

An Integrated Approach to Managing Fly Pests in Dairy Calf Greenhouses

Project leaders: D. A. Rutz¹, P. E. Kaufman¹ and J. K. Waldron²

¹Department of Entomology, Cornell University, Ithaca, NY

²New York State IPM, Cornell University, Geneva, NY

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 provide 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.

Dairy producer opinions of fly densities on their farms do not reflect the recommended spot card-based fly treatment guidelines. Producers determined that fly densities were high enough to warrant additional management practices spot card data estimated that densities were sufficiently low. Sticky cards and calf leg counts appear to reflect producer perceptions more closely than do spot cards.

Sticky traps removed 641,000 house flies and 91,000 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. 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. We are considering additional IPM strategies for inclusion in the second year of this study.

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 utilized 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. submitted for publication). 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. 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.

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 the results of the first year of a two-year study.

Objectives

Year 1

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.

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. Greenhouses were all of similar construction, however, three had concrete aisles (B, C and F). 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 22 and concluded on September 28, 2000. House fly and stable fly densities were monitored weekly with 10 spot cards, 3 x 5 inch white index cards, and five white sticky cards, 3 x 5 inch, placed equidistantly apart in the rafters of the greenhouse. Cards were positioned approximately 8 ft. above the floor. The numbers of spots per card and number and species of flies on sticky cards were determined weekly. Additionally, stable flies were monitored by counting flies on the legs of 15 calves per farm per week.

At the start of the study (June 22, 1999), 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, sticky 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 previously described objective fly measurements, 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 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 manure 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. 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 average number of flies per inch per respective side.

Producers recorded all 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 generate background parasitoid demography. Sentinel bags contained 30 live house fly pupae and each week, five sentinel bags were placed on each farm and recovered the following week. Pupae were held for parasitoid emergence.

Statistical analysis of the data were not performed as this is an in-progress study. Following the collection of data in 2001, full statistical analyses will be performed. We report on the following data collection methods: Spot cards, sticky cards, animal leg counts, actions taken by producers, impressions of fly annoyance, and Spider Web™ collections.

Results

The mean number of spots per card for each farm type (IPM or Control) document the changing levels of fly activity on the farms (Figure 1a). Initially, fly densities were high on Control farms, however, these levels fell in response to insecticides (permethrin and cyfluthrin) use on two of the three farms (F and G) (Table 1). Fly levels fluctuated over the next few weeks under varied insecticide applications. Fly levels on IPM farms were above threshold (50 spots/card) initially, but fell during week 3, followed by a return to earlier levels during weeks 4 and 5. It was during this time that Spider Web™ traps were first placed in greenhouses (Table 2). A steep decline in fly numbers was observed on all farms during the week 9 (August 17),

followed by a sharp increase in fly densities the following week. This coincided with a cold front and temperatures in the 50-60 °F range. Similar increases in fly numbers are observed annually and result from flies that have typically been residing out-of-doors, moving into the warmer farm buildings. Fly spots declined following week 12, signifying the end of the fly season.

These data are preliminary, but provide insight as to what has been occurring on the farms. The facilities using permethrin (farms F, G and H), saw little relief as this compound is ineffective against house flies (Kaufman et al. in press). In an interview with the operator of farm G, where cyfluthrin was used, the producer noted that the material was effective for less than one week, while in the past applications were only needed every few weeks. This observation is typical of a material that is still somewhat effective, but to which flies are developing resistance. In studies by Kaufman et al. (in press), cyfluthrin was found to kill only 70% of wild-source flies, as compared to 100% of laboratory-susceptible flies.

A sharp rise in fly densities was observed between weeks 3 and 7 on Farm C. During week 7, a calf-care specialist on Farm C was observed pouring refused water in front of calf pens. The producer was informed and this practice was discontinued. Following removal of wet bedding, proper disposal of refused water, and an aggressive placement of sticky traps, fly spots dropped rapidly and remained low for the remainder of the study. As a result, we present the spot card data without Farm C data (Figure 1b) since proper IPM guidelines were not in effect during the first half of the study. The dramatic rise in spot numbers was tempered in late July when fly numbers were high on Farm C, while the increase in spot numbers in late August is greater in Figure 1b (flies were under control on Farm C at this time). These results illustrate that the sticky traps are not a “silver bullet” and that fly management on dairy farms absolutely requires an integrated approach.

