stable fly leg counts and producer opinion of fly annoyance in eight calf greenhouses in New York during 2000 (A) and 2001 (B).

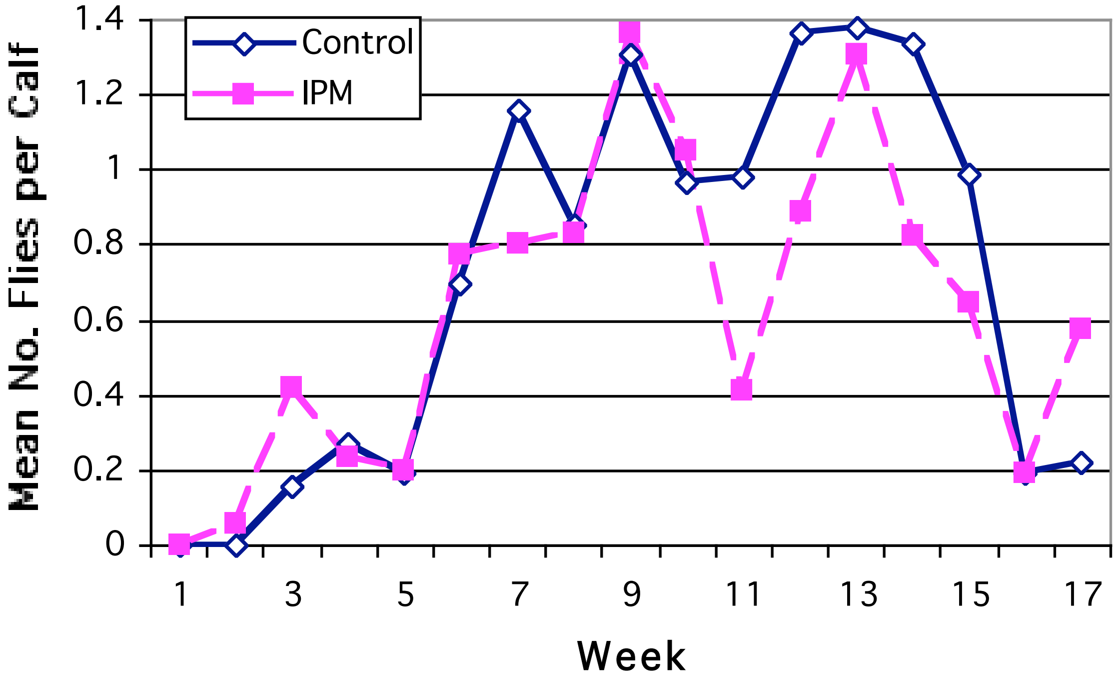


Figure 2. Mean number of stable flies counted on calves at farms under IPM management and farms under standard producer pest management practices in 2001.

