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Abstract


The stable fly, *Stomoxys calcitrans*, is a cosmopolitan pest of livestock, wild animals, pets and humans. It is a primary pest of cattle in the United States, estimated to cause more than $1 billion in economic losses annually. It also causes dissention at the rural-urban interface and is a problem in recreation areas such as Florida beaches and the Great Lakes. Due to its pestiferous nature and painful bite, methods to control stable flies have been investigated for over a century. A large amount of research has been reported on stable fly biology, ecology, genetics, physiology, and vector competence. For this bibliography, literature has been gathered from journals and other resources available to the authors, and a selected number of articles have been annotated. This bibliography represents an update of literature published since 1980; literature from pre-1980 was included if copy could be ascertained.

**Keywords:** ectoparasites, biting flies, livestock parasites, livestock pests, parasite transmission, pest management, veterinary entomology.

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Introduction

The stable fly, *Stomoxys calcitrans*, is a cosmopolitan pest of livestock, wild animals, pets and humans. It is a primary pest of cattle in the United States, estimated to cause more than $1 billion in economic losses annually. It also causes dissention at the rural-urban interface and is a problem in recreation areas such as Florida beaches and the Great Lakes. Due to its pestiferous nature and painful bite, methods to control stable flies have been investigated for over a century. A large amount of research has been reported on stable fly biology, ecology, genetics, physiology, and vector competence. For this bibliography, literature has been gathered from journals and other resources available to the authors, and a selected number of articles have been annotated. This bibliography represents an update of literature published since 1980; literature from pre-1980 was included if copy could be ascertained. For additional listings of stable fly literature, see also the following two bibliographies:


References

A


The development of eggs, larvae and pupae of *Stomoxys calcitrans* was studied at 20, 25, 30 and 35°C. Duration of each stage decreased with increased temperature. The best temperature for development was 25°C, and 35°C proved harmful to larval development.


Behavioral responses of stable flies to chemostimulants were categorized into 4 steps: activation, orientation, attraction and probing. The main stimuli included human breath, a human hand, and CO2. The highest response occurred when there was no air flow to disperse the odor. CO2 induced activation but not probing.


A stable fly salivary gland protein, a homolog of insect antigen 5, was tested to determine whether the protein suppressed bovine lymphocyte production, to determine specificity of the protein, and to test whether calves immunized with Ag5 would produce antibodies and memory lymphocytes. A recombinant form of the protein was used in the study, as well as the natural form.


Transmission of poliomyelitis by stable flies was tested using monkeys. Two monkeys were inoculated with the virus, and then exposed to several hundred stable flies. The flies were then allowed to bite healthy monkeys. The healthy monkeys that were bitten by the flies which had fed on the inoculated monkeys soon also acquired the disease. It was concluded that poliomyelitis could be transmitted by the bite of stable flies.


This research describes the mating behavior of Stomoxys calcitrans, comparing blood-fed (BF) and non-blood-fed (NBF) males with receptive and non-receptive females. It tests the virility and mating aggressiveness of BF vs. NBF males, as well as the ability of each test group to inseminate the receptive females. It was reported that only 6.31% of the NBF males were able to inseminate the receptive females, and it was a partial insemination. BF males were able to fully inseminate all the females within 12-24 hours. Reportedly, a blood meal causes the cells to enlarge around the ejaculatory duct, resulting in the accessory glands producing enough seminal fluid to transfer the sperm. However, after inseminating 2 or 3 females, the males lose their mating drive. Dissection of the accessory glands showed that the seminal fluid was depleted. It was concluded that male Stomoxys calcitrans need a blood meal before they can properly inseminate a female.


The experiments of Rosenau and Brues, which exposed flies to monkeys infected with poliomyelitis and subsequently allowed them to bite healthy monkeys, was cited, as well as experiments conducted by Frost. It was concluded that the transmission of poliomyelitis by flies was mechanical only, that flies were not biological vectors.


Reviews the economic importance of controlling stable flies and house flies on cattle. Describes the feeding habits, life cycle and breeding habits of the flies in South Dakota, as well as control methods. Suggests IPM as the most effective method of control.


Laboratory experiments were conducted to study the feeding response of stable flies to whole blood, plasma, erythrocyte fractions, platelets and saline. The flies fed on whole blood, plasma and erythrocyte fractions but not the platelets or saline, indicating that the phagostimulants could be ATP, ADP, AMP and cAMP.


Twenty-three microsatellite markers were isolated from *Stomoxys calcitrans*, 17 of which were polymorphic. Number of alleles per locus ranged from 2-9. Three microsatellite loci isolated by Gilles et al. (2004) were used for comparisons, and were successfully isolated.


A new method of rearing stable flies (modified from Champlain & Fisk 1954) is described. Adults are housed in larger cages, 36 X 36 X 36 inches, and fed blood with 5% sodium citrate to prevent coagulation. Larval medium is a modified CSMA. Eggs were buried 1” deep, kept at 28°C and 50% RH, which prevented fungal growth. A layer of sand was placed on the larval medium to prevent fungal growth, water was sprinkled on it on day 2, and a crust formed on day 6. The crust was crumbled into a fine consistency and watered. It was watered again on the 9th day which caused the mature larvae to begin pupariation.


Flies were collected in sweep nets at different places in and around a poultry facility in Brazil. The two most numerous species (*M. domestica* and *M. stabulans*) were analyzed for gonadotrophic profile. Stable flies were the least numerous species captured, and only newly emerged females and females ready to oviposit were collected. This led to the conclusion that stable flies use the poultry facility specifically to lay their eggs.


A review of the biology and life history of Macrochelidae, with emphasis on the efficacy of *Macrocheles muscaedomesticae* as a biological control agent for the house fly, *Musca domestica*. The mite is known to parasitize other dung-breeding diptera including *Stomoxys calcitrans*. However, *S. calcitrans* is not as attractive to the mite as *M. domestica* and seems to lack the nutrients needed by the mite. It has been reported that *M. muscaedomesticae* could destroy 3-4 stable fly eggs per day if offered these eggs in laboratory tests.


Flight mill studies and release-recapture experiments were conducted to evaluate the dispersal capabilities of stable flies. Flies were found to fly up to 29 km in the flight mill. Very few flies in the release-recapture experiment were recovered because the flies were not attracted to the traps. Flies were found up to 2 miles from the release site. These experiments were conducted to evaluate the possibility of using the sterile insect technique for the control of stable flies.


Techniques for rearing stable flies for the sterile male release program are described. The program is designed for rearing 1 million flies per week. Laboratory life cycles at different temperatures are studied to determine the number of eggs per fly and length of life stages. A modified larval rearing medium is described which consists of wheat bran, bagasse (sugar cane waste) and water.


Experiments were conducted with Tabanids and Stomoxys calcitrans to determine if these flies were cyclical vectors of Trypanosoma evansi, the causative agent of Surra disease. The experiments were unable to verify cyclical development of the parasites in the intestines of the flies.


Flies were captured in Manitoba traps and by sweep netting around cattle and frozen until dissection. Parameters measured were wing length and damage, stage of ovarian development, number of eggs in one ovary, and amount of blood feeding. The survey concentrated on the 2 most numerous muscids, Hydrotaea irritans and Morellia simplex, however data is included for two Stomoxyine species, S. calcitrans and Haematobosca stimulans.


Two populations of laboratory reared stable flies (2500 and 3500 flies) were analyzed for the presence of Vitamin A in their bodies, to investigate whether the vitamin was necessary for vision in this species. One population was fed dextrose, the other was fed blood. No Vitamin A was found in either population, but the researchers suggested that it may be found if only the heads were analyzed.

Barker, R. W., B. Stacey, and R. Wright.  Beef cattle ectoparasites. Oklahoma Cooperative Extension Service VTMD-7000. Oklahoma State University, Division of Agricultural Sciences and Natural Resources.


Tests were conducted to determine if stable flies responded to the height of sticky traps when flying, whether traps should be set a certain distance from the ground or from the top of the vegetation. Stable flies did not change their flight due to height of the traps. It was found that trap height should be constant with vegetation (20 cm above grass) and not ground level.


The attractiveness of CO2 to male stable flies was tested in the laboratory using a wind tunnel and compared with field catches on Nzi traps. Results showed that the majority of male flies flying upwind toward the CO2 were 2-3 days old, and most of the older males flew downwind, away from the CO2. This suggests that stable flies are attracted to CO2 only for the purpose of host location, since they need a blood meal to become sexually mature.


Twenty-two dairies in south-central Ontario were monitored for stable flies to investigate their origins, either by long distance migration or local sources from overwintering. Models were divided into farms as refuges: (H1) all are refuges, (H2) some refuges, (H3) none are refuges, and (H4) long distance migration. Overwintering flies were found at 3 dairies at the southern part of the research area, adjacent to Lake Ontario. This suggested the H2 model that some dairies were refuges for overwintering, and some flies arrived by long distance migration.

Several farms in southeastern Nebraska were monitored for stable flies over the winters of 1987, 1988 and 1989. Adult flies were found inside barns and caught on Alsynite traps. Breeding sites were sampled for immatures. The results of the study showed evidence that stable flies overwinter as developing immatures in silage, manure piles and grass clippings.


The usual method of collecting stable fly pupae from larval rearing medium is by floatation, but with this method the age of each pupa is not known. The new method of collecting pupae consists of a shelf at the end of the larval rearing pan containing a sponge wrapped in a towel to retain moisture. The wandering larvae climb onto the shelf to pupariate, and the sponge keeps the area moist enough for the pupae. The pupae can be collected each day, and they are free of debris from the rearing media.


Daily feeding patterns of stable flies were documented during the summer in 1981 and 1982, and the time and weather conditions were examined to investigate any correlations between these factors and feeding patterns. The most important weather factor was temperature, but relative humidity, radiation and wind also had some effect on stable fly feeding. In Nebraska, stable fly feeding follows a unimodal pattern, the maximum being during midday with less feeding at sunrise and sunset.


The design and operation of a new chilling table for immobilizing insects is described. The tables recirculate air more efficiently than previous methods, reducing the condensation. The tables are used by ARS for immobilizing stable flies, horn flies and mosquitoes.


The effect of temperature, solar radiation, relative humidity and wind speed on the number of stable flies captured on alsynite traps was tested using one trap in Kansas and 4 in Nebraska. Number of flies caught on traps had no correlation with number of flies on the cattle. Temperature,
relative humidity and solar radiation had significant effects on number of flies captured, but wind speed had no effect.