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 week 7, followed by a decline in the fly population and the spot card data support this (Figure 2). However, although producers determined that fly numbers increased from week 9 through week 11, the dramatic increase measured on spot cards was not similarly reflected among the producers. The mean number of both house and stable flies captured on sticky cards peaked during week 6 (Figure 3). It appears that the sticky cards were moderately effective in predicting producer viewpoint changes in fly abundance.

Producers appeared to use calf annoyance, as caused by stable fly feeding, as a determinant in their assessment of fly abundance (Figure 4). These data appear to show a close relationship between producer's perception of fly levels and actual fly counts on calves. Stable fly levels peaked during week 7, declined during the cool period around week 9 and again increased during weeks 10 and 11, similar to the spot card data presented earlier. Stable fly numbers as measured by calf leg counts were quite low in this study. Therefore, using the standard stable fly assessment of counting flies on animal legs may not be suitable in greenhouses. This needs to be investigated further.

The Cornell University recommendation for fly spots on dairy farms is 100 spots per card. Producers often reported that additional fly management actions were needed when house fly activity, as measured by spot cards, was below the established Cornell University guideline (Figure 5). Producers with more conservative tolerances of flies may choose to use 50 spots per card as a treatment threshold guideline. These results are a reflection of several factors that merit further investigation. This is a

reflection of several factors and merits further investigation. Among the factors are producer tolerance, observations of stable flies on animals (not measured properly by spot cards), failure of insecticides, and unrealistic expectations (all farms have flies).

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 were also common, however, as the summer progressed, breeding in this substrate became less common.

Data from the annoyance rating system will be presented in next year's final report from this project.

Farms in the IPM group were less likely to use insecticides than Control farms, including two farms that used no insecticides, a third used only fly baits while the fourth used only pour-on products for stable fly management (Table 1). This is in contrast to the three Control farms that relied heavily on pyrethroid-based insecticides. IPM Farm B used weekly applications of pyrethrins. The density of house flies on this farm was large and given the short-term control provided by pyrethrins, it is likely that flies were migrating in from outside sources or that resistance is present. Although, Kaufman et al (in press) reported low levels of resistance to pyrethrins on New York dairies, Farm B applied pyrethrins liberally and may have selected for higher resistance than is common on other dairies.

Spider Web™ traps were placed on all IPM farms in July (Table 2). Farm C required the most traps (31), while Farm D used the fewest (6). As would be expected, Farm C captured the most stable flies (40,000) and house flies (350,000) (Figures 6 and 7). Farm D was most efficient at capturing stable flies (1,750 / trap), while Farm C traps captured over 11,000 house flies per trap. In total, 91,000 stable flies and 641,000 house flies were removed from the five farms using 75 traps. Six to nine times more house flies were captured on traps as stable flies. Given the large numbers of stable flies captured on the IPM farms the use of the Spider Web™ certainly provided relief from this pest for calves as well as producers.

At the time of this report, the parasitoids that emerged from sentinel pupae have not been identified. However, we did recover several species of parasitoids indicating that some level of natural biological control is present (notwithstanding predators and pathogens). The parasitoid complex will be presented in the project final report. Commercially available parasitoid releases on IPM farms is being considered for the second year of this study.

Producers were very generous with their time and were positive in their attitude toward this project. Fly management in their facilities was a 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. We are still puzzled as to the source of house flies on Farm B. This facility was by far the cleanest and driest of the farms, however, spot card records indicate that house fly densities were higher than average and only slightly lower than Farm C (discussed previously). Because of the lack of fly breeding in the greenhouse and the severe spike in fly activity after the cold front moved (week 9), we believe that the house flies were produced either somewhere else on the farm or at an off-farm location. We plan to investigate this further during the second year of this study.

References Cited

- Kaufman, P.E., J.G. Scott and D.A. Rutz. Monitoring insecticide resistance in house flies from New York dairies. *Pest Manag. Sci.* (accepted for publication).
- Scott, J.G., R.T. Roush & D.A. Rutz. 1988. Insecticide resistance of house flies from New York dairies (Diptera: Muscidae). *J. Agric. Entomol.* 6: 53-64.