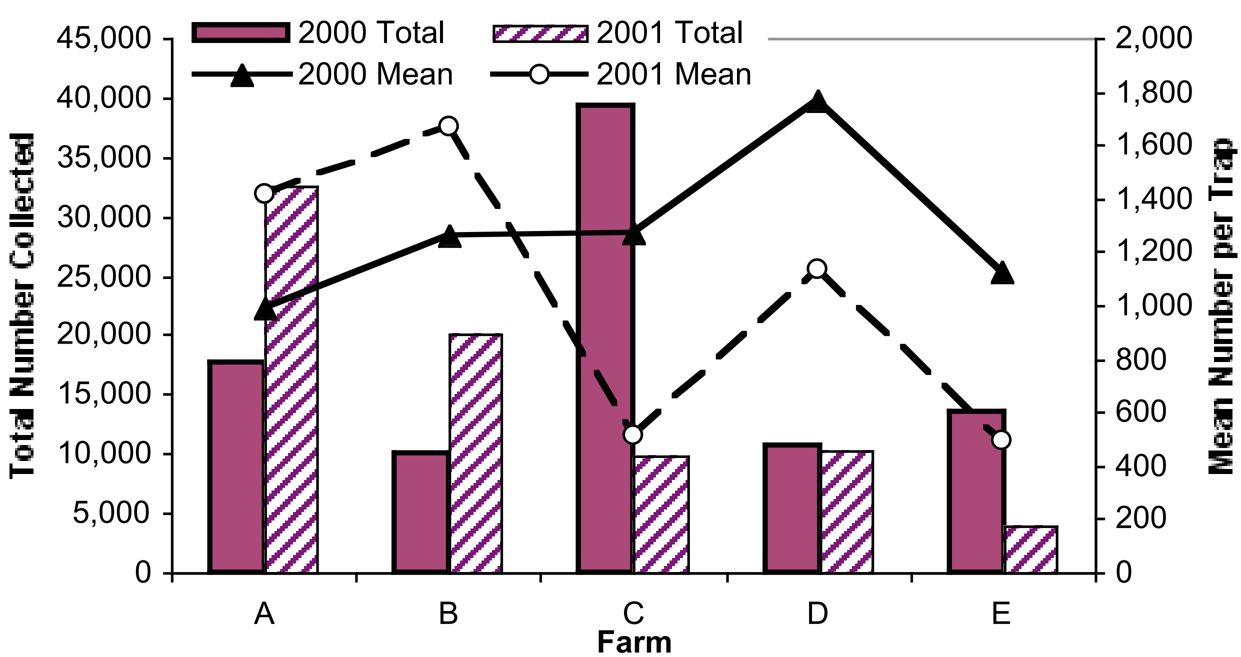


Figure 3. Total and mean number of stable flies captured on Spider Web™ sticky traps during 2000 and 2001.

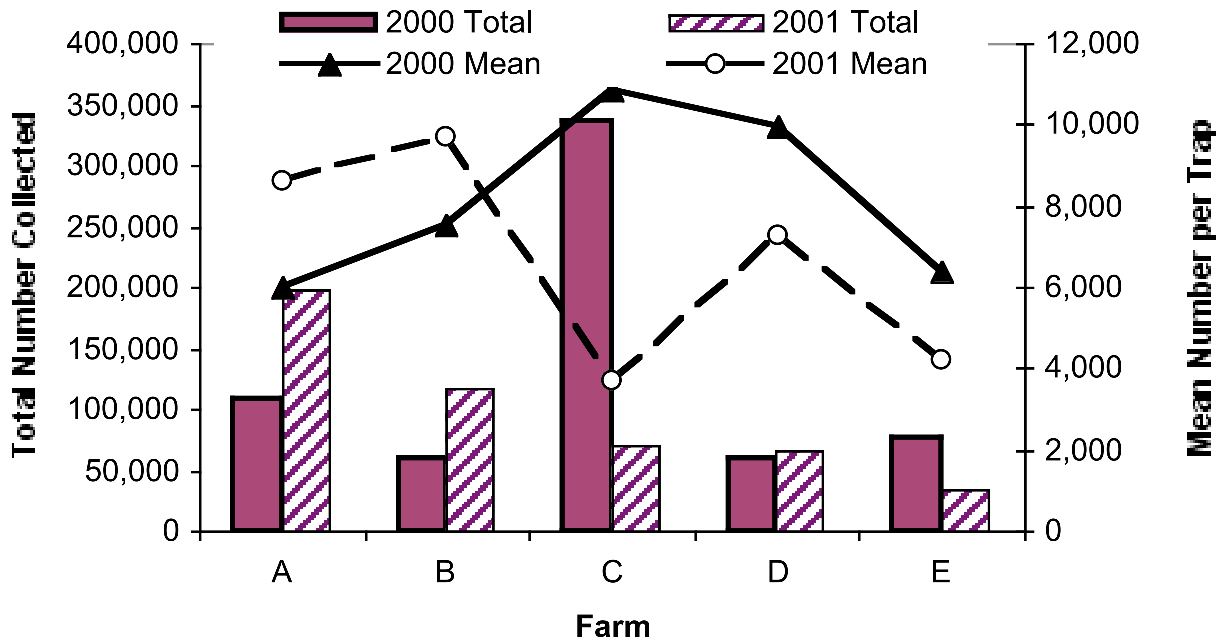


Figure 4. Total and mean number of house flies captured on Spider Web™ sticky traps during 2000 and 2001.