A number of chemicals were tested for attractiveness or repellency to 5 species of cattle flies, including Stomoxys calcitrans. Methods used were gas chromatography-electrophysiology (GC-EAG), gas chromatography-mass spectrometry (GC-MS), electrophysiology (EAG), lab behavior and field studies. S. calcitrans responded to several chemicals of each type: amino acid derivatives, fatty acid derivatives, and isoprenoids or derivatives. Of the chemicals which elicited responses in all fly species, 1-octen-3-ol and 6-methyl-5-hepten-2-one were attractants and naphthalene, linalool and propyl butanoate were repellents.


The efficacy of DDT to control stable flies was tested in two horse stables along the Gulf Coast in NW Florida. Stables were sprayed every 10-12 days, and the DDT continued to kill flies for 12 days in one treatment and 13 days in another. The treatment had no effect on the outside of the barn. As a spray used directly on the horses, DDT gave 100% kill for one hour, partial protection for 2-4 hours, and had a toxic effect on stable flies for several days.

The efficacy of using DDT emulsions for the control of stable flies breeding in marine grasses was tested in northwest Florida. This was to replace the current method of using creosote mixed with bay water, due to the economic cost of the current method. DDT was found to produce 99-100% control of stable flies in marine grasses.


Stable fly larvae were reared in different manures (cattle, horse, swine and chicken), bermudagrass hay and pine wood chips, alone and in combinations of manure and vegetation. The highest percent pupation occurred in horse manure, horse manure/hay mix, and the hay alone. The highest mean pupal weight occurred in horse manure. The chicken dung was the least effective manure for larval rearing, and no larvae survived on the wood chips alone.


A device for measuring and marking flies is described. The device restrains the fly with less risk of killing the fly by handling with fingers or forceps. It is used without anaesthetics, which also reduces fly mortality. The method was reported to have been used for 2 years, with 90% and 96% success rate, respectively.


The use of sand as the top layer in larval rearing media is reported to control the growth of mold. The sand adds volume to the media, and larvae remain beneath the sand layer. Their activity suppresses growth of mold beneath the sand. The larvae migrate into the sand layer to pupate. For stable flies, the sand must be moistened 1 day prior to pupating, otherwise they will pupate at the sand-media interface rather than in the sand layer. The sand also facilitates collection of the pupae by filtering.


An antimicrobial peptide is identified in the anterior midgut of the stable fly, Stomoxys calcitrans, which demonstrates antimicrobial activity against Gram-positive and Gram-negative bacteria, fungi and yeast. The AMP, designated “stomoxyn”, also has trypolytic activity against the trypanostigote (bloodstream) form of Trypanosoma brucei rhodesiense, the parasite which causes African trypanosomiasis. Since S. calcitrans feeds on the same vertebrate hosts as Glossina spp., the presence of this unique AMP may explain why S. calcitrans is not a cyclical vector of trypanosomiasis. Additionally, stomoxyn is adult specific, suggesting that it protects the stable fly from microbes entering the midgut with blood meals.


Life history and breeding media of the stable fly are discussed. The external mouthparts, method of feeding, and digestive system are described.


A management system for the control of flies at the Durban Remount Depot was described. An average of 3300 animals, mostly horses, mules and donkeys, were maintained at the depot. The management practices consisted of removing all the manure daily and putting it into trenches. It was then covered with sand or earth. The stables were cleaned and treated with a contact spray after removal of the manure. The management practices proved effective for the control of flies.


A study was conducted near Manhattan, KS to determine whether the wasted hay from large round bales served as breeding sites for stable flies. Three methods were used to make surveys. Core samples were taken from the sites where round bales had been placed throughout the winter; flies were caught on alsynite traps placed in pairs close to the feeding sites and far from the feeding sites; a mark-release-recapture survey was done. Results suggested that sites where round hay bales are placed during winter feeding make good breeding sites for stable flies.


Describes a new cage designed for rearing and feeding adult horn flies and stable flies, including a method for maintaining the proper humidity for horn flies.


Test herds of dairy cows treated with DDT or Rhothane maintained higher milk production than herds treated with a repellent spray. A correlation was found between stable fly and horn fly control and milk production. The greatest responses to treatments were found in the poorly managed herds that depended on pasture for feeding.

Bruce, W. N. and G. C. Decker. 1957. Experiments with several repellent formulations applied to cattle for the control of stable flies. J. Econ. Entomol. 50: 709-713.


Populations of stable flies, horn flies and face flies were monitored on Kentucky horse farms from May-October of 1987 and 1988 to study seasonal abundance and distribution of the flies. Stable flies were most abundant from mid-June until late August during both years. A smaller population peak was observed in September 1987 but not in 1988. Distributions of stable flies were influenced by the horses congregating, mating swarms, and the proximity to ovipositional sites.


The behavior of stable flies was observed at some livestock facilities near Gainesville, FL. Flies gathered on light-colored objects near livestock. All ages and reproductive stages gathered, suggesting that the primary purpose was thermoregulation. Male flies were found to remain on the “waiting stations” and make short flights to patrol their territory. They were also observed to engage other flies in physical conflict. Mating also occurred near the “waiting stations”.


A review of the effects of certain ectoparasites, primarily the horn fly, on the health and weight gain of cattle. Stable flies are not specifically discussed.
A method for rearing a large number of stable flies is described. It is similar to the method described by Peet-Grady (1951) for rearing house flies. Flies are provided with bovine blood by soaking cellucotton in water, squeezing it dry, and pouring blood over the cotton. Oviposition occurs in the food dishes, eggs are removed and put in beakers. They are then put into the larval medium, where they stay below the surface and pupate near the edges of the cage. Pupae are placed in holding cages for emergence.

A guide for the control of insects which affect horses. Mentions that stable flies can transmit a nematode parasite (*Habronema spp.*) to horses.


This study investigated the effectiveness of applying low volume (LV) and ultra low volume (ULV) insecticides to cattle by helicopter and fixed-wing aircraft for the control of stable flies and horn flies. Both feedlot cattle and range cattle were sprayed, and the average percent reduction in flies ranged from 40.4-85.8%, 16-24 hours after spraying. ULV applications of naled and dichlorvos by fixed-wing aircraft were found to be more effective than LV applications, and spraying was more effective when buildings and other obstructions were farther away from the cattle.


Six insect growth regulators, 5 insecticides, and a bacterial agent were evaluated for the control of stable flies in Nebraska feedlots. Studies were conducted on small plots and large plots. All of the treatments were efficacious in controlling stable fly populations. Since the IGRs affect specific life stages, there was a lag phase before the reduction of stable fly numbers. The authors suggest that the addition of IGRs would be beneficial in a fly control program.


A field experiment was conducted to determine the effect of stable flies on pastured yearling cattle as compared to feedlot cattle. Sprays and ear tags were used to eliminate horn flies and face flies as factors. An attempt was
made to maintain the economic threshold of 5 flies per front leg by releasing flies in the area, however the number varied. Results showed a 19% reduction in weight gain due to stable flies, or ~7% per fly.


exposed to low, medium, and high levels of stable flies (Diptera: Muscidae). J. Econ. Entomol. 86: 1144-1150.

The affect of stable flies on Brahman-crossbred and English X Exotic heifers was compared using low, medium and high densities of released stable flies. The Brahman-crossbred heifers showed tolerance to stable flies only at 12-13 months of age. At 13-14 months of age, both breeds responded the same to stable flies. Average daily gains of the Brahman-crossbred heifers were lower than the English X Exotic when stable flies were not present.


A mathematical equation was developed using nonlinear regression to calculate the economic injury level for stable flies on feeder heifers. The data was based on 8 separate experiments conducted from 1974-1991. The equation results in a negative exponential curve, and can be used to calculate whether selected control measures are appropriate for the stable fly infestation level.


Yearling Brahman cross and English X exotic cross heifers were exposed to a medium level of stable fly infestation (13-14 flies per minute on one front leg) daily for 112 days. Stable fly infestations reduced heifer weight gain from 1-84 days of treatment. From 85-112 days, when heifers were 15 months old, the fly infestations no longer reduced the weight gain. It was suggested that by this age the heifers had reached maturity and began to compensate from previous loss due to stable fly feeding. Breeds were not affected differently by stable fly feeding.


Tests were performed to determine the amount of metepa required to sterilize screwworm flies and stable flies. Topical treatments and feeding treatments were used. Stable flies were much more susceptible than screwworm flies. In topical treatments, the male screwworm flies required 5.5 times more metepa than male stable flies, where female screwworm flies required 18 times more than female stable flies. In feeding treatments, male screwworm flies required 3.9 times more than male stable flies, and female screwworm flies required 6.2 times more than female stable flies. Differences in the weight of the two species were considered in the calculations.


Screwworm flies require a much greater dose of metepa than stable flies to produce sterility. Rate of absorption, excretion, and detoxification of metepa was analyzed in screwworm flies and stable flies in an attempt to determine why this was the case. Multiplying the results of these three factors together gave a value that was comparable to the ratios of effective dose in stable flies and screwworms.


Some modifications of Campau’s (1953) rearing method for stable flies are described. A sponge is provided for oviposition, and sand is added to the larval medium for easier removal of pupae. It was also found that using a UV lamp stimulated oviposition so it was utilized instead of natural light.


Two applications of dimethoate were applied to the walls and ceilings of 2 dairy barns and loafing sheds to test its insecticidal effect against horn flies, house flies and stable flies. The applications were performed on June 10 and August 14, 1959. Dimethoate was found to be effective for up to 9 weeks against house flies and horn flies. Results for stable flies were inconclusive because the flies disappeared from the barns, including the control barn, shortly after the application. Residual effect from the first application seemed to enhance the effect of the second application. No dimethoate residue was found in milk from lactating cows.


The efficacy of oil-based and water-based 2% Ciodrin sprays were tested on cattle for control of face flies, horn flies and stable flies. Cows were
sprayed as they walked through a doorway using a “push-button” sprayer. Oil-based Ciodrin had a greater toxic effect initially, but the water-based has a longer lasting residual effect. Although there was a reduction in the number of flies per cow, better results could have been obtained with stable flies if the legs had been sprayed instead of only the head, neck and back of the cows.


The effect of 1-5 blood meals on the growth of the ultimate and penultimate follicles during the first ovarian cycle in stable flies is examined. Follicular growth rate was the same for flies given a daily meal and those supplied with blood ad libitum. In blood fed females, the fat body increased after the first blood meal, then declined. In sugar fed females the weight of fat body and ovaries did not change. Stable flies were found to require 2 to 3 blood meals to build up the nutrient reserves needed for oogenesis. Five blood meals were required to produce the first batch of eggs. Follicle growth after blood meals followed an exponential curve.