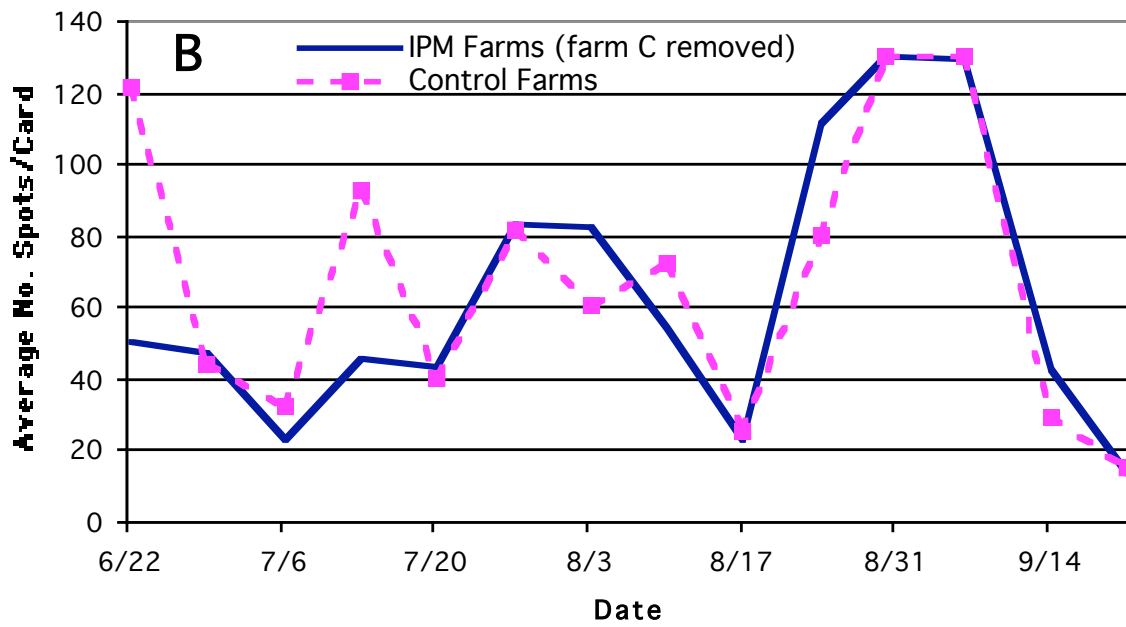
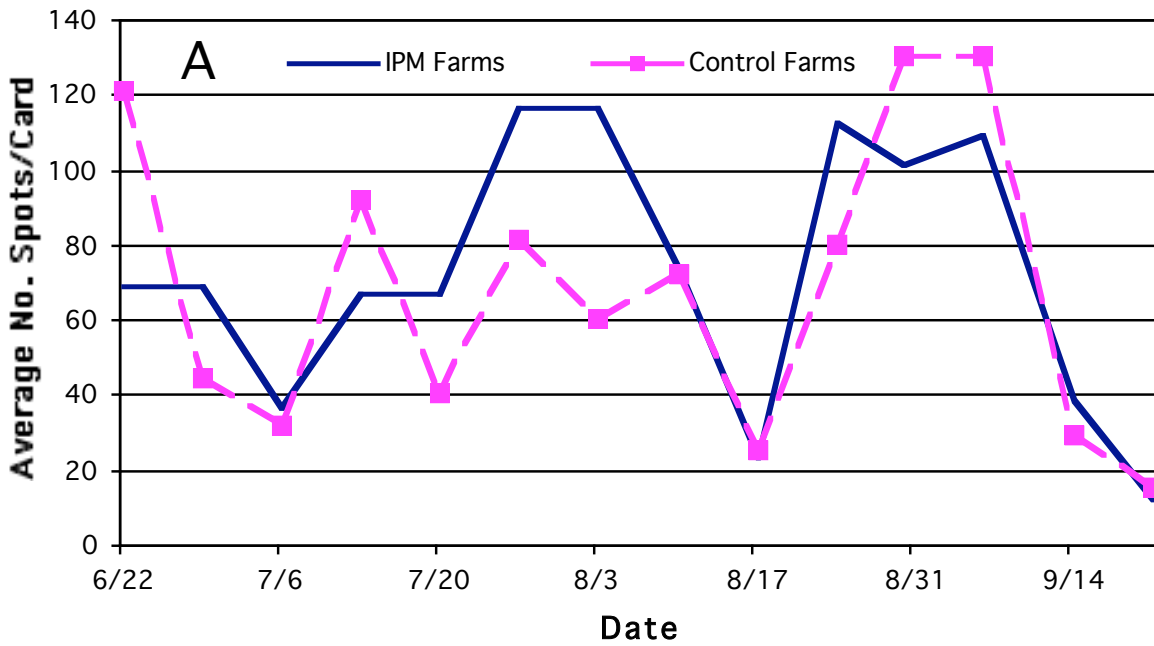


Figure 1. Season long fly densities as measured by spot cards on eight New York dairy farms.

