

## **Anhidrosis: Can Acupuncture Help Non-sweaters?**

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### *Introduction*

Anhidrosis is a decreased ability to sweat in response to increased body temperature. It most often occurs in horses living in hot, humid climates - like Florida and other Gulf coast states. It is an important problem for performance horses because thermoregulation is mainly accomplished by sweating in the horse. Between 65-70% of heat is lost via the evaporation of sweat and the humid environment further decreases efficiency of sweat evaporation and cooling of the horse.

### *Prevalence*

Researchers have not identified any age, sex, breed, or color predisposition for developing anhidrosis. Raising foals in a hot, humid climate is not protective, as both locally-bred and imported horses may be affected. Epidemiologic studies have suggested a prevalence of between 2-6% of horses, though the prevalence may vary depending on the severity of climate.

### *Diagnosis*

Anhidrosis can often be diagnosed presumptively, based on appropriate clinical signs and examination by a veterinarian. Patients often present with increased respirations and failure to cool after exercise. In situations that should elicit copious sweating, anhidrotic horses will have minimal or no sweat production. Some areas may still sweat, which can be confusing. In chronic cases, horses develop dry flaky skin (especially on the forehead), hair loss, fatigue, anorexia and decreased water consumption. Confirmatory testing utilizing intradermal injections of epinephrine or terbutaline can be performed if the diagnosis is unclear or to evaluate treatments.

### *Treatment*

There is no known successful therapy for anhidrosis except moving the horse to a cooler climate. Not only does this help manage the high body temperatures, but horses are also noted to start sweating once in a cooler environment. Therefore, it is essential that non-sweaters living in Florida are carefully managed to *prevent* high body temperatures from occurring.

Many horse owners feel that various feed supplements offer relief to their horses, but this is an anecdotal observation with no research support. Other treatments are attempted with minimal evidence, including oral supplementation with dark beer, salts, vitamins/electrolytes or thyroid supplementation. Most of these are not dangerous, but also do not appear to improve the animal's ability to sweat. Medical treatment has also been attempted with ACTH, alpha-2 agonists, prostaglandins (Lutalyse), antihistamines and Methyldopa (Aldo-Met), but has been generally unsuccessful.

### *Acupuncture Clinical Trial*

A total of 44 recently anhidrotic horses were enrolled in the study, based on appropriate clinical signs and an inadequate response to a quantitative intradermal terbutaline sweat test (QITST). Horses were randomly assigned to treatment or placebo groups, with owners and examining veterinarians blinded to treatment. Treated horses were given four acupuncture treatments at weekly intervals and four weeks of herbal medication, while control horses received sham acupuncture and hay powder. Horses were retested twice by QITST after the treatment month.

In treated horses, sweating responses to QITST increased significantly compared to baseline, but QITST results returned to baseline within four weeks after stopping treatment. Because there was also a nonsignificant increase in sweating in control horses, a significant difference between treated and placebo groups was not achieved.

Thus, acupuncture and herbal medication *may* have improved sweating in recently anhidrotic horses, although the effect lasted less than four weeks after discontinuing treatment. The use of this treatment requires further investigation to fully validate its usefulness.

# Pest Management Perceptions and Practices for Equine Farms in North and Central Florida<sup>1</sup>

Erika T. Machtinger, Norman C. Leppla, and Cindy Saunders<sup>2</sup>

## Introduction

Integrated pest management (IPM) for equine farms requires accurate diagnosis of pest problems and the coordinated use of science-based management practices. Currently, knowledge is limited about pest problems faced by horse owners in Florida and management of pests on equine facilities. To develop an effective IPM system for horse farms, horse owners' pest problems must be identified, and current management practices of equine facilities must be understood.

Equine facilities have unique pest management problems due to facility structure and horse husbandry practices. In Florida, homes on small equine farms are generally located in close proximity to pastures, stalls or run-in sheds, manure piles, and other fly breeding habitats (Figure 1). Because of this association, homeowners have a high risk of exposure to pathogens that can be transmitted by filth flies to humans (Förster et al. 2007). Substrates, such as straw or sand, that are used in equine husbandry vary significantly between horse farms and other livestock facilities. Substrate type and management can influence the development of some insect pests on a property. Additionally, typical areas surveyed for biological control agents and filth fly development on cattle or poultry operations, such as silage areas, calf hutches, and laying houses, are not found on equine facilities. These differences make it challenging to adapt insect pest management protocols for equine farms that were developed on other livestock facilities.



Figure 1. Single-family homes are often located adjacent to horse paddocks or stables in equine farms in Florida.

Credits: Erika T. Machtinger

While many control methods are available for managing insect pests affecting horses, there is insufficient information on the efficacy of most of them. Commercial products used by horse owners for pest control include biological control agents, chemical sprays, personal protection devices (fly masks, wraps, and blankets), baits, and traps. Many of these products and other components of an IPM system currently may be over or under utilized by Florida equestrians because of the lack of information and training on developing IPM plans for equine farms.

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Although horses are numerous in Florida and important to the state economy, research on managing their pests is limited, and practices are excluded from national surveys. The 2006 USDA survey, which details management practices on equine farms nationwide, did not include properties with fewer than five horses. This restriction potentially eliminated approximately half of the properties in the United States that house horses, certainly the small equine farms, and presents an inaccurate analysis of the needs and practices of the equine industry.

The purpose of this survey was to gain knowledge about IPM use on equine farms in Florida and use it to guide research and Extension activities. The objectives were to determine the perceived pest problems and current pest management practices used on equine farms and to identify the research and Extension needs of horse and facility owners in North and Central Florida.

## Survey Design

The survey was conducted from 15 November, 2010 to 20 June, 2011 by using Survey Monkey ([www.surveymonkey.com](http://www.surveymonkey.com)) to collect and analyze responses from anonymous respondents. The survey link was sent to 16 major equine organizations in north and central Florida, including regional shows, clubs, and associations, requesting that it be distributed to their members. It also was provided to county Extension agents and printed in the Central Florida Equine Magazine. The survey had three sections: 1) basic demographic information of the participants, 2) pest problems and management practices on their facilities, and 3) opinions on the quality and availability of research and Extension materials.

## Survey Results

Horse owners in north and central Florida attempt to manage their pest insects with a variety of methods, many of which could be components of an IPM program. However, based on survey responses, many opportunities are available for research and Extension programming on IPM practices for more effectively managing pests on equine farms. Responses to the survey questions ranged from 274 to 299; however, not every respondent answered every question. Therefore, response percentages were used to analyze the data.

## A Diverse Clientele

The equine industry in north and central Florida represents a diverse sector of agriculture (Table 1). There were many differences in property acreage and number of horses, and over 21 riding disciplines were cited. More than 90% of the survey respondents were pleasure riders or engaged in performance activities, which was significantly higher than the 2005 American Horse Council survey results that found 60% of Florida horses were used in recreation and showing. Equestrians participating in these activities are likely to be affiliated with at least one organization or group that had access to the survey; therefore, it was expected that higher numbers might respond. Most facilities were 10 acres or less (56.4%), housing between one and five horses (63.7%).

## Perceived Pest Problems

Pest problems clearly were observed seasonally in Florida equine facilities. Overwhelmingly, respondents said they experienced pest pressure in the summer months (June, July and August) (86.1%) (Figure 1). This response was expected because insect pests in Florida are aided in development by high humidity and temperatures, particularly in the summer months.

Many arthropods were indicated as major pests on equine farms. The most common pest species were mosquitoes, stable flies, and gnats, with many write-in responses for “yellow fly” and the so-called “cow fly” that respondents may have applied to the horn fly, stable fly, or even house fly (Figure 2). The colloquial term “cow fly” typically refers to the horn flies often found on the backs of cows. Midges, *Culicoides* spp., “yellow fly,” and “cow fly” were options in the base question represented as their correct common names (deer fly and horn fly, respectively). This variability in name recognition demonstrated that many respondents may not be familiar with common names and, therefore, use colloquial terminology. This potential confusion was observed again in the follow-up question regarding pest identification. Respondents considered stable flies a problem (63.1%) and thought they could identify them accurately (61.5%). However, this response is surprising because stable flies are not often observed feeding on horses. Although stable flies can be found on horses, particularly feeding on the forelegs (Mullens et al. 1988), they do not linger, preferring to rest on nearby walls or fence lines (Gerry et al. 2007; Mullens et al. 1988), making it unlikely that horse owners would observe and correctly identify them. Additionally, although respondents reported most pest pressure in the summer, stable flies are most abundant in late winter and spring on horse farms in Florida (Machtinger 2011; Pitzer et al. 2011).