The methods used to rear a colony of *Stomoxys calcitrans* to the 4th generation was described. The colony was started in New Zealand for the purpose of shipping a population to Kerrville, TX. Pupae of the 4th generation were shipped by air in vacuum flasks.


Inflated beach balls of different colors and coated with adhesive trapped more stable flies on Florida beaches than Alsynite traps.


Different colored plastic boards (blue, red, white, orange) were coated with adhesive and tested for trapping stable flies on Florida beaches. More flies were trapped on the blue boards than any other color, although blue was not significantly different from red. Flies tended to land on the leeward side of the boards. This experiment investigated the efficacy of traps to reduce the number of flies on the beaches.


A brief summary of stable fly behavior, economic importance, biology and control.


Resistance to the organophosphate insecticides dichlorvos, stirofos and the pyrethroid permethrin was tested in stable flies from 8 Kansas feedlots. Resistance was found to all of these chemicals, being highest for dichlorvos and lowest for permethrin. Six of the 8 populations were tested for resistance to methoxychlor, but no resistance was found.


A study was conducted to determine the types of flies occurring on several types and ages of dung in Southeastern Washington. Adults were collected with sweep nets, and samples of dung were collected from which larvae were reared. *Stomoxys calcitrans* was found only on cow and
chicken dung, in one location only (Pullman), from June-August. They were reported to be rare in the area.


Discusses advances in control of biting flies from 1964-1966, with a section on stable flies and tabanids. Research on New Jersey and Florida beaches concerning the control of these flies is cited. The use of the WHO tsetse fly kit was used to determine tolerance levels to some chemicals in stable flies. Resistance to dieldrin was found in the Panama City, FL strain of stable flies, and resistance to DDT in the Kerrville, TX strain.


The analgesic response of mice to biting flies was tested using intact stable flies, stable flies with mouthparts removed, and house flies. After being exposed to intact stable flies for 1h, fly-naïve mice exhibited an analgesic response when subsequently exposed to intact flies, but there was no analgesic response when exposed to altered stable flies or house flies. However, mice which had previously been exposed to intact stable flies exhibited an analgesic response when exposed to altered stable flies, but not house flies. This suggests that the analgesic response of mice is induced by the bite of a fly, and that just the presence of biting flies could have adverse effects on animals in an anticipatory manner.


Female stable flies were dissected, and the muscles and epithelium of the oviducts were studied under an electron microscope. These structures were characterized at the cellular level. Occurrence of a fragmented Z line in the muscle cells suggest the ability for super contraction in the stable fly ovarian muscles.


The ultrastructures of peripheral nerve cells, branch nerves, and nerve-muscle junctions were examined in the oviduct of stable flies. Flies were dissected and observed by electron microscopy. The characteristics of the nervous system in that location were described.


Contains a brief summary of stable fly biology and control.


Stable fly populations were surveyed on 2 dairy farms in Aguascalientes State, Mexico, which has a semi-arid climate, over 3 years. The surveys were divided into 4 phases: increasing phase I (April-September), fluctuation (September), increasing phase II (October) and decreasing phase (October-December). Relative humidity had a high effect on population size during the increasing phase I, and temperature had a high effect during the decreasing phase. Rainfall had no significant effect of stable fly populations.


A survey of fly species collected from chicken manure in Alabama from 1950-1952. Stable flies comprised 1.374% of the collected species.


D


The control of stable flies along the northern Florida shoreline using creosote oil mixed with diesel oil is described. Shoreline grasses were sprayed with the treatment from September 4-October 20, 1941, along ~700 miles of shoreline. The treatment reduced stable fly populations from 1000 eggs, 15.4 larvae or ~25 adult flies per square foot to zero population. Creosote remained viable in the grasses for 18-30 days.


Eagleson, C. 1938. Resistance of Stomoxys calcitrans (L.) to laboratory application of pyrethrum spray. J. Econ. Entomol. 31: 778.


Several thousand stable flies, horn flies, house flies and mosquitoes were marked with $^{32}$P and released at Buffalo Well in Lake County, Oregon. Bait animals were stationed 1 and 5 miles from the release site, at 8 locations, and traps were placed near the bait animals. The area around the release site was primarily sagebrush. A number of stable flies were recaptured at stations 5 miles from the release site after only 1 hour and 45 minutes. Direction of flight followed wind direction. No flies were recaptured to the north, which was against the wind.


The physiological and nutritional responses of steers were measured in the lab when exposed to 0, 10, 20, or 30 stable flies for 15 minutes, 3 times per day. Flies were caged, and put on the backs of the animals. Heart rate, respiration, rectal temperature, amount of feed consumed and waste produced, and nitrogen and cortisol concentrations were measured. No signs of stress were recorded in the steers during the experiment.


During the warm summer and autumn months flies attack many dogs of different breeds kept outdoors throughout Hungary. These ectoparasites, as they feed, cause damage usually at the edges, tips and/or bases of the ears. The flies' bites result in severe irritation to the skin, causing dermatitis. The skin is covered by bloody crusts and scabs. The painful bite of flies usually causes restlessness, head shaking and scratching the ears, leading to further irritation and bleeding. Based on the species identification of flies caught on four infested dogs the specimens of the common stable fly, Stomoxys calcitrans (Diptera: Muscidae) occurred. The authors summarize the biology of the blood-sucking fly species,
which is also called "dog fly" in some countries. The treatment of the affected dogs and the control possibilities are also discussed.


Baited fabric targets and electrocution devices such as those developed by Vale (1993) were tested for their efficiency against stable flies. These cloth targets were made of blue and black cloth, and captured 6 times more stable flies than Alsynite traps.


microorganisms carried by synanthropic flies caught at different rural location in Germany. J. Med. Entomol. 46: 1164-1166.


A review on the blood feeding behavior of insects including several families of Diptera, which devotes half a page to *Stomoxys calcitrans*. The mouthparts and feeding process are described, and feeding stimuli discussed. Gatehouse (1970) is cited as saying that olfactory stimuli do not induce probing, but probing can be induced when chemoreceptors on the tarsi contact ATP or leucine. It is suggested that many different factors induce the feeding of stable flies.


A survey was done in 15 counties of Northwest Florida and neighboring counties in Alabama and Georgia to identify potential areas for stable fly breeding sites. One of the main sources of stable flies seemed to be on livestock farms which fed green chop and silage, and these were within 70 miles of the Florida beaches. Stable flies had been reported to breed in marine grasses, but migration from the farms was also likely as they can migrate long distances. The livestock farms are a possible source for the stable flies on the Northwest Florida beaches.

G


A new morphological character is described to differentiate between the stable fly species *Stomoxys calcitrans* and *S. niger*. It was found that the maxillary palpi are longer in *S. niger*, regardless of sex, and the character is visible in the field using a magnifying glass. Populations of both species were studied at different elevations on La Reunion Island, and populations in West Africa were surveyed to confirm the consistency of the character.


Experiments were performed on each life stage of stable flies to determine their tolerance of salinity. Eggs were placed on filter paper with different salinity concentrations (20-160 parts per thousand). Studies for survival and development were conducted in beakers. Larval rearing media was treated with 6 solutions of NaCl from 10-34 ppt. Larvae and pupae were weighed to monitor development, and adult longevity was determined. Salinity was most harmful to larvae. Survival declined at salinity of >25ppt, and no larvae survived to pupariation at concentrations above that of sea water (34 ppt). Salinity also had a negative effect on fecundity in adult flies.


Reviews the economic injury level of stable flies on cattle, identification of stable flies, and how to determine the abundance of flies using the count of 5 flies per front leg or 10 tail flicks. Discusses control methods including sanitation to reduce larval development sites, knockdown or residual spray for control of adults, using sprays on cattle, and biological control.


Mark-release-recapture experiments were conducted on Mackinac Island, Michigan to examine the dispersal patterns and of stable flies. The island was populated with 500-600 horses each summer, transported in for recreational purposes. Flies were obtained from the USDA lab in Gainesville, FL, marked with different colors for each area and each release, and recaptured on adhesive panel traps. Dispersal was found to coincide with host location and availability, not wind direction.


Literature on the responses of blood-feeding Diptera to host stimuli are reviewed and summarized, including the effect of wind, biotic factors, long- and short-range responses to olfactory cues, and visual responses. Includes research on Glossinidae, Muscidae, Tabanidae, Culicidae, Ceratopogonidae, Phlebotominae and Simuliidae. Discusses chemical attractants, responses to colors, efficacy of the different traps.


Eight microsatellite markers were isolated from \textit{Stomoxys calcitrans} from La Reunion Island. Number of alleles per locus ranged for 4-15. Several heterozygote deficiencies were detected. Four of the microsatellite loci were successfully isolated from \textit{S. niger}.


Laboratory experiments were conducted to compare the survival and developmental rate of the immature stages (eggs, larvae, pupae) of \textit{Stomoxys calcitrans} and \textit{S. niger niger} at five different temperatures (15, 20, 25, 30 and 35°C). \textit{S. calcitrans} had a significantly higher survival rate than \textit{S. niger} at 20°C. At 15°C, there was high mortality for \textit{S. calcitrans} larvae and \textit{S. niger} eggs. The pupae of both species had high mortality at
35°C. Results suggest that the tropical *S. niger* is better adapted to lower temperatures than *S. calcitrans*.


Laboratory experiments were conducted to compare life history parameters of *Stomoxys calcitrans* and *S. niger niger* at five different temperatures. In the first experiment, all life stages were reared at the same temperature (15, 20, 25, 30 and 35°C). In the second experiment, immature were reared at 25°C and the adults were exposed to different temperatures. Mean adult longevity was greatest for *S. calcitrans* at 20°C, however they experienced high mortality perhaps due to an inadequate larval diet in these experiments.


The efficiency of 2 Alsynite sticky traps (Williams trap and Broce trap) and 2 phthalogen blue cloth traps (Vavouva and Nzi) were tested on 2 farms on La Reunion Island. Total fly catches were higher on the sticky traps but they were less specific to *Stomoxys* spp. On farm 1 the Vavouva trap proved more efficient for catching *Stomoxys*, but on farm 2 the Williams traps was more efficient. Considering that the cloth traps can hold more flies and are easier to use than the Williams trap, the results supported the use of the Vavouva trap as part of a stable fly control program.


*Stomoxys calcitrans* and *S. n. niger* were sampled on La Reunion Island, on 7 farms along an altitude gradient (100m-1600m above sea level) to examine the effects of temperature on fly abundance. There was no relationship found between maximum or mean abundance and temperature, but minimum numbers during winter were higher at the lower altitudes. A greater difference was found between fly abundance and husbandry methods of the farms.