Table 1. Insecticide treatment records from eight New York dairy farms during 2000.

Week	IPM					Control		
	A	B	C	D	E	F	G	H
June 22	--	--	--	--	--	--	--	--
June 29	--	PYR	--	MET	--	PER	CYF-S	--
July 6	--	PYR	--	MET	--	PER	CYF-S	--
July 13	--	PYR	--	MET	--	PER	--	PER
July 20	--	PYR	CYF-P	--	--	PYR/MET	CYF-S	--
July 27	--	PYR	--	--	--	--	CYF-S	PYR
Aug 3	--	PYR	CYF-P	--	--	PER	CYF-S	PER
Aug 9	--	PYR	CYF-P	--	--	--	--	--
Aug 17	--	PYR	--	--	--	PER	--	--
Aug 24	--	PYR	--	--	--	--	--	--
Aug 31	--	PYR	--	--	--	PER	PER	--
Sept 7	--	--	--	--	--	PER	--	--
Sept 14	--	PYR	--	--	--	PER	--	--
Sept 21	--	PYR	--	--	--	--	PER	--

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

Table 2. Use of Spider Web™ traps on five New York dairy farms during 2000.

Farm	Date 1 st Trap Placed	Week	Number Traps Used ¹	Days in Place ²
A	July 6	3	18	15
B	July 13	4	8	19
C	July 20	5	31	12
D	July 29	6	6	21
E	July 6	3	12	14

¹Number of Spider Web™ traps placed in greenhouse over course of study. Each trap contained two 10-foot lengths.

²Mean number of days one length of trap was exposed for fly capture.

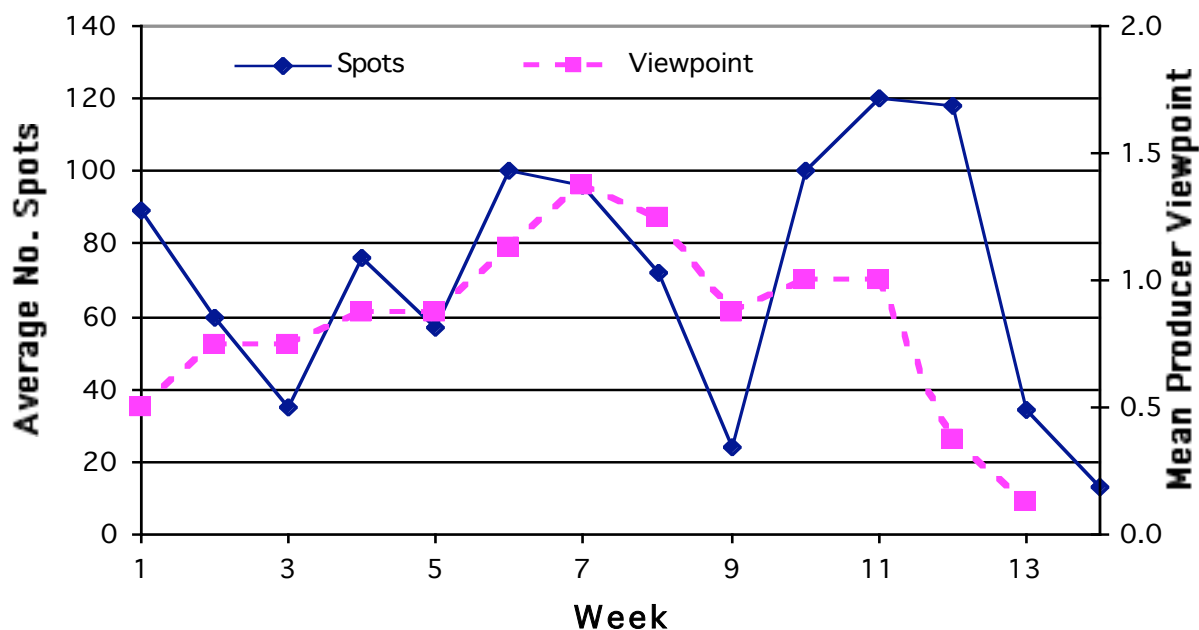


Figure 2. Comparison of producer viewpoints on changes in fly presence and fly densities as measured by spot cards.