Respondents may be observing horn flies or house flies and mistaking them for stable flies or they may assume that flies

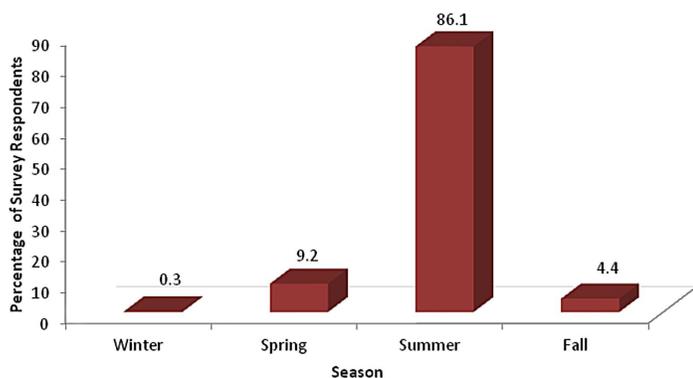


Figure 2. Seasons when survey respondents perceived the most pest problems.

found in the stable are classified as “stable” flies. Based on responses, the ability of the survey population to accurately identify pest species is questionable and presents an opportunity for education on insect identification.

## Pest Management Practices and Opinions

Pests were not monitored by the majority of the survey takers. Over 76% of respondents did not monitor pest populations on their properties during the year, mainly because they lack knowledge about the required methods and materials (59.1%) (Figure 3). Owners of small equine facilities are frequently employed full-time away from the operation. Smaller boarding and training facilities that provide riding lessons and other services are often family-run, and these families may lack time to learn and implement monitoring methods and gather the required information. When asked to describe monitoring techniques in the comment box, many of the respondents listed some form of control, such as biological control, traps, or insecticides. In the context of IPM, monitoring requires regular observations to determine the abundance of pests on a property. These observations provide the basis for pest management decision making and action relative to economic or damage thresholds (Higley and Pedigo 1996). Based on these responses, it is clear that monitoring in the context of IPM is not widely understood by equine farm owners.

Horse owners demonstrated a very low tolerance for pests. Survey respondents were asked how many pests they would tolerate around their animals, or their action threshold, and the majority responded with less than 10 pests. Unfortunately, action thresholds have not been determined for horses because the economic or damage levels are difficult

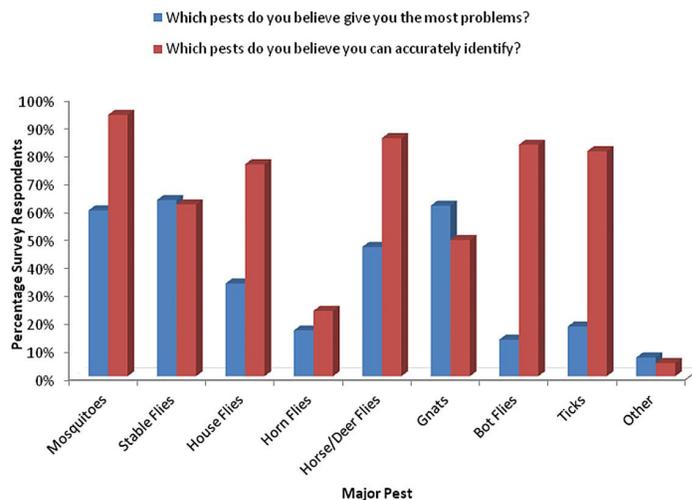


Figure 3. Comparison of perceived pest problems and ability to identify pests. Respondents were allowed to select multiple pests.

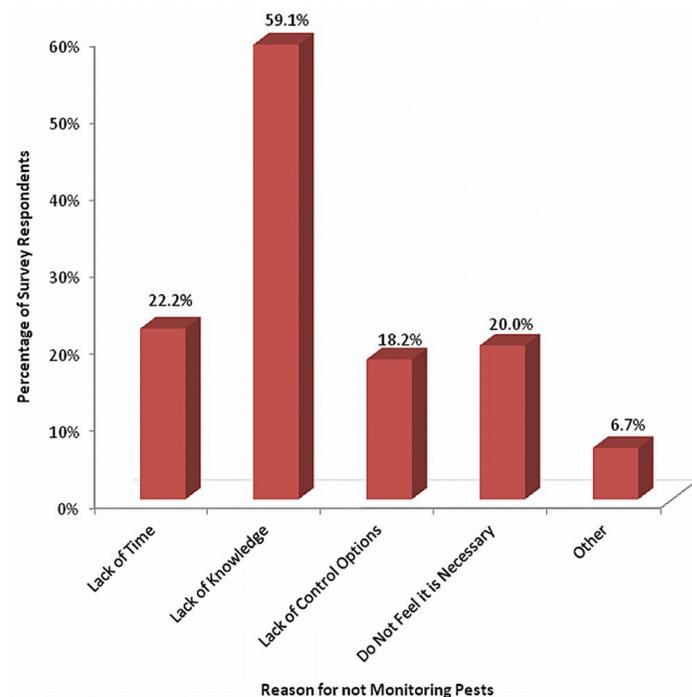


Figure 4. Survey respondent reasons for not monitoring pests on equine farms.

to assess quantitatively in terms of losses. In this survey, it might have been difficult for owners to assign numbers of pests around their animals into the groupings we provided, so they answered 10 or lower, wishing to convey a low but not necessarily accurate number. Future research on economic losses to horse owners attributed to equine pests may further guide the research community on the needs of this sector of agriculture and provide action threshold guidelines to horse owners.

Manure management is one of the most important sanitation practices in IPM of filth fly pests, such as house and

stable flies, and some form was practiced by virtually all the respondents (Figure 4). All but three of the 272 respondents to the pest problems and management practices section of the survey managed their manure and bedding waste, suggesting that they may be aware that it could attract and support filth fly pests. The most common methods of waste disposal were distribution with a spreader (49%), dragging pastures (22.1%), placing it in a pile (24.8%), and active composting (25.9%). Apparently, owners and operators of equine facilities are attuned to managing manure and bedding waste to maintain the health and welfare of their animals. Farms practicing rigorous sanitation may limit breeding of some filth flies (Kaufman et al. 2005), and manure management should continue to be encouraged on equine facilities.

Owners of an equine facility typically require more than one method to control pest insects on their farm. Survey respondents were asked to indicate how many control methods were used (Figure 5). Most of the respondents used two (32.9%) or three methods (27.8%) and about half as many used one (11.9%) or four (15.3%). The use of five or six methods was rare and just one of the respondents reported using seven. Horse owners were not asked why they used more than one method for controlling insect pests, but it can be assumed that no single method is adequately effective for all pest species. Additionally, they may be attempting to control pests in different locations where different methods are required, e.g., in barns, on horses, around feeding areas. The abundance of pest species varies with season, so specific methods may be more effective at certain times of the year.

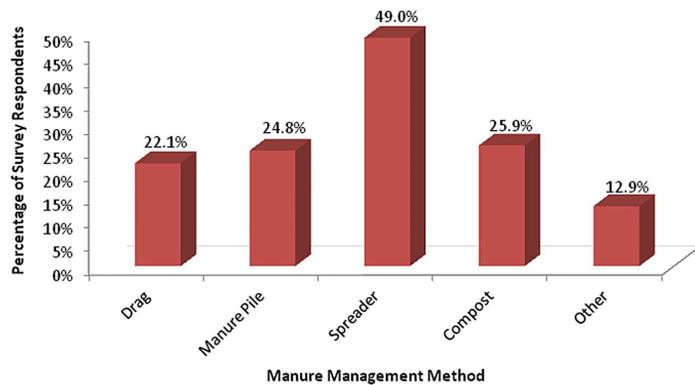


Figure 5. Types of manure management methods used in equine farms. Respondents were allowed to select multiple pests.