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Portuguese with English summary).

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laboratory screening tests. J. Econ. Entomol. 46: 982-985.

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stable fly larvae. J. Econ. Entomol. 51: 228.

A short note that adding vermiculite to the standard CSMA fly rearing
medium produces better results when rearing stable flies. A modified
recipe and procedures are included.

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Dipteres Stomoxys calcitrans L. et Chironomus cingulatus M.G. Trans. 9th
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some arthropods of public health and veterinary importance: livestock

Graham, O. H., and J. L. Hourrigan. 1977. Eradication programs for the arthropod

Granett, P. 1960. Use of an animal membrane in the evaluation of chemical
repellents against the stable fly. J. Econ. Entomol. 53: 432-435.

Granett, P., and H. L. Haynes. 1945. Insect-repellent properties of 2-
Ethylhexanediol-1,3. J. Econ. Entomol. 38: 671-675.

Granett, P., and H. L. Haynes. 1955. Use of Cyclethrin in livestock sprays for
control of flies. J. Econ. Entomol. 48: 409-412.

Granett, P., and E. J. Hansens. 1956. The effect of biting fly control on milk

Granett, P., and E. J. Hansens. 1957. Further observation on the effect of biting fly
control on milk production on cattle. J. Econ. Entomol. 50: 332-336.


Greenberg, B. 1965. Flies and disease. Do flies spread disease? Surprisingly the evidence is still inconclusive. Efforts to provide an answer have nonetheless yielded significant information on the nature of infection. Sci. Amer. 213: 92-99.


Lists the pathogens of stable flies, the incidence rate, location and life stage affected.


A pamphlet on the use of parasitoid wasps for the control of house flies and stable flies in feedlots.


Thirty Holstein heifers were used to study the efficacy of organophosphate-impregnated ear tags against horn flies and stable flies in Argentina. The ear tags had no effect on stable flies, and during 6 weeks of the study, the treated animals had more stable flies than the control group.


The overwintering ability of *Muscidifurax zaraptor*, *Spalangia cameroni* and *Urolepis rufipes* (Hymenoptera: Pteromalidae) were examined. Pupae of *Musca domestica* were exposed to the parasitoids and placed at different depths in silage. The parasitoids were also of different ages. Second/third instar larvae were most successful at overwintering, and the greatest survival was at a depth of 0-3 cm. *Spalangia* spp. were less tolerant of cold conditions than the other two species.
H


Hale, K. M. 2011. Proximate causation of stable fly (Stomoxys calcitrans (L.) host use: the influence of phenology and host blood suitability. Doctoral Dissertation. Montana State University, Bozeman, MT.


Hansens, E. J. 1951a. The stable fly and its effect on seashore recreational areas in New Jersey. J. Econ. Entomol. 44: 482-487.

A survey was conducted to determine the numbers and breeding areas of stable flies on Island Beach in New Jersey in 1946-47. Flies were so abundant that they were causing losses in tourism at beach resorts. Outbreaks of flies were found to coincide with west winds, and flies would breed in the vegetation that was washed ashore. Flies were controlled with .5% DDT.


Fenvalerate ear tags reduced fly loads on dry dairy cattle by 95 % between July and September. Fly dislodging behaviour, such as ear flicks which correlated with numbers of Musca autumnalis on the face and stamps/kicks which correlated with numbers of Stomoxys caldtrans on the legs, was also significantly reduced. There was no significant difference between the tagged and untagged groups in the total time spent grazing each day. Milk yields were not statistically significantly different, but the tagged group showed a greater increase in milk yield between lactations, of 1-45 kg/cow daily in the first 12 weeks of the lactation.


Three chemicals, apholate, aphoxide and methaphoxide, were tested for inducing sterility in stable flies. The chemicals were applied topically to the flies, and apholate was tested as a residual film. All of the compounds induced sterility in the flies.
Experiments were carried out to determine the age at which stable flies first mate after adult emergence, the number of females a male fly will inseminate, and whether females mate only once. They found that males would begin to copulate with females at 1 day after emergence, but did not transfer sperm until 2 days old. Males were found to mate with 2-9 females. Females mated only once unless they were not inseminated during the first mating. If this was the case they would mate again until inseminated.

Stable flies were obtained from New Zealand, Japan, Thailand, and South Africa, and mated with the lab-reared colony at Kerrville, TX to test mating compatibility. All crosses were found to be compatible. This experiment was conducted to determine compatibility for the SIT control method.

Feeding activity of horn flies was monitored in the lab and on a steer, and compared with the feeding activity of stable flies. Feeding activity differed between lab and host trials, the feeding taking twice as long on a host. They also fed more often on the host, the average number of
feedings being 24 for males and 38.4 for females, whereas on a blood pad in the lab they only fed from 7.5-10.5 times per day. In contrast, stable flies feed ~2 times per day.


Herms, W. B. 1943. Medical entomology: with special reference to the health and well-being of man and animals. The Macmillan Company, New York, N.Y.


The Pteromalid wasps *Trichomalopsis dubius* and *Dibrachys cavus*, pupal parasitoids of the house fly and stable fly, are described. The key by Rueda and Axtell (1985) is modified to include the newly discovered species. Biological notes, field and laboratory observations and distribution of the species are included.


This is a discussion of the immune responses in insects, including phagocytosis, encapsulation by blood cells, and antimicrobial peptides. It focuses on the antimicrobial peptide defensin, which is produced in the anterior midgut, and discusses the work by Lehane on the defensins found in *Stomoxys calcitrans* midgut. It is suggested that the midgut not only produces defensins, but triggers an immune response from other tissues.


Attractant self-marking devices (ASMDs) were tested using different colors and varying amounts of fluorescent dust, for their effectiveness in
attracting stable flies. The devices were made using Williams traps coated with fluorescent dust. No significant differences were found between colors or amount of dust, and the number of flies caught on the fluorescent traps was comparable with the number caught on Williams traps without dust. The only difference found was with arc yellow, which attracted so many butterflies that it was impossible for the stable flies to become stuck on the traps. The results show that Williams traps can be used to estimate the number of stable flies per day marked by ASMDs set up at the same locations.


A report of ongoing and proposed projects to determine whether control of stable flies in agricultural areas would have an impact on the number of flies on the beaches. Ongoing projects include a survey of stable fly populations on dairy farms and on the beaches, and a survey of hymenopteran parasitoids. Proposed projects include mark-release studies and rate of blood digestion.


An experiment was conducted to compare the attractiveness of CO2 and CO to stable flies. Malaise traps were baited with CO2 and CO, which was released at 3L/min. for 3 consecutive days. Six traps were used at 2 sites, 3 traps for each gas, and control traps were also used. Hoy found that the traps emitting CO2 attracted significantly more stable flies (2-6 X) than either the CO or the control traps. He concluded that the “release of CO2 increased the catch of the traps”. Finally he discussed two methods of generating CO2 for the purpose of trapping stable flies in a dairy environment.


I


Electroantennograms and wind tunnel experiments were used to measure the response of stable flies to several chemicals emitted by rumen digesta. The strongest response was elicited from dimethyl trisulphide, which is found in cheese flavor, human skin odor, and livestock wastes. Other attractants included carboxylic acids, butanoic acid, p-cresol and skatole. Ketones were also detected in the rumen volatiles, and are stable fly attractants that are found in human or bovine breath, skin odor, and human sweat. This study supported previous findings that oct-1-en-3-ol is not a stable fly attractant by itself.


Several laboratory experiments were conducted to test the oviposition behavior of stable flies using horse and cow dung. In the first experiment, flies were caged and dung was placed beneath the cage. Flies could not access the dung but could locate it by olfactory cues. Next, the flies were
given access to both types of dung. In both experiments the flies preferred horse dung. When given access, they oviposited in the horse dung but avoided the cow dung, only ovipositing in the vicinity. Flies were also tested in a wind tunnel, where they also preferred horse dung. In electroantennogram tests, the chemostimuli were similar in both attractants, however more CO₂ was emitted from horse dung.


Field studies were conducted to determine the amount of nectar feeding in wild stable flies. In flies collected on Florida beaches, 11.8% of males and 22.8% of the females had fed on nectar. Of flies collected on dairies, 2.9% of the males and 7.4% of the females had fed on nectar. Lab experiments were conducted to compare the longevity of stable flies fed honey solutions, pollen and water, or sucrose solutions. A 32% pollen diffusate produced the greatest longevity, with a maximum of 19 days. Males fed only sugars were not able to fertilize the females. Females fed only sugars did not show egg development beyond stage I.


A lab experiment was conducted to test the reproductive rate and longevity of stable flies given different treatments of sugar and blood meals: blood ad libitum with sugar ad libitum, morning, evening or none; sugar ad libitum with blood morning, evening or none. Water was supplied ad libitum. The highest reproduction and longevity were achieved with the blood ad libitum: evening nectar treatment. They concluded that moderate nectar feeding was not harmful and may aid in the survival of dispersing flies, but feeding on too much nectar may be detrimental to reproductive rate. Blood feeding was necessary for both reproduction and longevity.


A review of the dispersal of certain synanthropic Diptera, including house flies, screwworm flies, stable flies, midges and black flies. Discusses techniques used to monitor dispersal, and technology for future research.


Supercooling points were determined for egg, 3rd instar larvae, newly emerged adults and feeding adults of horn flies and stable flies. Chilling injury was also studied at 4°C. Eggs had the lowest supercooling points, and 3rd instar larvae had the highest. All stages of both flies were freeze intolerant. Both species had similar patterns between life stages, and the horn fly was found to be more adapted to colder overwintering sites than the stable fly.


K


Notes on the parasites of cattle and their control, including descriptions of the house fly and stable fly, horn fly and face fly, cattle grubs and lice.


An extension fact sheet to aid in the identification of fly pests, some nonpest species, parasitoids and predators. Includes photos and descriptions of several species of flies at different life stages.


Tested the effect of juvenile hormone analogue MV-678 on different life stages of the stable fly. MV678 was incorporated into the larval diet, applied topically to puparia, and applied topically to 6-hour-old adults. In the larval experiment, a high percent of pupae were formed at the lowest concentration, but there was no adult eclosion during the entire experiment. Some pupae were found to contain pupal-adult intermediates. No treated adults survived more than 7 days. The experiment demonstrated that MV-678 would be an efficient control for stable flies.