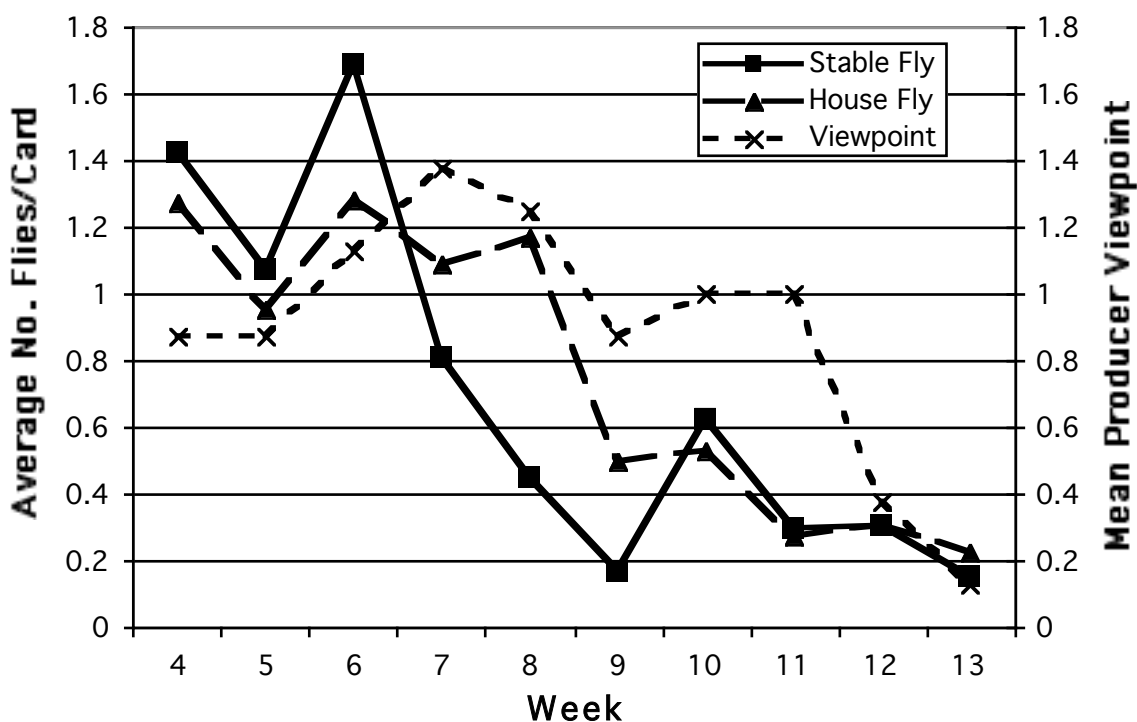


Figure 3. Number of house and stable flies captured on sticky cards and producer opinion of fly annoyance in eight calf greenhouses in New York during 2000.