The survey respondents were asked to indicate the pest control methods they used most often to manage insect pests (Figure 6). Insecticide application was the predominant method of pest control (95.9%). Physical exclusion with

fly masks (66.2%) was also commonly practiced, although respondents also used traps (38.0%), biological control (22.0%), and feed-through insecticide control (14.6%). Insecticides and repellents are commonly marketed to the equine industry, and the high numbers of respondents using insecticides suggest an over-reliance on chemical control. Horse owners clearly prefer conventional pest control methods targeted at adult insects but try options to control immature insects. Incorporating methods for controlling larvae is useless if insect pests are not breeding

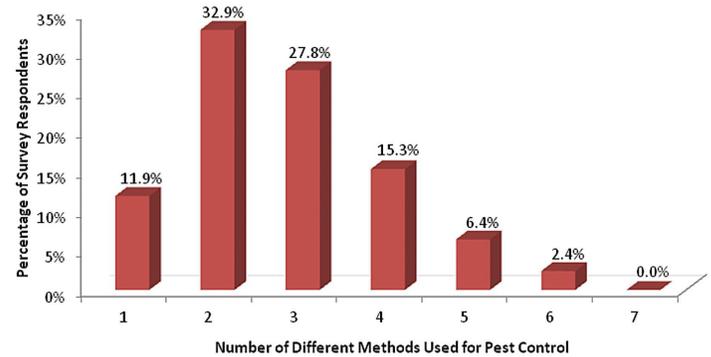


Figure 6. The percentage of survey respondents that used one or more methods of pest control.

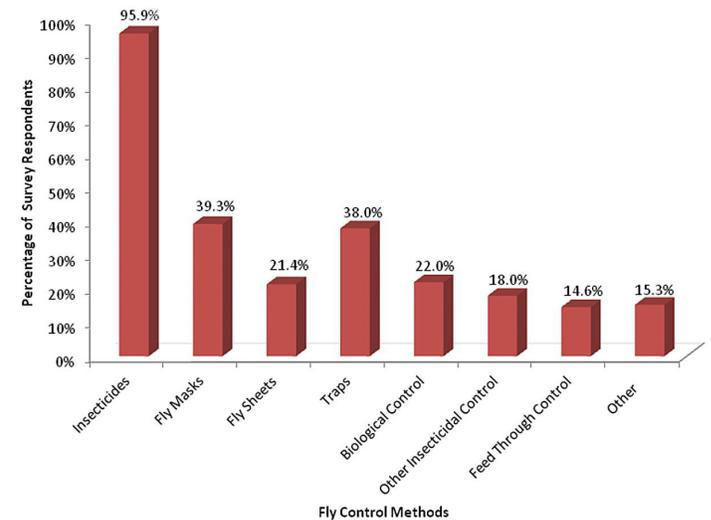


Figure 7. Types of pest control methods used on equine farms in north and central Florida. Respondents were allowed to select multiple types of pest control methods

on equine farms. Because of a lack of monitoring, respondents were uninformed about pest type or abundance on their property. Nevertheless, some respondents expressed a willingness to use expensive and potentially harmful insecticides with no substantiated basis for their need or efficacy.

Annual expenditures by horse owners for pest control seemed unnecessarily high. About 74% of respondents spent in excess of \$100 and 33.0% more than \$200 annually on fly control products (Figure 7). Even with multiple methods and high annual costs, an overwhelming majority found products to be only somewhat effective (72.3 %). Horse owners attempting to manage pest problems might find a product marginally effective but continue to purchase and use more of it until some level of satisfaction in control is reached. This level of use and the associated expense may be due to the varying sizes of horse farms surveyed in terms

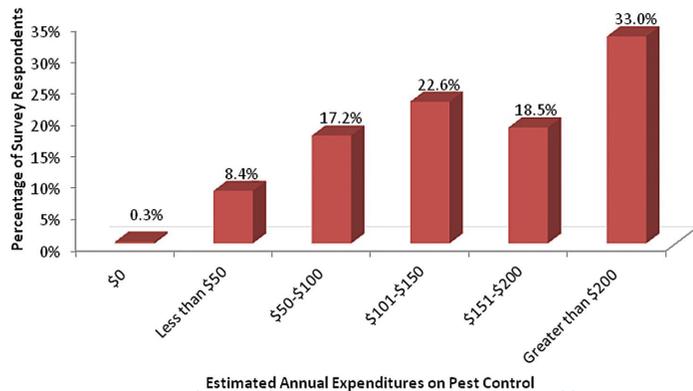


Figure 8. Estimated annual expenditures on pest control by survey respondents.

of horse numbers, or potentially to horse owners using large amounts of a product or multiple products. Clearly, horse owners in Florida are willing to pay for pest control on their farms. However, these expenses may be excessive or unnecessary, depending on the farm. Educating owners about pests and pest control methods could help minimize expenses while maximizing control as part of an effective IPM plan.

## Research and Extension Requests

Horse owners displayed significant preferences in research and Extension (Table 2), with more than half of the survey respondents indicating that current research was not meeting their needs (54.3%). Horse owners were asked to provide feedback on their research preferences. The high percentage of pesticide use suggested that the survey population had a positive attitude about chemical control. However, over 80% of respondents requested that more research be conducted on biological control, and non-toxic solutions were the most popular write-in answer. When asked which sources they most frequently use to obtain information on pest control, the most common answer was the internet. Respondents also consulted in similar frequencies with veterinarians, employees at feed stores, friends, and Extension agents. This survey was conducted online and, since the internet was the primary source of

information used by facility owners, it is likely that they were predisposed to internet browsing and proactive in researching pest control products. The distinct preference and requests for information on biological control and non-toxic solutions found in this survey should help to establish research and Extension priorities.

## Future Educational Opportunities and Conclusions

The results of this survey indicated that more research and Extension efforts are warranted in support of the small equine farm sector. Many equine property owners have insufficient knowledge of the identification, biology, and presence of filth fly pests on their properties, which is required to develop successful IPM programs. They continue to rely on insecticides because they lack adequate understanding of available alternatives. Although a comprehensive understanding of IPM practices was not demonstrated by respondents, a willingness to protect themselves and their animals was apparent. A concerted effort should be made to educate equine facility owners about the benefits of carefully planned IPM programs for managing external pests of horses and to provide online resources for proactive farm owners and managers. This need for pest management information presents an opportunity for increasing production and distribution of IPM educational materials to Extension agents, equine farm owners, and large animal veterinarians.

## Selected Educational Links

IPM Florida <http://ipm.ifas.ufl.edu/>

External Parasites on Horses <http://edis.ifas.ufl.edu/ig139>

External Parasites around Animal Facilities <http://edis.ifas.ufl.edu/ig054>

Deer Flies, Yellow Flies and Horse Flies, *Chrysops*, *Diachlorus*, and *Tabanus* spp. (Insecta: Diptera: Tabanidae) <http://edis.ifas.ufl.edu/in155>

Pesticide Safety around Animals <http://edis.ifas.ufl.edu/ig128>

## Selected References

**American Horse Council (AHC). 2005.** The Economic Impact of the Horse Industry in the United States. AHC, Washington, D.C.

**Coble, H. D., and E. E. Ortman. 2009.** The USA IPM Roadmap. In E.B. Radcliff, W. D. Hutchison, and R. E. Caneldo (eds.), *Integrated Pest Management: Concepts, Tactics, Strategies and Case Studies*. Cambridge University Press. Cambridge, England.

**Florida Department of Agriculture and Consumer Services (FDACS). 2004.** Florida Horse Industry. FDACS. Tallahassee, FL.