Outbreaks of *Stomoxys calcitrans* along the Northwest coast of Florida led to the search for breeding places for the species. Cattlemen on inland farms claimed that the flies migrated inland from the coast, and the largest concentrations of flies occurred on the beaches after a northerly wind. Investigators inspected turtle grass, *Thalassia testudinum*, and manatee grass, *Halodule wrightii*, and found no stable fly larvae, nor did they find larvae in the decaying organic matter in the marshes. Females were purported to oviposit in black humus soil but no larvae were found in that location. However, larvae and pupae were discovered in *Sargassum*, a brown seaweed which gets washed up on the beaches.


Lab tests were conducted to test the efficacy of the mite, *Macrocheles muscaedomesticae*, as a predator on house flies (*Musca domestica*), stable flies (*Stomoxys calcitrans*), and blow flies (*Phormia regina*). The mites were effective on eggs and 1st instar larvae of *M. domestica* and *Phormia regina*, but had no significant effect on those of *Stomoxys calcitrans*. The stable fly eggs were not attractive to the mites.


Kunz, S. E. 1981. Biological activity of Bay Sir 8514 against the stable fly in laboratory studies. Southwest. Entomol. 6: 147-149.


Developmental times of egg, larval and pupal stages of the stable fly were investigated in a laboratory experiment using the temperature of the larval medium rather than air temperature. Immatures were reared at 75, 85 and 95ºF (23.9, 29.4 and 35.0ºC). The data were calculated as percentage of time spent in each stage. Time spent in each stage was shortened as temperature increased, except at 35ºC, where the 3rd instar larval stage and pupal stage were lengthened.

Kunz, S. E., R. L. Harris, B. F. Hogan, and J. E. Wright. 1977. Inhibition of development in a field population of horn flies treated with diflubenzuron. J. Econ. Entomol. 70: 298-300.


Counts were taken of house flies and stable flies 10 times per week over a year to estimate the rates of population increase in central Florida. A 45x45cm grid was used for house flies, and counts per animal were used for stable flies. Observations were made at a dairy farm, a horse stable, a hog farm and a poultry farm. Stable flies were not counted at the poultry farm. Rate of increase under these natural conditions, from one generation to the next, were relatively low, generally less than $6\times$.


The structure of Stomoxyn, an antimicrobial peptide from the gut epithelium of the stable fly, *Stomoxys calcitrans*, was studied in solution. Stomoxyn exhibits antimicrobial activity against both Gram + and Gram – bacteria, some fungi, and the trypanosome *T. brucei rhodesiense*. The structure of Stomoxyn is similar to cecropin A.


The path of water, sucrose solution, and blood were traced in the alimentary canal in stable flies of different ages. Newly emerged flies generally refused water for the first 2 ½ hours, sucrose for the first 4 hours, and blood meals for the first 12 hours. In younger flies, water and sucrose went mainly to the midgut, with a small amount going to the crop. Blood meals were found to go to both the crop and midgut in flies under 16 hours of age. However, as the flies aged, the amount of water and sucrose going to the crop increased, as did the blood going to the midgut. By 16 hours of age, all of the blood imbibed was going to the midgut. The time required for digestion of a blood meal is reported to be 24-36 hours at 20-21°C and occurs in the posterior part of the midgut.


Examines digestion of a blood meal in Stomoxys calcitrans by electron microscopy. The midgut is divided into 3 zones, the fore midgut (reservoir), the opaque zone, and the posterior midgut. Results show that the stable fly has different methods of storage and secretion of digestive enzymes in the midgut than other insects. Storage of digestive enzymes in S. calcitrans occurs in secretory membrane bound vesicles derived from the endoplasmic reticulum.


Two antimicrobial peptides were isolated from the anterior midgut of *Stomoxys calcitrans*. Designated Smd1 and 2 (Stomoxys midgut defensins 1 and 2), they are defensins which exhibit anti-Gram-negative activity. Smd1 and Smd2 are expressed exclusively in the anterior midgut, unlike other insect defensins which are expressed in the fat body and hemocytes. This suggests that the anterior midgut, where blood meals are stored before digestion, may have its own immune activity as a protective measure against microbes entering the midgut with the blood meal.


All life stages of *Stomoxys calcitrans, Musca domestica* and *Drosophila melanogaster* were exposed to high concentrations of ozone. There was a
detrimental effect on egg hatch (15-17% reduction). No detrimental effects were observed in the other life stages. In house flies (the only species used in adult tests), egg production was increased five-fold by ozone exposure.


Data are compared with the effects of the insecticides on stable flies.


A review of the role of semiochemicals in host location and the potential for the use of semiochemicals and pheromones for the control of biting flies. Describes the use of semiochemicals in traps and discusses the most common chemicals used. Offers suggestions for potential control methods using pheromones and semiochemicals and the importance of isolating more of these chemical signals.


Information on control measures for flies, including preventative (sanitation), non-chemical and chemical control methods.


Stable fly populations were monitored on 4 dairies near Lethbridge, Alberta during 1989, 1990 and 1991 using alsynite traps and leg counts on cattle. In 1989, fly populations increased from May-August, with peaks occurring in late August and again in late September. In 1990, the populations began increasing in late June-early July, with a minor peak in late August and a major peak in late September-mid October. In 1991, the populations increased as in the previous years, but had only one peak in mid-September. The highest rainfall occurred during May and June. The data suggested that stable flies overwinter in the area and become abundant in the 2nd or 3rd generation.


Lab experiments were conducted to examine the relationship between life history parameters of the stable fly and temperature. All life stages were studied individually, including preovipositional period and fecundity. The optimal temperatures for stable fly development in this experiment were between 25-30°C.


Stable fly larvae were reared on egg yolk agar with added cultures of certain bacterial species isolated from a stable fly colony. Bacterial species evaluated were Acinetobacter sp., Aeromonas sp., Empedobacter breve, Flavobacterium odorum, and Serratia marcescens. Stable flies did not develop on uninoculated plates. Larvae died during the 1st instar on plates inoculated with Aeromonas sp. and Serratia marcescens. Larval survival and percent adult emergence were greatest on plates inoculated with Acinetobacter and F. odorum. Larval survival in some mixed cultures were greater than in pure cultures, and lower in other mixed cultures.


repas de sang et conséquences épidémiologiques. Parasite 15: 611-615 (In French).


McCoy, C.W. 1963. Mass liberation of laboratory reared parasites *Spalangia muscidarum* (Richardson), for control of *Stomoxys calcitrans* (L.) and
Musca domestica (L.) in Lancaster County, Nebraska. M.S. Thesis, University of Nebraska, Lincoln.


The rearing method for stable flies at the Kerrville, TX. laboratory is described. It is simpler than methods described earlier, and consists of mixing 1 part CSMA with 5 parts wood shavings. Eggs are placed in a 7 x 9” jar and maintained at 80°F. Larvae feed on the medium, and pupate under the dry layer that forms. If the medium becomes too moist, a small amount of rolled oats can be added. Pupae can be left undisturbed, and adults removed as they emerge. Adults are placed in another cage and fed citrated beef blood. Oviposition sites are provided which consist of a ball of damp cotton covered with black cloth. A 5% ammonia solution is applied to stimulate oviposition.


Lab experiments were performed to test the mean length of the wandering phase of stable fly larvae, mean time to 50% pupariation and rate of pupariation at 3 different moisture levels and different light levels. The effect of larval density was also tested. Stable flies pupariated fastest and had the greatest survival rate at the moderate moisture level of 67% (compared with 17% or 84%). Temperature had an effect on rate of pupariation: mean time to 50% pupariation decreased with increased temperature. Density had no effect on mean time to 50% pupariation, or on rate of pupariation.


Experiments were conducted to determine the effect of different moisture levels, temperature, light, osmolality and pH on pupariation site selection of stable fly larvae. Larvae chose the highest moisture level (71%), but survival was highest at medium levels. They chose a temperature range of 24-28°C and survival was highest at 26°C. More pupae were found at the highest pH (9.3) but survival was highest at 7.2 and lowest at 9.3. They chose the lowest osmolality (111 mmol/kg) and survival was highest at the higher levels (254 and 403 mmol/kg). Most larvae pupariated in the dark and tended to aggregate.


The efficacy of fiberglass panels treated with permethrin was tested as a control for stable flies in the laboratory and in the field. The fiberglass panels act as an attractant to the flies, and once in contact with the permethrin they die within 24 hours. When permethrin was applied to traps at .5g/m², 98-100% of the flies died within 24 hours for the first 3 weeks, and 90% in the 4th week. When the concentration was increased to 2.5g/m², over 99% of the stable flies in the test area were killed over a 6-week period. The authors calculated that using 1 trap for every 5 domestic animals would decrease the stable fly population by 30%.


A large number of Stomoxys calcitrans were reared in the laboratory to monitor life history parameters under constant temperature and humidity. Egg incubation period, larval and pupal periods were monitored at 25°C and 30°C. Two different rearing media were used at each temperature for larvae and pupae. Length of the pupal period was monitored under different relative humidity.


The incubation period of 9 species of muscoid flies were compared at temperatures ranging from 59°F-109°F, in 5-degree intervals. Both high and low temperatures were found to slow egg hatch. Eggs of Stomoxys calcitrans hatched between 79-94°F.


Two peptides, dromyossuppressin (DMS) and leucomyosuppressin (LMS) suppress the spontaneous contractions of visceral muscle in insects. These peptides were previously isolated from *Stomoxys calcitrans*, and in this study they were isolated from *Hematobia irritans*. Neurons reactive to LMS were located in both species.


The corpora cardiaca of the stable fly and tsetse fly were studied, and unique elementary neurosecretory granules (ENG) in the intrinsic neurosecretory cells (INC) were described. Those of *Stomoxys calcitrans* contain square or rectangular granules, whereas *Glossina morsitans* has spindle-shaped ENG. The shapes are unique to these dipterans.


A survey was conducted to compare management practices between dairies in southern and central California, with the purpose of determining which contained more breeding sites for house flies and stable flies. It was concluded that different management practices influenced fly breeding.


The residual properties of microencapsulated permethrin with an emulsifiable concentrate solution were compared on the shoulder and leg hair of lactating dairy cows. Microencapsulated permethrin was found to remain on the hair much longer than the concentrate. It remained on the shoulders of the cows longer than on the legs due to daily washing of the legs. The use of permethrin against stable flies on dairy cows is questioned since stable flies attack mainly the legs, and the permethrin is washed off the legs relatively fast. This also raises the possibility of stable flies acquiring resistance to permethrin due to the low dose on the legs of the cows.