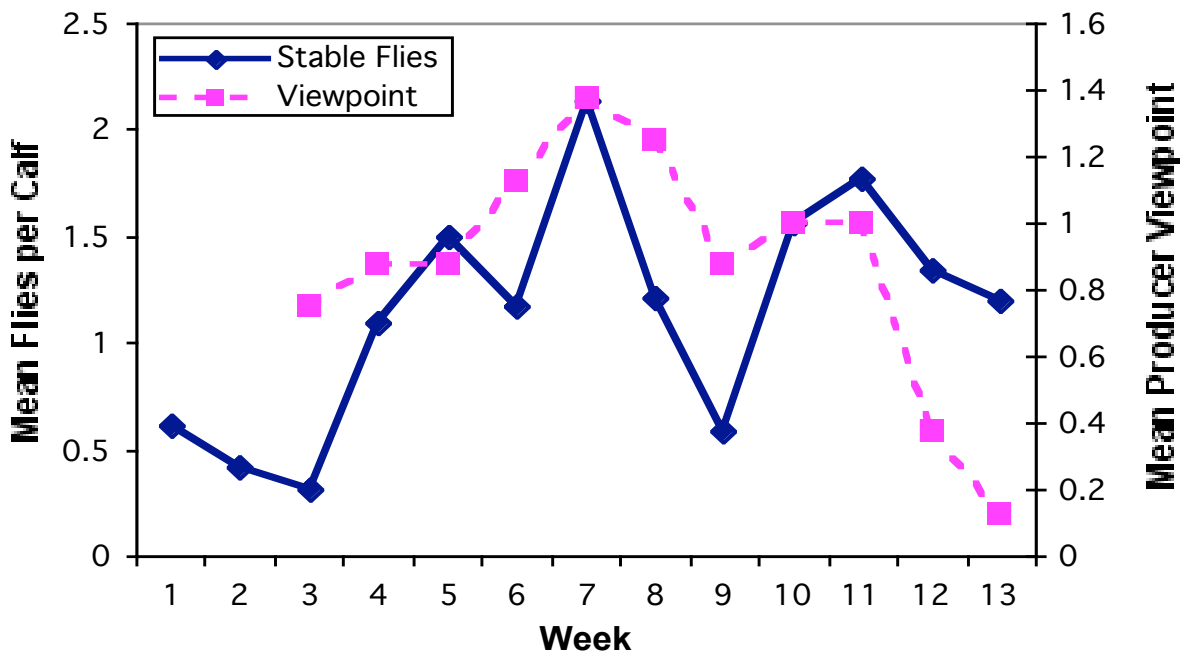


Figure 4. Stable fly leg counts and producer opinion of fly annoyance in eight calf greenhouses in New York during 2000.

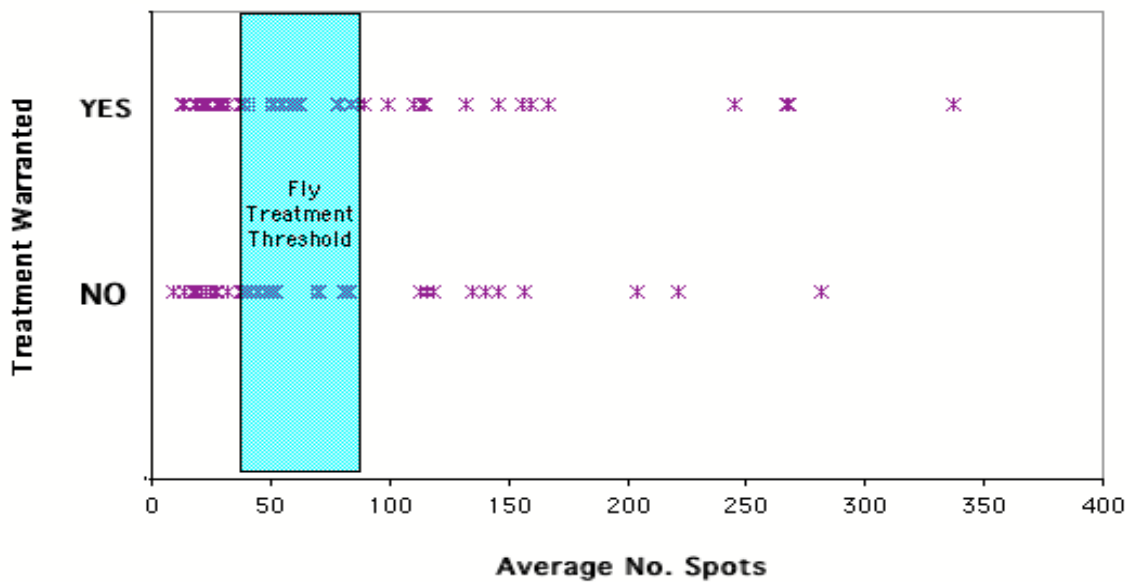


Figure 5. Relationship between producer perception of fly management need and actual fly densities.