**Förster, M., S. Klimpel, H. Mehlhorn, K. Sievert, S. Messler, and K. Pfeffer. 2007.** Pilot study on synanthropic flies (e.g. *Musca*, *Sarcophaga*, *Calliphora*, *Fannia*, *Lucilia*, *Stomoxys*) as vectors of pathogenic microorganisms, *Parasitol. Res.* 101: 243–246.

**Gerry, A. C., N. G. Peterson, and B. A. Mullens. 2007.** Predicting and controlling stable flies on California dairies. University of California, Agriculture and Natural Resources. Communication Services. ANR Publication 8258.

**Higley L. G., and L. P. Pedigo. 1996.** Economic Thresholds for Integrated Pest Management. University of Nebraska Press. Lincoln, NE.

**Machtinger, E. T. 2011.** Studies on the field ecology, breeding biology and parasitism of house flies, *Musca domestica* and stable flies, *Stomoxys calcitrans*, (Diptera: Muscidae) to improve integrated pest management for North Florida small equine farms. M.S. Thesis, University of Florida, Gainesville, FL.

**Mullens, B. A., J. A. Meyer, and S. E. Bishop. 1988.** Stable fly activity on California dairies. *California Agriculture* 42: 20–21.

**Pitzer, J. B., P. E. Kaufman, J. A. Hogsette, C. J. Geden, and S. H. Tenbroeck. 2011.** Seasonal abundance of stable flies and filth fly pupal parasitoids (Hymenoptera: Pteromalidae) at Florida equine facilities. *J. Econ. Entomol.* 104: 1108-1115.

**Reinmeyer, C. R., and B. W. Rohrbach. 1990.** A survey of equine parasite control practices in Tennessee. *J. Am. Vet. Med. Assoc.* 196: 712-716.

**(USDA) United States Department of Agriculture. 2006.** Equine 2005, Part II: Changes in the U.S. Equine Industry, 1998-2005. USDA-APHIS-VS, CEAH #N452-0307. Fort Collins, CO.

Table 1. Equine activities, property descriptions, and number of horses maintained by survey respondents.

Parameter	Number of Respondents	Percentage of Respondents
Equine activity (n=283)		
Pleasure riding	139	49.1
Performance horses	118	41.7
Other	26	9.2
Property status (n=284)		
Barn/facility owner	240	84.5
Boarder at a facility	36	12.7
Rider at a facility	3	1.1
Other	5	1.8
Property acreage (n=282)		
1-10 acres	159	56.4
11+	123	43.6
Number of horses (n=294)		
1-5 horses	181	63.7
6+	103	36.3

Table 2. Types of research and Extension information requested by the respondents<sup>1</sup>.

Type of Research or Information	Number of Respondents	Percentage of Respondents
Research Meets Needs (n=280)		
No	152	54.3
Yes	128	45.7
Research Requests (n=276)		
Biological control	231	80.2
Cultural control methods	140	48.6
Insecticides	121	40.0
Trapping options	61	22.1
Physical barriers	23	8.0
Other	11	3.8
Extension Requests (n=277)		
Biological control	172	62.1
Pesticide use	112	40.4
Cultural control methods	106	38.3
Trapping options	83	30.0
Identification	62	22.4
Sampling methods	61	22.0

<sup>1</sup>Respondents were allowed to select multiple requests for Extension and research.

## List of active ingredients in common insecticides

### Cypermethrin

- Bite Free Biting Fly Repellent (0.15%) + 0.20% pyrethrins
- Endure Sweat-Resistant Fly Spray for Horses (0.15%) + 0.20% pyrethrins
- Repel-X Lotion (0.15%) + 0.20% pyrethrins
- Tri-tec 14 Spray (0.15%) + 0.20% pyrethrins
- \*Tri-Tec Concentrate Fly Spray for Horses (0.60%) + 0.8% pyrethrins

### Permethrin

- Bronco Equine Fly Spray (0.10%) + 0.05% pyrethrins
- Repel-X RTU (0.10%) + 0.05% pyrethrins
- Flysect Water-Based Repellent Spray (0.15%) + 0.075% pyrethrins
- Flysect Super 7 (0.20%) + pyrethrins
- Bug Block (0.20%) + 0.10% pyrethrins
- DuraGuard (0.20%) + 0.10% pyrethrins
- Mosquito Halt Repellent Spray for Horses (0.20%) + 0.13% Prallethrin
- Manna Pro Equine Fly & Mosquito Spray (0.25%)
- UltraShield (0.40%) + 0.10% pyrethrins
- Repel 35 Insect Spray Bio-Groom (0.50%)
- Zonk-It! 35 (0.5%)
- \*Adams Concentrate (1%) + pyrethrins
- \*Solitude Wipe-On Fly Repellent (1%)
- \*Flysect Super-C Concentrate (1%) + 0.5% pyrethrins

### Pyrethrins + piperonyl butoxide

- Equisect Fly Repellent (0.10%)
- Fly Gone 7000 (0.10%)
- Flysect Citronella Spray (0.10%)
- Flys-X (0.10%)
- FlySpray 44 (0.10%) + citronella
- Pyranha Wipe n'Spray for Horses (0.10%)
- Wipe II Fly Spray with Citronella (0.10%)
- Flysect Repellent Spray (0.15%)
- Endure Sweat-Resistant Fly Spray for Horses (0.20%)
- Wipe Original Fly Protectant (0.20%)
- Super Shield Red Fly Repellent (0.25%)
- \*Repel-Xp Concentrate (0.40%)
- \*Horse & Stable Spray (0.5%)

### Resmethrin

- Absorbine Concentrated Fly Repellent (0.55%)

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**Roll-ons and Towels** are ready-to-use products that can supplement fly control if protection is breaking down and flies are beginning to bite at specific sites on the horse.

### Cypermethrin

- Endure Roll-On for Horses (0.15%) + 0.20% pyrethrins

## List of active ingredients in common insecticides

### Permethrin

- Bug Block Easy Wipe (0.20%) + 0.10% pyrethrins
- Ultra Shield Towelettes (0.40%) + 0.08% pyrethrins

### Pyrethrins

- Flysect Roll-On (0.40%)
- Roll-On Fly Repellent (0.40%)

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**Spot-Ons** are concentrated products that applied in small amounts to specific sites on the horse. The active ingredient becomes distributed over the animal and protection may last longer than sprays or wipes. Reactions in horses may include skin sensitivity, increased itchiness, redness, rash, and hair discoloration or hair loss at the application site.

### Spot-Ons (permethrin)

- Brute Pour-on Insecticide (10%)
- Celebration Spot-on for Horses (45%)
- Durvet Fly Rid Plus (45%)
- Equi-Spot Spot-on Fly Control (45%)
- Freedom 45 Spot-on (45%)
- UltraSpot (45%)

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**Dusts** are fine particles of talc or clay that carry the insecticide. They may be useful in specific instances, such as louse control. Coumaphos is an organophosphate insecticide.

### Coumaphos

- Co-Ral Zipcide Equine & Livestock Dust (1%)

### Cypermethrin

- Python Dust (0.075%)

### Permethrin

- Horse Lice Duster III (0.25%)
- Prozap Insectrin Dust for Livestock & Poultry 0.25% permethrin

## Typical Values for Hay Analyses\*

Katie Young, Ph.D.

Purina Animal Nutrition

DM - dry matter: normally averages about 90%

CP - crude protein

Alfalfa : 15-24%

Grass: 5 -14%

NDF - neutral detergent fiber

- Includes indigestible fiber (lignin) and fermentable fiber (hemicellulose and cellulose)
- 33-44 normal for alfalfa
- 57-70 normal for grass
- > 65, horse is less likely to eat

ADF - acid detergent fiber

- An estimate of the poorly digestible fiber portion - includes cellulose and lignin
- 27-34% normal for alfalfa
  - If ADF is in the low 20's, may be insufficient indigestible fiber (bulk) for hindgut health
- 34-44% normal for grass (higher ranges in grass hay may increase risk of digestive disturbances)
- < 31 good; > 45 poor

As NDF and ADF increase, palatability and voluntary intake will decrease.