Weekly searches for stable fly and house fly breeding sites were made at 3 small feedlots, 1 large feedlot and one dairy. One-time searches were made at an additional 25 feedlots, all in eastern Nebraska. Breeding sites
were classified into 16 categories, and the distribution of fly breeding in these areas was studied. Spilled feed was the major breeding site on large feedlots; drainage ditches, fencelines and empty lots were the main source on small feedlots; and stored manure and straw bedding were the main breeding site at dairies.


Pteromalid parasitoids were released on 2 California dairies and their affect on stable fly and house fly populations was evaluated. Results showed that the releases had no significant effect on fly populations, perhaps because of the number of other dairies in the vicinity and the ability of flies to disperse.


The efficacy of painted plywood Nzi traps was compared with that of the phthalogen blue cloth Nzi traps for capturing stable flies and Tabanids. Traps were baited with 1-octen-3-ol. It was found that plywood traps painted with a matte blue paint performed as well as the cloth traps. However, traps with shiny paint did not perform as well.


An “aktograph”, a device used to detect the flight activity of stable flies was described. An experiment was conducted using the aktograph to monitor flight activity of stable flies that were recently engorged on blood. Flight activity was monitored under total light and total darkness. There was more activity in light conditions, and males were more active than females.


Five heifers were kept in a stall with straw bedding and diflubenzuron boluses were administered to each one. After 3 weeks the bedding was removed and spread out. Another group of untreated heifers and their bedding was used as a control. The spread out bedding was sampled for house flies and stable flies. It was found that fewer flies emerged from the treated bedding.


A brief summary of the life history of *Stomoxys calcitrans*.


Discusses several experiments involving the transmission of anthrax by stable flies and tabanids, including some with negative results. Anthrax was successfully transmitted by the flies when their feeding on infected animals was interrupted, and they were transferred to a susceptible host to complete their blood meal. Anthrax was found in the feces of stable flies and tabanids 24 hours after feeding on an infected animal.


Corpora allata are removed to examine the effect of juvenile hormone on ovarian development. Cell lysis occurred in flies with no CA and a diet of sugar only, but not in blood fed flies. Follicles did not grow in any flies in the absence of juvenile hormone, but when the CA was implanted back into surgically altered flies, the ovaries began to develop, and when given blood meals they produced yolk.


The effect of stable flies on piglets was studied using 4 sets of 5 pigs each. Two sets were exposed to over 1000 stable flies and 2 sets were free from flies. Amount of feed consumed and weight gain of the piglets was calculated. Stable flies did not significantly affect the average daily gain of piglets at a rate of 7 flies per animal.


Morgan, P. B., and R. S. Patterson. 1977. Sustained releases of Spalangia endius to parasitize field populations of three species of filth breeding flies. J. Econ. Entomol. 70: 450-452.


Mramba, F. W. 2006. Ecological and public health aspects of stable flies (Diptera: Muscidae): microbial interactions. PhD Dissertation, Department of Entomology, College of Agriculture, Kansas State University, Manhattan, KS.


Laboratory experiments showed that *Enterobacter sakazakii* can remain in the gut of stable flies for at least 20 days, and the bacteria supports the development of stable flies. However, no *E. sakazakii* were found in manure substrate which had not been sterilized, indicating that the bacteria cannot compete with other microbes in the natural environment. It was also shown that stable flies contaminated their food source with the bacteria, indicating their ability to transfer *E. sakazakii* to host animals.


Muir, F. 1924. On the original habitat of *Stomoxys calcitrans*. J. Econ. Entomol. 7: 459-460.

Disagrees with C.T. Brues placing the origin of stable flies in the palearctic region of central Europe. Offers the opinion that *S. calcitrans* probably originated in the Indo-Ethiopian region with other Stomoxyine species.


Stable fly populations were monitored using alsynite sticky traps, and were found to peak during spring and early summer (April-June) in Southern California dairies. During this time the abundance of flies significantly exceeded the economic injury level of 5 flies per leg on the cattle. Stable fly abundance seemed to be related to the amount of rainfall occurring in March.


Stable fly populations were monitored over 5 different years and compared with amount of rainfall earlier in the year. The amount in rainfall in March was found to significantly affect stable fly populations in
May and June. Earlier spring rains had no significant effect on fly numbers.


Repellent behaviors (head throws, leg stamps, tail flicks and skin twitches) against stable flies were studied on 100 individual cattle on 4 dairy farms. Behaviors and fly numbers differed on individual cows. Young animals displayed more behaviors and repelled more flies, and some cows exhibited more repellent behaviors than others. There was evidence of habituation to fly attack. No evidence was found correlating stable fly parasitism with milk production.


O


Experiments were conducted to determine the effects of gamma radiation of male and female stable flies, as preliminary data for a sterile release control program. An increase of sterility was reported with increase of dosage. A dose of 4krad to pupae and 5krad to adults reduced the egg hatch to 1%. Females became sterile at a dose of 2krad, and laid no eggs at higher doses. Radiated males remained sterile for their entire mating life, but radiation had no effect on their longevity, virility, or ability to transfer sperm to the female.


The cytochrome c oxidase subunit I (COI) mtDNA gene was characterized for Stomoxys calcitrans, Haematobia irritans, and Musca domestica. The gene was 1536bp in size for each species, and coded for a 512 amino acid peptide. The COI gene is A+T rich in these species, with a predominance of A+T rich codons. The start codon was identified as TCG.


Eight new primers are designed to amplify 4 regions of dipteran mtDNA which have been difficult to isolate using universal primers. Dipteran families used were Muscidae, Calliphoridae and Oestridae. The target mtDNA regions were the Control Region and 3 tRNA gene clusters. The newly designed primers successfully amplified the target regions.


The Control Region and flanking regions of the Muscidae mitochondrial genome are described and compared with Calliphoridae, Oestridae and Drosophila spp. Conserved regions are described which are homologous among all species tested. Four Muscidae species are examined, including Stomoxys calcitrans. The S. calcitrans mtDNA proved more difficult to amplify, and sequence results from another experiment were used to confirm the presence of certain areas of its mtDNA.


Patterson, R. S. 1981. Importance of monitoring house fly and stable fly immature and adult populations in IPM programs using biocontrol. Proc. of
Workshop on Status of Biological Control of Filth Breeding Flies, Gainesville, FL, February 4-5, 1981.


*Spalangia endius* were released weekly for 13 weeks to determine their efficacy for the control of stable flies and house flies. Evaluation methods included using sentinel pupae, collection of wild pupae, and counting adult fly populations. The parasitoid *S. endius* was found to be ineffective for fly control.


Pinkus, H. 1913. The life history and habits of Spalangia muscidarum Richardson, a parasite of the stable fly. Psyche 20: 148-158.
Developmental rates are described on different hosts and at varying temperatures. Ovipositional habits are addressed, and some unique life habits such as “possuming”. Techniques for lab rearing are discussed, and a parasite breeding cage is described which the author developed.


STKR, a G-protein-coupled neurokinin receptor from the stable fly, *Stomoxys calcitrans*, was tested with 4 different peptide agonists. The receptor exhibited different levels of calcium and cyclic AMP responses, depending on the agonist involved.


Q


Behavior of cattle exposed to biting flies was monitored in Manitoba, Canada during 1983 and 1984. The behaviors observed were the same as those described previously, such as head toss, tail swish, ear flick, foot stomp. The study primarily monitored mosquitoes and Tabanids, although stable flies were listed as flies parasitizing the cattle.


Field investigations were conducted to determine the effect of moisture, temperature, organic matter, pH, and other insect species on stable fly populations. No correlation was found between stable fly populations and the physical factors, but there was a possibility of competition between stable flies and other insects, especially Syrphidae.


The effect of horn flies, stable flies and house flies on cattle was tested, exposing lactating cows to over 70,000 flies. Stable flies were found to have the most effect on the cows, reducing milk production by 9.3%. When repellent oil was applied to the cows, milk production was reduced 12.4%. When a petroleum repellent spray was used, loss in milk production increased to 22%.


Results presented regarding the use of neem, formulated in a bolus, to reduce stable fly and horn fly development in cattle feces. Targeted for use in 'organic' livestock production.


Bacterial species collected from natural stable fly oviposition substrate were cultured in the lab and assays were performed to determine attractiveness of each microbe to stable flies. Oviposition substrates used were natural unsterilized, natural sterilized and sterilized inoculated with bacteria. Two bacterial species promoted oviposition and larval development, but were not as beneficial as natural substrate containing a variety of microbes.


Discusses the reasoning which led to the hypothesis that poliomyelitis was not a “contagious” disease that could be transferred from person to person.
When it was realized that it could be a vectored disease, tests were performed by exposing 12 healthy monkeys to monkeys (unreported number) which had been inoculated with the virus. Six of the 12 healthy monkeys contracted the disease. The authors did not draw conclusions.


S


The parasitoid wasp, *Nasonia vitripennis*, was found in the fly rearing facility at Kerrville, TX. It was readily parasitizing the blow fly *Chrysomya rufifacies*. Experiments were conducted to determine if the wasp would also parasitize the stable fly, *Stomoxys calcitrans*, and the horn fly, *Haematobia irritans*. The wasp parasitized both the stable fly and horn fly pupae but was more numerous on the blow fly pupae. This was the first report of *N. vitripennis* parasitizing these fly species in the United States.


The use of alternative bedding substrates was tested in calf hutches for the suppression of house fly and stable fly larvae. Straw bedding is absorbent, and can absorb 2 to 3 times its weight in water, supplying maggots with a moist media in which to grow. Ground corn cob is nonabsorbent, and was found to suppress maggot growth by >90%. Feeding cyromazine to calves in their milk also suppressed maggot occurrence by 79%. It was concluded that outdoor calf hutches were a good breeding site for muscoid flies when straw bedding was used, but the use of alternative substrates or cytomazine significantly reduced maggot production.


Activity patterns of stable flies were tested at LD 12:12, total darkness (DD) and total light (LL). Patterns were the same for LD and DD, showing a unimodal pattern of diurnal activity. However, in field conditions both unimodal and bimodal patterns are followed. The evidence in this experiment did not support earlier work that reported hunger to have an effect on circadian patterns.


Wind tunnel experiments were conducted using CO$_2$, acetone and 1-octen-3-ol as attractants for stable flies. Fly behavior was recorded using a video camera. CO$_2$ produced progressively higher responses at increasing concentrations. The other two chemicals produced a decrease in response at the highest concentrations.