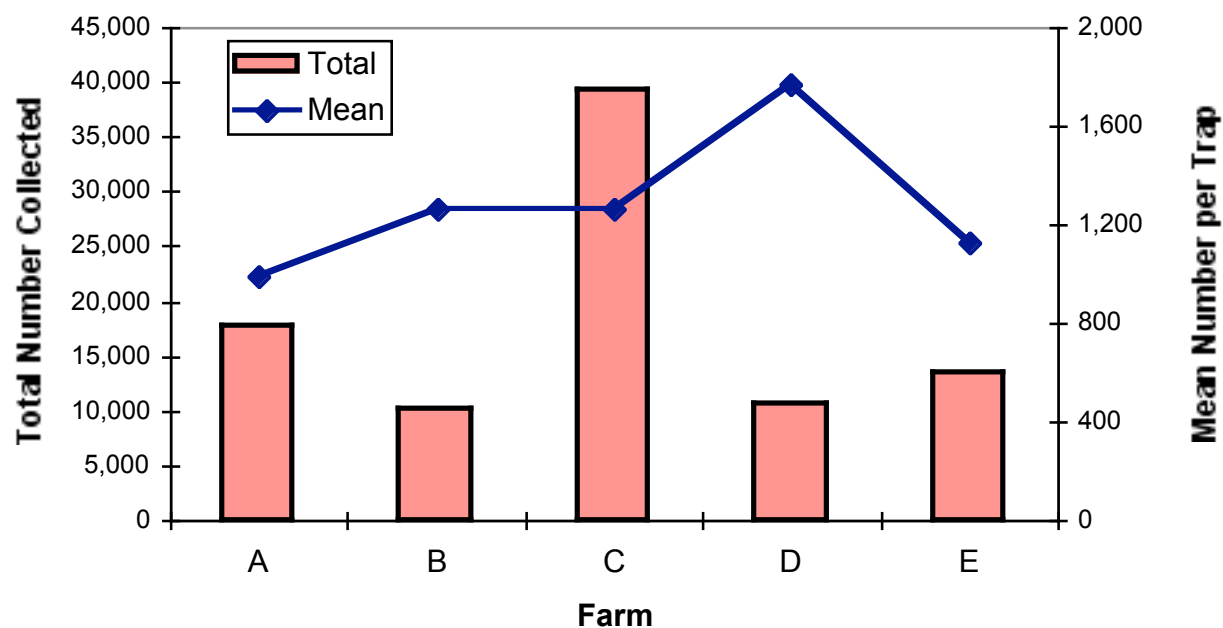


Figure 6. Total and mean number of stable flies captured on Spider Web™ sticky traps during 2000.

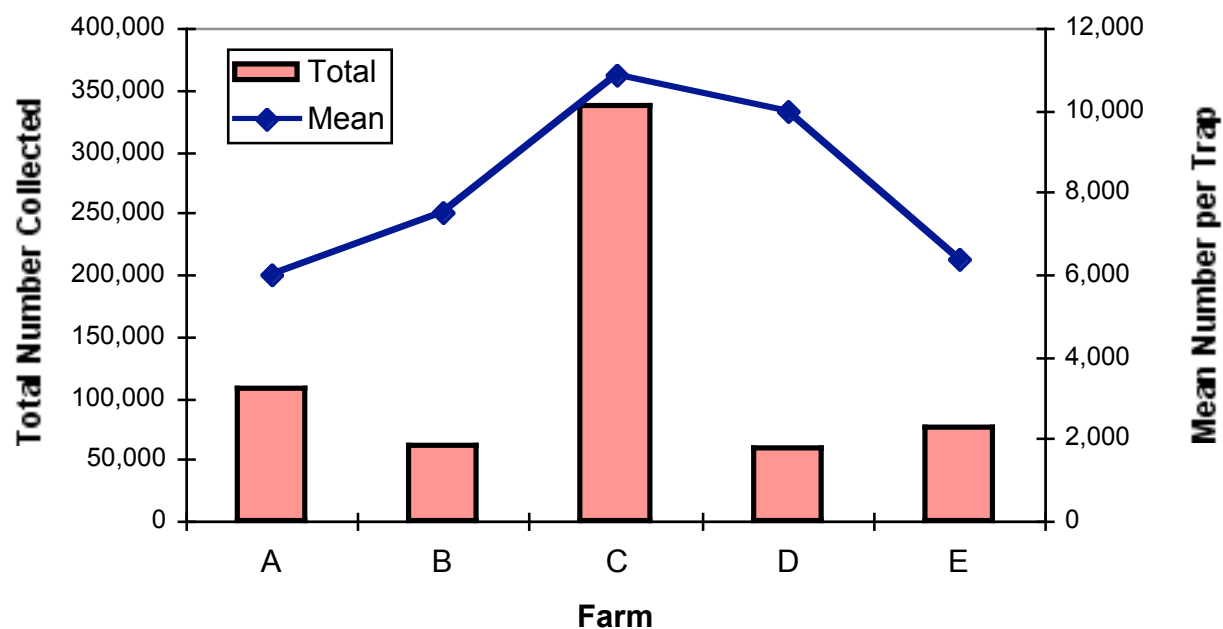


Figure 7. Total and mean number of house flies captured on Spider Web™ sticky traps during 2000.