RFV - relative feed value:

- Calculation based on NDF and ADF
- Higher RFV means higher quality and digestibility of nutrients

### MINERALS

	Legume	Grass	Comments
Calcium (Ca)	1.5% (1.2-1.8%)	0.52% (0.3-0.7%)	
Phosphorus (P)	0.28% (0.23-0.33%)	0.24% (0.16-0.33%)	
Potassium (K)	2.4% (1.9-2.9%)	1.9% (1.3-2.5%)	Recommendation for HYPP horses: 0.6 - 1.1% total K in the diet. Soaking hay will reduce potassium (as well as other nutrients**).
Copper (Cu)	9 ppm (3.3-15 ppm)	9 ppm (4.2 - 13.8 ppm)	Minimum Cu requirement ~ 10 ppm for most classes of horses
Zinc (Zn)	29 ppm (0 - 1181 ppm)	39 ppm (0-1877 ppm)	Minimum Zn requirement ~ 40 ppm for most classes of horses

### SOLUBLE CARBOHYDRATES

Starch	0.99 - 3.1%	0.88 - 3.7%	
WSC	7.2 - 10.8%	6.5 - 15%	Includes sugars and all fructans. Soaking hay will reduce soluble carbohydrates somewhat (as well as other nutrients**).
ESC	5.7 - 8.7	4.6 - 10.2%	Includes sugars and short chain fructans. Soaking hay will reduce soluble carbohydrates somewhat (as well as other nutrients**).
NSC	8.8 - 13%	8.0 - 17.7%	Obsolete assay - similar to Starch + WSC
NFC	27 - 34%	14.9 - 24.4%	Calculated value - much error, little valuable information

\*All values except DM on an as fed basis

\*\*Soaking hay will reduce all water soluble nutrients, including soluble proteins, some minerals, and some soluble carbohydrates (primarily sugars). When feeding soaked hay, be sure that the total ration includes additional nutrients to meet the horse's requirements.

Quality Standard	Crude Protein (CP)*	ADF**	NDF**	RFV	Comments
Prime	Alf >19 Grass - NA	<31	<40	>151	Basically dairy quality alfalfa; may be too low ADF to maintain hindgut - mix with grass hay for horses. Unsuitable for easy keepers, obese horses, metabolic syndrome horses. Horses will need additional vitamin and mineral source (Enrich 12***).
1	Alf 17-19 Grass >18	31-35	40-46	125-151	Good quality alfalfa (high caloric content) - appropriate for performance horses, lactating or gestating mares, growing horses, hard keepers. Alfalfa is appropriate for gastric ulcers, IR horses. Unsuitable for easy keepers, obese horses, metabolic syndrome horses. Need additional vitamin, mineral and possibly protein source (Enrich 12*** for maintenance horses, Enrich 32*** for growth, lactation, performance, etc.).
2	Alf 13-17 Grass 13-18	36-40	47-53	103-124	Moderate-poor quality alfalfa, good alf/grass mix, or excellent quality grass (moderate to high caloric content). Appropriate for performance horses, lactating or gestating mares, growing horses. May need to limit intake for easy keepers, obese horses, or metabolic syndrome horses. Need additional protein, vitamin and mineral source (Enrich 32***)
3	Alf <13 Grass 10-13	41-42	54-60	87-102	If alfalfa - very poor quality (unsuitable). If grass hay - very good quality (moderate caloric content). Appropriate for most classes of equines, hard keepers will probably need additional calorie sources. May need to limit intake for easy keepers. Need additional protein, vitamin and mineral source (Enrich 32***).
4	Alf - NA Grass 7-10	43-45	61-65	86-75	Moderate quality grass hay (low to moderate caloric content). Appropriate for easy keepers, obese horses, or metabolic syndrome horses. All horses will need additional protein, vitamin and mineral sources. Performance horses, broodmares and growing horses will likely need additional energy sources (Strategy, Ultium, Omolene 200/300/500).
5	Alf - NA Grass <7	>45	>65	<75	Very poor quality - too much indigestible fiber for horses to digest and absorb nutrients. May increase the risk of digestive disturbances such as impactions. If no other hay available, may replace with a complete feed (Equine Senior/Adult/Junior, Omolene 400, Horse Chow).

Chart based on Quality standards as classified by the Hay Market Task Force of the American Forage and Grasslands Council

\* CP is not used in the calculation of RFV, thus reported CP amounts are simply estimated crude protein contents.

\*\* As fed basis

\*\*\*Nature's Essentials Enrich 12 and 32 products are appropriate for horses that need no additional calories beyond hay

## **Granulation Tissue-Not That Straightforward!**

Andrew Smith, DVM  
Large Animal Surgery Resident  
University of Florida

Fibroplasia, or the formation of granulation tissue is a normal part of wound healing. Apart from the nuisance of becoming exuberant, granulation tissue has many important functions, which change continuously during the healing process. It fills in the wound gap, forms a barrier against external contaminants, provides myofibroblasts for wound contraction, and forms the bed over which epithelium can migrate.

Granulation tissue provides several cell types that have important functions during healing, however, too much, termed “exuberant” granulation tissue can inhibit wound healing. Exuberant granulation tissue will typically develop in wounds of the distal limb, wounds under over areas of high motion, and/or the presence of infection, necrosis, or foreign bodies. When treated appropriately, most cases resolve without reoccurrence.

Occasionally, equine wounds can transform into or become infected to become more pathologic diseases that often look similar to exuberant granulation tissue. Differential diagnoses of exuberant granulation tissue include: fibroblastic sarcoids, squamous cell carcinoma, hemangiomas, habronemiasis, badiobolomycosis, condiobolomycosis, botryomycosis, or pythiosis. A presumptive diagnosis can sometimes be made based on history and clinical features; however, a **Definitive Diagnosis** usually requires biopsy and histological assessment. A definitive diagnosis is important because treatment is specifically tailored to the underlying pathological process. For some, prompt treatment is imperative as this can significantly affect the overall prognosis.

Therefore, in wounds showing particularly complicated healing or frequent recurrence of exuberant granulation tissue, further testing should be performed for definitive diagnosis. Definitive diagnosis is critical because the current best practice for managing EGT is usually contraindicated in the management of other more pathologic diseases.

## Horse Health Myths and Misinformation

Amanda M. House, DVM, DACVIM  
UF College of Veterinary Medicine

Many of us have heard or passed down myths regarding equine health care. During this session, some of the most common myths and misinformation will be discussed about equine veterinary care. Colic, cough, preventative health care, and lameness myths will be demystified!

### Colic Myths and Misinformation

1. *Never allow a horse with colic to roll.*
2. *The horse passed manure, so he must be doing fine and can be fed again.*
3. *Horses with colic should receive enemas.*
4. *Mineral oil should be force fed to horses with colic.*
5. *Colic surgery is a death sentence.*

The truth about colic: Colic is the number one cause of death in horses, excluding old age. The good news is that the vast majority of cases are mild and resolve with medical treatment. Although most horse owners hope to never have to think about it, understanding what colic is and adopting strategies for its management and prevention are an important part of responsible horse ownership and management. The USDA's National Animal Health Monitoring System published the results of a 1998 study on equine colic which determined that the incidence of colic was 4.2 events for every 100 horses per year, that 1.2% of colic cases will require surgery and that 11% will be fatal. The cost of colic was estimated to be \$115 million in 1998, and that has certainly increased in the last 10 years. So what is colic?

Colic is a clinical sign of disease, but is not actually a disease itself. Colic is defined as any abdominal pain and can come from any abdominal organ, not just the gastrointestinal tract. Abdominal discomfort from liver or kidney disease will sometimes cause signs of colic. The signs of colic can vary from mild to severe. Mild, early signs of colic can include a poor appetite, decreased manure production, lip curling, depression, or laying down more than normal. The most common signs associated with colic include pawing, stretching out, flank watching, teeth grinding, bloated abdomen, kicking at the abdomen, rolling, and getting up and down. Owners and care takers should know what is normal for their horses, so that abnormal behaviors can be recognized as soon as possible.