Compares the response of *Stomoxys* spp. and *Glossina* spp. to host defensive behavior and other flies while taking a blood meal. *Stomoxys* were found to take more risks, remaining on the host longer in spite of defensive behavior. *Glossina* were more responsive to host behavior and tended to leave the host more quickly. It was suggested that these results could relate to the life cycle of the flies. Stomoxys could take more risks in order to acquire the blood meals needed for reproduction, due to their higher fecundity and shorter life span.


Activation (flight activity) of stable flies and time spent on a target was tested using carbon dioxide, acetone and octenol. CO$_2$ and acetone elicited an increase in activation and the flies stayed longer on the “host”.
However, high concentrations of octenol caused a decrease in activation and also decreased the time on the “host”. The authors suggest that the responses to octenol are dynamic, and may be affected by concentration and flux.


Field studies of stable fly populations were studied during the summers of 1980 and 1981 in Cuming County, Nebraska. Flies were captured on Williams traps weekly and counted. Females were dissected to determine reproductive stage. Survival rate of females was higher than previously reported. More males dispersed from their origin than females. Population changes seemed to correlate with weather changes.


Nematode larvae of the family Habronematidae were found in lung tissue of 3 horses on a farm in Al Dhaid (UAE). Larvae were found in 147 of 561 male and 64 of 739 female *Musca domestica* sampled on the farm. All of the 15 *Stomoxys calcitrans* tested were negative for Habronematidae larvae.


A survey was conducted during the summers of 1983 and 1984 to determine the species of pupal parasitoids and arthropod predators of house flies and stable flies. The survey was conducted on 2 dairies and 3 feedlots near North Platte, NE. Both natural and artificial breeding sites were used for the flies. Results showed that the major parasitoids attacking the flies were *Muscidifurax zaraptor* and *Spalangia nigroaenea* for the house fly and *Aleochara lacertian* and *S. nigroaenea* for stable flies. Staphilinids were the primary predators.


Studies were conducted on the biology and life history of stable flies, using both lab-reared and wild flies. Observations were made on the minimum and maximum duration of each life stage, as well as behavioral factors. Behavioral factors studied included biting rates at specified hours, with humans as hosts; breeding incidence in bay-grass media of different ages; overwintering.

Simmons, S. W., and W. E. Dove. 1941. Breeding places of the stable fly or "dog fly" *Stomoxys calcitrans* (L.) in northwestern Florida. J. Econ. Entomol. 34: 457-462.

Stable flies were found to be breeding in two major substrates in Northwest Florida. Contrary to the findings of King and Lenert (1936), the authors found stable flies breeding in the bay grasses *Halodule wrightii* and *Thalassia testudinum* washed up along the shores. They were
found in the grasses washed up by storms, far enough above the tide mark to not be submerged each day. The other major breeding site was found to be piles of peanut litter left after harvesting of peanuts. It was estimated that over 100,000 piles of peanut litter were distributed over the 1,000,000 acres of peanuts harvested in the region, and most were breeding sites of stable flies.

Simmons, S. W., and W. E. Dove. 1942a. Waste celery as a breeding medium for the stable fly or “dog fly” with suggestions for control. J. Econ. Entomol. 35: 709-715.

Waste celery is found to be a major site of stable fly breeding, in addition to bay grasses and peanut litter, in Northwest Florida. Celery waste is dumped in piles after harvest and begins to ferment, creating a good medium for larval growth. In addition, it was found that plowing the waste celery under after harvest was not effective in controlling late instar larvae and pupae. Instead it supplied them with a great rearing medium from which the adults could easily emerge. Some suggestions for insecticidal control are discussed.

Simmons, S. W., and W. E. Dove. 1942b. Creosote oil with water for control of the stable fly, or “dog fly”, in drifts of marine grasses. J. Econ. Entomol. 35: 589-592.

The efficacy of using creosote mixed with bay water for the control of stable flies on beach grasses was conducted in northwest Florida. The experiment tested the mixture against the previously used method of creosote mixed with diesel oil. Creosote mixed with water performed as well as creosote mixed with diesel oil as an insecticide against stable flies, with a projected savings of $15,000 for treating the bay from Pensacola to Apalachicola.


Three categories of feedlots in Nebraska were monitored for immature stable fly populations from 1986-1988. The categories were: minimum management (type A), intermediate management (type B) and intense management (type C). Feedlots were divided into 5 areas for collection of larvae: feed apron, mound, side fences, back fence and general lot. In the 1986 study, the majority (85%) of stable fly immatures were collected from the feed apron and mound areas. In 1987, feedlot types A and B had the highest number of immature, and the highest percent were collected at the feed apron and mound. Feedlot type C produced very few flies. During both years, the population peaked early in the season, and there was a strong correlation between number of immature and number of adults 2 weeks later. 1988 produced different results, with adult populations increasing gradually during the season at all lot types, and there were negative correlations between the numbers of immature and adults. The authors suggest that the 1988 results could be due to drought conditions during that season, with stable flies utilizing alternative breeding sites. They conclude that during years of normal rainfall, the feed apron is the primary breeding site for stable flies, and that an estimate
of the adult population could be made by sampling the breeding areas for immatures.


Two sampling methods for immature house flies and stable flies (core sampling and pupal traps) were tested at two cattle feedlots in 1986 and 1987. Samples were taken at 5 locations on each feedlot: the mound, feed apron, back fence, side fences and general lot. Core samples were more consistent but few pupae of either species were collected. Pupal traps captured a greater number of immatures but were more variable. Both methods supported earlier research which found that the feed aprons were the best developmental site for immature stable flies and house flies.


The efficacy Spalangia cameroni as biological control of flies was tested on 3 farms in 1999 and 2000. The parasitoids had a significant effect on house fly numbers, but not stable flies. It was suggested that stable fly
larvae may burrow deeper into the substrate than house fly larvae, making them more difficult for parasitoids to reach. The parasitoids may also have had a preference for house flies due to being lab reared on that species.


Stable flies were kept at 23, 32 or 38°C and 7, 43, 75 or 97% relative humidity to test the effect of temperature and humidity on the amount of blood ingested. No significant differences were found in amount of blood ingested, but there were significant differences in the percentage of flies that fed at the different temperature/humidity combinations. A higher percentage of flies fed at high temperature/low humidity, and the lowest percent of flies fed at low temperature/high humidity combinations.


Field studies were conducted for 3 years (1980-1982) to determine the factors causing mortality of immature stable flies. Life tables were produced from the results, and the majority of immature deaths were due to “unknown causes”. Predation was the second most important factor.
Sentinel stable fly breeding sites were set up on four farms in Missouri to identify predators and competitors of immature stable flies. The most common predators recovered were staphylinids and macrochelid mites. Competitors included one species of Dermaptera, 2 species of Hemiptera, 8 coleopteran families and 5 dipteran families.


The mating competitiveness of males of a genetic sexing strain (with a sex-linked resistance factor to dieldrin) was compared with a normal strain. Males were irradiated with 2500R cesium-137, and results were obtained by mating males with dieldrin-susceptible females. During the course of the experiment, a test was performed using carmine eye females to confirm female monogamy. It was concluded that the use of SIT could be enhanced by using dieldrin-resistant males.
A machine is described that sorts stable fly pupae by color, separating black pupae from brown. Pupae progress down a hopper, pass through a trough and onto rollers, where they fall into a scanner which compares their color to a preset standard color. Black pupae are directed through a different valve than brown pupae. Using this machine, pupae of the genetic strain [T(1;3)2] could be separated by sexes, as in this strain the male pupae are brown and female pupae are black. Since the machine can sort up to 1200 pupae/min., it would be an efficient method to use in a sterile male release program.


Insecticide treatment against house flies and stables flies using DDT in kerosene oil proved to be effective when applied to only certain areas of barns or houses. A concentration of 25% DDT was recommended for barns. Only areas where flies would land to rest needed to be sprayed, saving the time and money required to spray the entire barn.


Experiments were conducted *in vitro* to investigate the effect of stable fly salivary gland extracts on bovine lymphocytes. Results showed that the SGE was not directly toxic to cells, but did suppress the activity of bovine lymphocytes. In addition, a 27 kDa protein was detected in stable fly SGE which caused an IgG reaction.


Genetic variation of stable fly populations from Nebraska, Texas and Canada was analyzed using PCR-RFLP. Mitochondrial DNA and ribosomal DNA were examined using 16 restriction enzymes. No significant genetic variation was observed.


T


Five adhesive traps (the Farnam Bite-Free prototype trap, with and without Alsynite; the Olson trap, the Broce trap and the Farnam EZ trap) and the cloth Nzi trap were compared to test their efficiency for trapping stable flies. The adhesive traps proved to be more efficient than the Nzi traps, and the Bit-Free traps were the most efficient. However, the adhesive traps seemed to be biased toward younger flies, whereas the Nzi traps captured older flies.


Compared the frequency of nectar feeding and blood feeding in rural and urban populations of stable flies. Flies caught on Alsynite sticky traps were analyzed for the presence of sugar using the anthrone assay. Sugar was detected in more flies collected in the urban areas than in rural areas. In rural areas, more flies collected in pastures had fed on sugar than those in cropland, with those adjacent to feedlots having fed on nectar the least. The frequency of flies with blood detected in the gut was also higher in the urban environment. There was no difference in the frequency of blood or sugar feeding between male and female flies. It was concluded that stable flies are opportunistic nectar feeders, and there is a positive interaction between blood feeding and sugar feeding, perhaps because feeding on nectar gives the flies energy to seek a blood meal.


A survey was done over 5 years, from 2001-2005, in Eastern Nebraska, and adult stable fly populations were correlated with temperature and precipitation. Results suggest that peak stable fly populations are greatest after cold winters followed by warm springs. Results also show that precipitation was the factor limiting populations during midsummer.


Puparia of stable flies and horn flies were observed hourly for the first 24 hours after pupariation, every 2 hours for the next 24 hours, and every 5 hours after that until eclosion. Some puparia were punctured and treated with a tissue fixative, and others were observed under the microscope.
without being punctured. Ten intra-puparial stages were described: pupariation, prepupa, larval-pupal apolysis, cryptocephalic pupa, larval-pupal ecdysis, phanerocephalic pupa, pupal-adult apolysis, early pharate adult, red-edyd pharate adult, and late pharate adult. It was determined that horn flies diapause in the red-eyed pharate or late pharate adult stage.


Sampling methods compared were a stanchioned calf, fly counts per front leg of cattle, and an Alsynite trap. The majority of flies were caught at 1400. Seasonal peaks occurred in mid-July and a smaller peak in early September. There was no significant difference found between the sampling methods.