Normal behaviors, appetite, and physical exam parameters can vary a little bit from horse to horse. In general, adult horses should have a normal rectal temperature of 99-101.0°F, a heart rate of 24-48 beats per minute, and a respiratory rate of 10-24 breaths per minute. The gums should be pink and moist with a capillary refill time of less than 2 seconds. Most horses will pass 6-10 piles of well formed manure in 24 hours. Horse owners and managers should routinely use thermometers and stethoscopes to evaluate the normal physical exam parameters for their horses.

Treatment for colic depends on the suspected cause. Pain medication such as Banamine<sup>®</sup> is typically indicated for initial management. Banamine<sup>®</sup> usually takes about 30 minutes to take effect, so sedatives such as xylazine and detomidine can help relieve pain while the Banamine<sup>®</sup> begins working. Buscopan™ is another drug that may be administered by your veterinarian and may help treat spasmodic colic by stopping intestinal spasms. Fluid therapy is typically also administered by an oral or intravenous route, depending on the severity and suspected cause of the colic. Laxatives like mineral oil and Epsom salts are often utilized for impactions. Horses that are exhibiting signs of colic should generally be kept off feed until the suspected cause has resolved. It is important to remember that mild intestinal upsets and colic that require surgery may start out with very similar signs. Persistent pain remains the #1 indicator for exploratory surgery in cases of colic. Fortunately, the prognosis for horses that undergo surgery is better now than it has been in the last 50 years. Most horses will return to their previous level of competition after about a 2-3 month post-surgical rest.

Remember to stay calm if you notice that your horse is showing signs of colic. Remove the feed, but not the water, from the stall. Walking can help prevent injury if your horse is trying to go down and roll, but remember to first consider your safety as well as that of the horse. If the horse is too painful and cannot be safely walked, leave them in the stall until your veterinarian arrives. Call your veterinarian as soon as you notice a problem. Take the horse's heart rate, respiratory rate, and temperature before the vet arrives. Evaluate your horse's gum color and moisture. It is important to have the horse's previous medical and diet histories available. Have there been any changes in the horse's routine? This information will be helpful for the veterinarian evaluating the horse.

Do not give more than one dose of pain medication without consulting your veterinarian. Do not walk the horse or yourself to exhaustion. Absolutely do not try to pass a tube or force feed mineral oil. Mineral oil in the lungs can result in a fatal pneumonitis. It is also not advisable to insert a hose or anything rectally into a horse to give an enema. Remember that chronic mild signs of colic over several days or longer may also indicate a serious problem and require veterinary evaluation.

### Cough Myth

1. *Persistent coughs are usually caused by bacterial infections.* In fact, the most common cause of a persistent cough from the lower airways is Recurrent Airway Obstruction (also known as heaves), which is an allergic lower airway disease. Upper airway problems (such as dorsal displacement of the soft palate) may cause coughs as well, and would need to be evaluated by endoscopy.

### Lameness Myths

1. *Wraps: You have to wrap both legs if there is an injury to one. Wraps must be applied in one direction (ie inside to outside).* These are common myths that we have all heard about the application of equine wraps. In fact, it is OK to just wrap one limb, although we often will apply a support wrap to the contralateral limb. Wraps can be applied in either direction, as long as the pressure is applied evenly.
2. *The lameness looks high up in the leg...don't forget the foot!*
3. *Lacerations or wounds near a tendon or joint are not severe as long as the horse isn't lame.* Wounds may involve the tendon sheath or joint initially with minimal lameness. Wounds or lacerations near these critical areas should always be evaluated by your veterinarian.

### Preventative Health Care Myths and Misinformation

1. *Only horses that travel need to be routinely vaccinated.*
2. *Once a year vaccination for eastern equine encephalitis (EEE) is adequate.*
3. *Deworm every horse every 8 weeks.*

The truth about vaccinations and parasite control: Routine vaccination is a critical component of developing a health maintenance program for horses. It is important to emphasize that there is no standard vaccination program that is suitable for every horse, and that individual programs should be developed with your veterinarian. Vaccinations help to prime the immune system to respond quickly when a horse is exposed to an infectious agent. Although vaccinations cannot guarantee disease prevention in all circumstances, they help minimize the risk of infection and aid in the prevention of certain diseases. Vaccination is not a substitute for other good management practices, and should be used in conjunction with proper nutrition, deworming, pasture management and minimizing stress and overcrowding for optimal results in each horse and herd. Ideally, all horses in a group should receive vaccinations and be on the same schedule when possible.

The vaccination program appropriate for an individual horse or herd needs to take into account things such as age, sex, geographic location, use of the horse, pregnancy status and risk for developing the disease. Currently, there are vaccines available for tetanus, encephalomyelitis, West Nile virus, rabies, rhinopneumonitis (equine herpes virus), influenza, strangles, Potomac horse fever, botulism, equine viral arteritis, anthrax, and

rotavirus. The vaccines are administered by an intramuscular or intranasal route depending on the disease. Influenza and strangles have both intramuscular and intranasal vaccines available. Adverse reactions to vaccination are not common but are a potential risk of vaccination. Signs of an adverse reaction may include muscle soreness, swelling, fever, anorexia, and lethargy. If the signs are severe or are not self-limiting, your veterinarian should be informed and may want to initiate additional therapy.

When considering a vaccination program for your horse, it is important to remember that each horse's immune system will respond a little differently to vaccination. Not every horse will be protected to the same degree or for the same amount of time following vaccination. A primary series of the vaccines with booster doses will be required for an appropriate immune response before exposure to the disease. It will take 1-2 weeks after a completed vaccine series for your horse to be protected against the disease. After the initial vaccine series, most horses will require annual or semi-annual booster vaccinations. It is recommended that ALL horses, regardless of age or use, be vaccinated for EEE/WEE, tetanus, rabies, and West Nile Virus. In Florida, all horses should be vaccinated for EEE/WEE at least 2-3 times per year.

Establishing a deworming program for equine parasites has become a somewhat controversial topic of discussion. Due to the emergence of resistant parasites (worms that are not killed by traditional dewormers), some of the emphasis is shifting to prevention and control, rather than just routine rotational treatment with anthelmintics. The American Association of Equine Practitioners (AAEP) recommends establishing a program with your veterinarian that works best for your horse and/or herd, in conjunction with these suggestions for environmental management:

1. Clean and dispose of manure in the pasture at least twice weekly.
2. Mow and harrow pastures regularly to break up manure and expose parasite eggs to the sun.
3. If possible, rotate pastures by allowing other livestock to graze them.
4. Group horses in a pasture by age to reduce exposure to certain parasites, and maximize the deworming program geared to that group.
5. Prevent overgrazing and reduce fecal contamination by keeping the number of horses per acre to a minimum.
6. Feed horses in a feeder for hay and grain rather than on the ground.
7. Remove bot eggs from the hair routinely to prevent ingestion.

Individual horses can be monitored for parasites with a fecal examination and egg count. In Florida, the peak worm season is fall, winter, and spring. Treatment should be focused around these times. The effectiveness of different dewormers can be measured using a fecal egg count reduction test, which involves performing a fecal egg count before and after deworming your horse. Although it is critical to target the large and small strongyles in adults, as well as roundworms in foals, rotation of dewormers should not be done as often as every 4-8 weeks, because this may promote resistant worms. Ideally, a dewormer can be used for several treatments prior to rotation to a new drug. It is important to remember that treatment with ivermectin is done at 2-month intervals, while moxidectin is done at 3-month intervals. Equine tapeworms are difficult to identify in fecal examinations, and deworming for tapeworms is recommended biannually or annually with a product containing praziquantel (Zimectrin Gold®, Equimax®, Quest Plus®), or double dose pyrantel pamoate or tartrate. A blood test has been developed that identifies antibodies to tapeworms in horses. This test is only available at one lab in the United States at the University of Tennessee's College of Veterinary Medicine. However, there are likely horses with tapeworms that this test will not identify, and it is more practical to be sure horses are dewormed annually to biannually for tapeworms. Consult your veterinarian for a deworming strategy that works best for your horse and/or herd.