The amino acid sequence of STKR, the G protein coupled receptor from Stomoxys calcitrans, is compared with other peptide sequences. The receptor is tested for biological activity with different peptide agonists.


Travis, B. V., F. A. Morton, and J. H. Cochran. 1946. Insect repellents used as skin treatments by the armed forces. J. Econ. Entomol. 39: 627-630.


Stable flies were observed feeding on nectar during the fall of 1982 in Florida. Flies were captured and analyzed to confirm the nectar feeding. Flies that had fed on blood were also found to have fed on nectar, the preferred plants being salt bush and goldenrod. Flies which had recently fed on blood were not interested in feeding on human blood. In the laboratory, stable fly longevity was tested when fed on nectar, and they were able to survive on plant material for at least nine days.


Tulloch, F. 1906. The internal anatomy of Stomoxys. Proc. R. Soc. Lond. (B) 77: 523-531.

Describes the internal anatomy of Stomoxys as compared to Glossina.


Stable flies and mosquitoes were allowed to feed on Bacillus anthracis-infected guinea pigs and mice, and removed before finishing the blood meal. They were then allowed to feed on susceptible rodents. It was confirmed that both stable flies and mosquitoes transmitted B. anthracis to the susceptible rodents.


U


Urueta, E. J. 1975. Insectos asociados con el cultivo de africana en Uraba (Antioquia) y estudio de su relacion con la pudricion de la flecha-
V


The conversion of [U-14C]acetate into lipids was followed by injecting the chemical into stable flies before and after blood meals. The acetate was converted to triacylglycerol by the fat body, and the accumulation of the lipid was greatest after the first blood meal. Males had a reduced concentration after the third blood meal, at which time they begin mating activity. Females had reduced concentration of lipids in the fat body after the second blood meal, at which time the lipids were transported to the ovaries. It is suggested that the synthesis of lipids is a necessary part of the reproductive cycle of stable flies.


Twenty-one Holstein dairy cows were monitored for their reactions to stable fly activity on a private dairy in Aguascalientes, Mexico, during July and August. The climate in the region was semi-arid, with an average rainfall of 74mm. Cows were monitored for fly-dislodging activities such as ear twitching, head-tossing, leg stamping, muscle twitching and tail switching. Cows were reported to perform the activities at the highest rate when fly counts were over 20 flies per front leg. Tail switching was the most frequent activity.


The attractiveness of different wavelengths of light to female stable flies was tested. Stable flies were most attracted to wavelengths between 340-500 mµ, ultraviolet to blue-green. They were more attracted to white light than infrared, but in the absence of white light, they were attracted to the
infrared. This result was contradictory to other research which suggested that stable flies were blind to red light. The authors suggest that the attractiveness of blue light to stable flies could explain their accumulation at large bodies of water.


The purpose of this experiment was to determine if stable fly mortality increased at temperature and relative humidity conditions that were comparable with their movement toward large bodies of water, such as Lake Superior. Test conditions were 36 hour exposure to 3 different RH at 5 degree intervals. Mortality was high at 20% RH at all temperatures. Mortality increased significantly at 85°F, but was least at 80% RH. The results were consistent with conditions in which flies move toward bodies of water.


*Serratia marcescens* were cultured from house flies caught at Nebraska feedlots and dairies. Laboratory experiments were conducted to determine the infectivity of *S. marcescens* to stable flies, to compare the wild isolate with cultures maintained at the UNL School of Biological Sciences, and to determine if stable flies could be infected through their food source. Although stable flies became infected with this bacteria, they were only facultatively pathogenic and therefore would not be an important means of stable fly control.


During 1991-1993, pupal parasitoids were released weekly at small independent feedlots. Puparia were collected, and mortality was calculated by parasitoid species, unknown causes and duds (puparia in which no adult flies or parasitoids emerged). Spalangia nigroaena had a slight (9%) effect on stable fly mortality, and Muscidifurax zaraptor caused 1.1% mortality in house flies. Results seemed dependent on climatic variations.


Wells, R. W. 1931. Some observations on electrified screens and traps. J. Econ. Entomol. 24: 1242-1247.


The purpose of this study was to separate the direct effects (biting) and indirect effects (bunching) of stable flies on feeder cattle. Four treatments were applied, with 10 cattle in each group. Treatments were: no flies, no bunching; flies, no bunching; no flies, bunching; flies and bunching. The effect of bunching was achieved by placing the groups of cattle into smaller pens. Direct effects (biting) were found to cause 28.5% of the reduction in weight gain, while bunching (and the resulting heat stress) was responsible for 71.5%.


During collection of stable flies from sticky traps in northwest Florida, flies were observed to be infested with mites, which were later identified as *Macrocheles muscaedomestica*. Mites were found predominantly on abdominal segments 2 and 3, but also on the head and thorax. This was the only species of mite found on the flies. Percentage of flies infested with mites was higher on dairies (5.6%) than on the beaches (1.7%).


A survey was taken of stable fly numbers in a vertical distribution using sticky traps attached to fire and Navy observation towers. A lateral survey was taken by placing sticky traps 4 ft above the ground in a power line right-of-way, some at the center in the open and others in adjacent wooded areas. The most flies were captured below 4 ft from the ground, and preferred the open areas to wooded areas.


In this study, male stable flies were irradiated with Cs$^{137}$ to cause reciprocal translocations in chromosomes, then crossed with females with certain combinations of two mutant forms: carmine eye (ca) and rolled down wing (rd). Using a “pseudolinkage” breeding scheme, the authors determined that the mutations were not sex-linked, sex determination is located on chromosome 1, carmine eye (ca) on chromosome 2, and rolled down wing (rd) on chromosome 4.


Reciprocal translocations were used to determine the location of a 3$^{rd}$ mutant phenotype in the stable fly, black pupa (bp), which occurs only in the pupal stage. No color changes are present in larvae or adults with this phenotype. After crossing irradiated males with bp females and backcrossing, the F2 generation was examined. A correlation between chromosomes 1 and 3 was found by examination of male testes. Since it was found previously that sex determination is on chromosome 1, this suggests that the black pupa mutant gene is on chromosome 3. The authors suggest that new genes can be mapped by their linkage to one of the three mutants, carmine eye (ca), rolled down wing (rd) and black pupa (bp), since these genes are on different chromosomes.


Wright developed an assay to test the juvenile hormone activity of several compounds when applied topically or in the diet of stable flies at all life stages. The prepupal stage was found to be the most susceptible to juvenile hormone, and the synthetic juvenile hormone SJH II produced the strongest results. Most of the compounds tested were ovicidal when applied topically. When applied to prepupae the juvenile hormone compounds produced a pupal-adult intermediate: head and thorax were developed and had setae, but the abdomen was not fully developed and no adult genitalia developed. It is suggested that juvenile hormone could be a possible control method for stable flies.


An insect growth regulator, TH-6040, was tested on stable flies and house flies in the laboratory, in a cattle feedlot, and in a wastewater treatment plant. In the laboratory, 1 µL of different concentrations was applied to white pupae. In the field, the compound was applied to the breeding medium. TH-6040 was not effective when applied topically to pupae. It was highly effective when ingested by larvae, causing morphological deformations and thinning of the cuticle.
Wright, J. E. 1975. Insect growth regulators: development of house flies in feces of bovines fed TH-6040 in mineral blocks and reduction in field populations by surface treatments with TH-6040 or a mixture of stirophos and dichlorvos at larval breeding areas. J. Econ. Entomol. 68: 322-324.


Twenty-nine compounds were tested on different life stages of the stable fly to determine if they had juvenile hormone activity against this insect. The compounds tested were 11 juvenile hormone analogues, 9 potential chemosterilants, and 9 plant extracts, which had demonstrated juvenile hormone activity in other insect species. In this experiment, only the juvenile hormone analogues were effective against stable flies. These compounds had considerable effect on larval, pupal, and adult stages but little effect on eggs. Application of the JH analogues to larvae and pupae caused larviform pupae or pupal-adult intermediates.


The insect growth regulator TH-6040 was tested for ovicidal activity in stable flies and horn flies. In laboratory tests, stable flies were put into cylinders in which the walls were treated with TH-6040. Horn flies were treated topically. In the second test, flies were released in a stall with a steer which was sprayed with TH-6040. Ovicidal activity of TH-6040 was high even when one sex was treated, then mated with untreated flies.


The effect of TH-6040 on egg hatch was tested on the stable fly and the house fly. In the first test, the substrate was dusted with the compound, so that eclosing adults had to emerge through the powder. In the second test, TH-6040 was applied directly to the insects. TH-6040 was very effective on preventing egg hatch in the stable fly. It was also transferred from treated to untreated flies. However, TH-6040 was not as effective on house flies.


Sixty-two terpenoid compounds, each with a different functional group, were applied to stable fly larvae at 10µg/pupa (1 µL of a 1% solution in acetone) to determine if chemical structure was related to juvenilization. Compound activity was determined by the presence of a pupal-adult intermediate in the puparium 8 days after treatment. Six of the compounds were found to be very effective on stable fly pupae. Four compounds of interest, which were similar to cecropia juvenile hormone, were found to be more effective when used on Tenebrio molitor, but were less effective than cecropia JH on the stable fly pupae.

A method for determining the concentration of a juvenile hormone analogue, Altosid, in stable fly rearing medium is described. Altosid was extracted from the rearing medium using benzene-methanol. 100% recovery of the compound was reported 22 days after treatment. The persistence of Altosid would be sufficient to cause morphogenic effects in stable fly pupae, suggesting that it would be an effective control of this insect.


The effectiveness of an insect growth regulator, Stauffer R-20458, was tested in a cattle feedlot in Keith County, NE. Insect growth regulators primarily affect the pupal stage of stable flies, preventing adult eclosion. Plots were sprayed with a 1% concentration of the IGR at 1L/m². Sprayed areas were covered with screens to catch eclosing adults. Reduction in stable fly adults in the treated area was 74-95.6%. The IGR did not affect house flies in the area. The product was found to persist in the soil after 22 days. It was also tested in crusty soil, and there was only a 32% reduction in flies. The authors concluded that Stauffer R-20458 is more effective if used in moist substrate.


The effectiveness of the insect growth regulator Thompson-Hayward 6040 was tested in rhinoceros dung against house flies and stable flies. Nineteen rhinoceroses were fed the IGR for 60 days, and the dung was
collected daily. The dung was then seeded with house fly and stable fly eggs. TH 6040 was 100% effective at inhibiting adult emergence both at 1mg/kg and .1 mg/kg. The rhinoceroses showed no adverse effects from the IGR.