## Breeding the Problem Mare



Margo L. Macpherson, DVM, MS, DACT  
Malgorzata Pozor, MedVet, PhD, DACT  
Erin Runcan, DVM, DACT  
University of Florida

## What is a Subfertile Mare?

AKA The "Problem" Mare

- ▶ Not pregnant after repeated matings
- ▶ Cannot carry a pregnancy to term
- ▶ Has known reproductive pathology
- ▶ Behavioral issues that affect reproduction

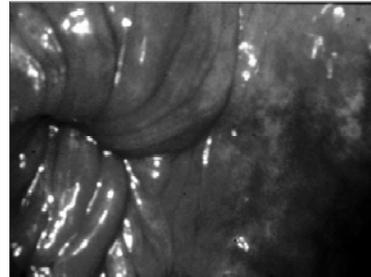


## What Causes Subfertility?

- ▶ Breeding management
- ▶ Conformational defects
- ▶ Susceptibility to endometritis
  - Infectious endometritis
  - Post-mating induced endometritis

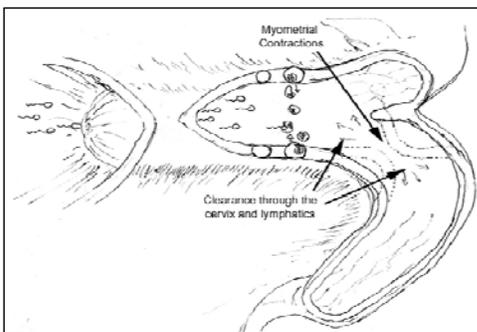


## ALL MARES GET ENDOMETRITIS



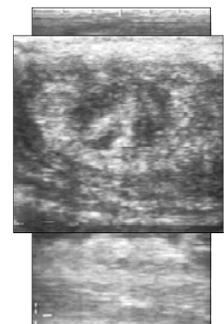
SO WHY ARE SOME MARES DIFFERENT?

## Resistant vs Susceptible Mares



## Susceptible Mares

- ▶ Prior to breeding
  - Minimal inflammation
- ▶ After breeding
  - Acute inflammatory response
- ▶ Poor ability to clear inflammation/infection



### “Typical” Susceptible Mare

- ▶ Middle-aged or aged
- ▶ Pluriparous
- ▶ Pendulous uterus
  - Poor contractility
- ▶ Perineal defects



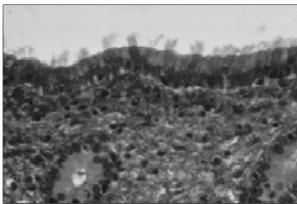
### “Atypical” Susceptible Mare

- ▶ Middle-aged
- ▶ Maiden
- ▶ Cervical incompetence during estrus



### Other Factors: Mucus Production

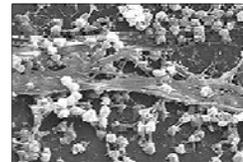
- ▶ Produced by endometrial ciliated cells
  - Protective
  - Excessive in endometritis



Causey, et al. 2000, 2008.

### Other Factors: Biofilm

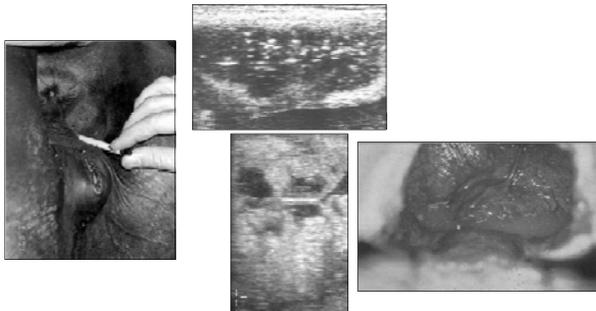
- ▶ Heterogenous mix of bacteria
  - Supported in extracellular matrix
  - Normal flora/protective
  - *Pseudomonas* spp, *E. coli*
- ▶ Properties of bacteria can change with conditions
  - Can result in disease
    - Dental caries
  - Antibiotic resistance



*Staphylococcus* biofilm

### Problem Solving the Problem Mare

The “Usual” Stuff



### Uterine Culture



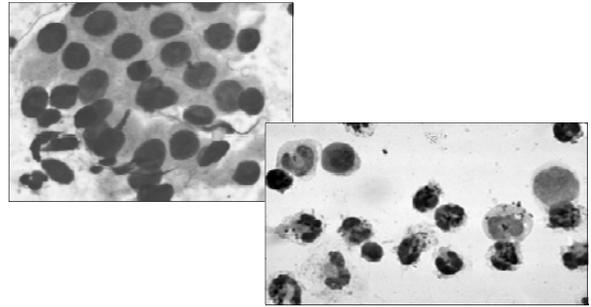
## Uterine Cytology: Methods

- ▶ Uterine swab
- ▶ Uterine cytology brush
- ▶ Uterine biopsy



Nielson J. 2005

## Uterine Cytology



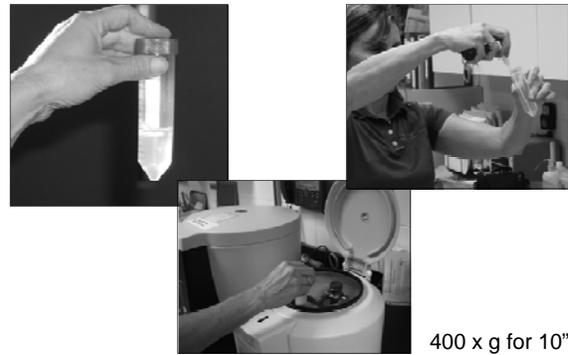
## Diagnosis of *S. zooepidemicus* vs *E. coli*

- ▶ Strep infections
  - More uterine fluid
  - More positive cultures
  - More positive cytology
- ▶ *E. coli* infections
  - Low volume uterine lavage
  - RT-PCR



Riddle et al, 2007; Eaton et al, 2010; Burlison et al, 2010

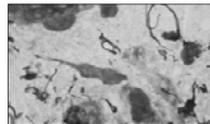
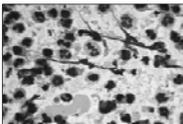
## Low Volume Uterine Lavage: Sample Processing



400 x g for 10"

## Intpretation of Results

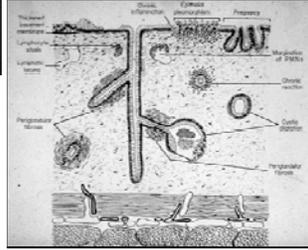
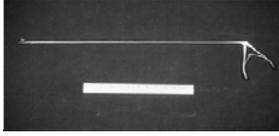
- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>▶ Traditional cytology                             <ul style="list-style-type: none"> <li>◦ 5 PMN's/hpf</li> <li>◦ Degenerate cells</li> <li>◦ Bacteria                                     <ul style="list-style-type: none"> <li>• <i>Streptococcus</i></li> </ul> </li> <li>◦ Fungal organisms</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>▶ Low volume lavage                             <ul style="list-style-type: none"> <li>◦ Presence of PMN's</li> <li>◦ Debris in fluid</li> <li>◦ Mucus strands</li> <li>◦ <i>E. coli</i> culture</li> <li>◦ Fungal culture</li> </ul> </li> </ul> |
|---|--|



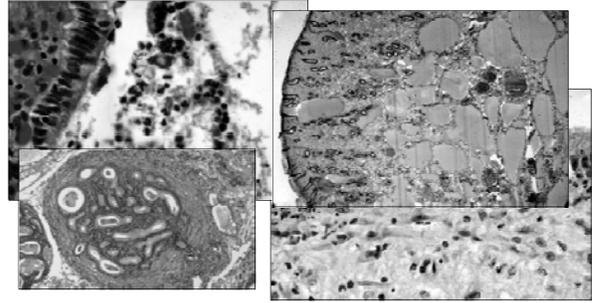
## Which Method to Use for Detecting Endometritis?

- ▶ Uterine Swab Cytology
  - High rate of false negatives
- ▶ Uterine Cytology Brush
  - Higher specificity than uterine swab
- ▶ Low Volume Lavage
  - Higher sensitivity for *E. Coli* infection
- ▶ Uterine biopsy
  - More sensitive for Gram negative bacteria

## Endometrial Biopsy

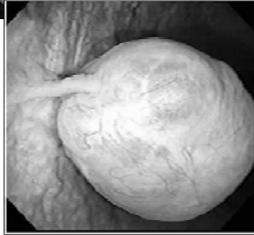
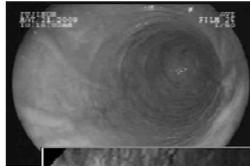


## Inflammatory cells



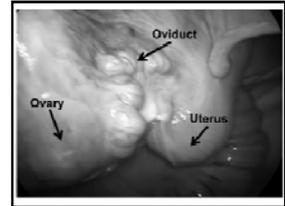
## Hysteroscopy

- ▶ Visualization of uterine lumen
- ▶ Localized abnormalities of the endometrium
- ▶ Visually-guided procedures
  - Deep horn insemination
  - Biopsy
  - Laser procedures



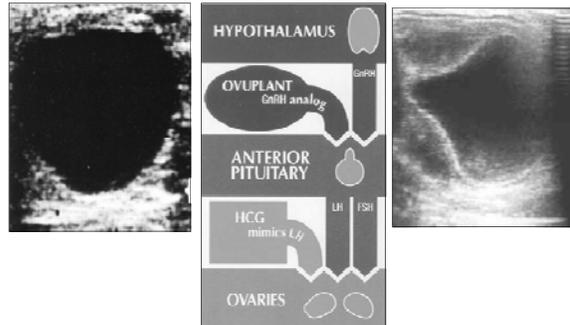
## Oviductal Patency

- ▶ Barren mares
- ▶ Oviductal blockage
  - Plugs
  - Salpingitis
  - Adhesions
- ▶ Laparoscopic evaluation
  - Flush
  - Prostaglandin E



## Treatment Strategies

## Breed Close to Ovulation



## Treating the Problem Mare

### The "Usual" Stuff



## Things to Use When Nothing Else Works



## Immunostimulants

- ▶ *Mycobacterium phlei* cell wall extract (MCWE)
  - Settle® (Bioniche Animal Health)
    - 1.5 mg, IU or IV
    - Administered early in estrus
  - Modulates immune response
    - Both routes effective
    - Not tested combined with antibiotics



Fumoso, et al. 2007

## Immunostimulants

- ▶ *Propionibacterium acnes*
  - EqStim® (Neogen Corp.)
- ▶ Pregnancy rates improved
  - Combined with traditional treatments
    - Oxytocin
    - Antibiotics
    - Uterine lavage

Rohrbach, et al. 2007

## What About Steroids?

- ▶ Dexamethasone (Bucca, et al. 2008)
  - 50 mg, IV
    - Within one hour of mating
    - Combined with other therapies
  - No change in pregnancy rate
    - Decreased clinical signs
- ▶ Prednisolone (Papa, et al. 2008)
  - 0.1 mg/kg, PO, q12h
  - 4 days starting 48h prior to mating
  - Improved pregnancy rates
- ▶ Use with bacterial endometritis?

## Immunomodulation

- Susceptible mares
  - Post-mating induced endometritis
- Infected with *E. coli*
- Mycobacterium cell wall extract
  - MCWE, Settle™
    - 1.5 mg, IV
- Dexamethasone
  - 0.1 mg/kg, IV
- Endometrial biopsies and uterine cultures
  - 3, 24, 72 h

Christoffersen, et al. 2012, Woodward, et al. 2012

## Immunomodulation

- Pro-inflammatory cytokines (IL-1 $\beta$ , IL-6, IL-8)
    - Decreased with dexamethasone
  - Anti-inflammatory cytokines (IL-10)
    - Increased with dexamethasone
  - Serum amyloid A proteins
    - Decreased with MCWE
  - Bacteria and uterine fluid
    - Decreased with both treatments
- TAKE HOME: THERE MAY BE A PLACE FOR STEROIDS IN TREATING THE MARE WITH INFLAMMATION**

Christoffersen, et al. 2012, Woodward, et al. 2012

## Mucolytics

- DMSO, kerosene
  - Chemical curettage
- N-acetylcysteine (NAC)
  - aka Mucinex<sup>®</sup>
  - Mucolytic/anti-inflammatory
  - 30 ml 20% solution
    - diluted in 150 ml saline
  - Infuse day prior to breeding
  - Oxytocin 4-6 h after infusion
  - Uterine lavage at 24 hours



Dascanio, 1989

Gores-Lindholm, et al. AAEP2009.

## Buffered Chelators

- Enhance antimicrobial activity
  - Alter cell wall
  - Paired with most antimicrobials
- Tris-EDTA
- Tricide<sup>™</sup>
  - Commercially available
    - Rood and Riddle
    - 200-500 ml/infusion
    - Lavage 12 h later



Youngquist, et al. 1984; Lyle AAEP 2011

## Conclusions: The Problem Mare

- Success requires attention to detail
- Patience is important!
- Use therapies wisely



## MATCHING FORM TO FUNCTION

Conformation is the physical appearance of an animal due to the arrangement of muscle, bone and other body tissue. The overall blending of body parts determines a horse's performance capability to be a natural and graceful athlete. Consequently, allowing you to predict longevity and usefulness for any given discipline.

### What do we evaluate?

- Ratios
- Proportion/Balance
- Angles

### When do we use evaluation criteria?

- Head
  - Sinus capacity – air exchange
  - Throatlatch - Larynx
- Neck
  - 2:1 ratio
  - Long vs short
- Shoulder
  - 45 degree angle
- Entire body
  - Equal proportion/balanced into thirds
  - Heat girth = Leg length
- Back
  - 1:2 ratio
- Hip
  - Equilateral triangle
- Legs (Forelimb and Hindlimb)
  - Cannon bones
    - Knee to Hock ratio
  - Pasterns
    - 45 degree angle

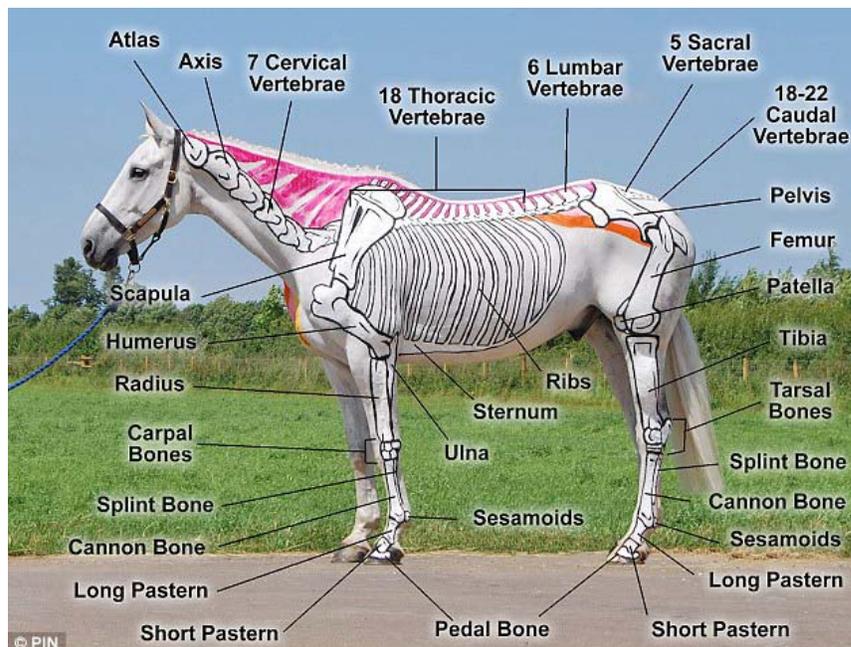


Figure: Gillian Higgins. 2011. *How your Horse Moves*.

*No horse is perfect and many horses excel even with their conformational faults!*