UTILIZATION AND METHODOLOGY REGARDING EQUINE PARASITE MANAGEMENT

by

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(Under the Direction of Kari Turner)

ABSTRACT

Anthelmintic resistance became one of the leading problems in parasite management. Cyathostomins, small strongyles, are the most widespread parasite observed in equine fecal egg assessments due to their high prevalence and increasing resistance to anthelmintics. In order to provide county Extension agents recommendations, horse owners were surveyed on their parasite management procedures and where they receive new information regarding equine management practices. Limiting the use of anthelmintics by incorporating fecal egg counts became the solution to decrease resistance; however, the survey shows 42% of the respondents are aware of anthelmintic resistance and are not trending toward this procedure. Another part of this study was to compare reliability and precision of McMasters and mini-FLOTAC methods in quantifying cyathostomins in field situations within the horse. Results indicated that the mini-FLOTAC procedure provides more sensitivity and reliability in quantifying cyathostomins in horses.

INDEX WORDS: Anthelmintic resistance, Extension, McMasters, Mini-FLOTAC

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CHAPTER 1

INTRODUCTION

The main goal of a successful deworming program is to reduce parasite infestations and improve health in individual horses while preventing the development of parasite resistance to available anthelmintics. Deworming programs must fit the parasites being targeted, and efficacy of anthelmintics should be evaluated to determine resistances developed by the targeted parasites.The two deworming programs that are most widely used today in the equine industry are the rotational and selective treatment programs.

In the 1960s, the equine industry relied on rotational deworming to target large strongyles which caused many clinical cases and deaths (Nielsen et al., 2014). Horse owners were recommended to rotate different anthelmintics of the benzimidazole class every 8 weeks throughout the year (Kaplan & Nielsen, 2010). In the 1970s and 80s, tetrahydropyridine and macrocyclic lactone classes of anthelmintics were introduced into the rotational schedule (Kaplan & Nielsen, 2010). Researchers and veterinarians based the rotational deworming schedule on the lifecycle of the large strongyles so that it would decrease the amount of eggs entering the environment thus killing off the population (Reinemeyer, 2009). Large strongyles have decreased significantly over the past several decades due to intense anthelmintic treatments from rotational deworming, but large strongyles are still present and are rarely seen in clinical cases. but caused the other populations of parasites to increase due to resistance to available dewormers (Nielsen et al., 2008).

The selective treatment deworming program was proposed and implemented to decrease resistance caused by the overuse of current anthelmintics (Corning, 2009). In the selective treatment program, fecal egg counts are incorporated to assess each individual horse's need to be dewormed (Nielsen et al., 2014). Horses are classified as low, moderate, or high egg shedders based on their fecal egg counts using a scale published by the American Association of Equine Practitioners (AAEP). Low egg shedders are defined as having 200 EPG or less. Moderate egg shedders have 200 EPG to 500 EPG. High egg shedders have above 500 EPG (Nielsen et al., 2013). Fecal egg counts have been shown to have a high repeatability within each horse, meaning high shedders are more likely to be high shedders regardless of environment and treatment (Scheuerle et al., 2016). The McMasters and mini-FLOTAC techniques have been used to quantify cyathostomins to categorize horses within the scale mentioned above.

The McMasters technique, developed in Australia in 1939, is the most widely used for quantifying small strongyles eggs in equine fecal samples and is currently recommended by the World Association for the Advancement of Veterinary Parasitology for determining anthelmintic effectiveness against parasites. However, the McMasters technique lacks sensitivity to detect lower fecal egg counts (Lester & Matthews, 2014). The mini-FLOTAC technique was developed in the past decade as a new alternative method for parasite quantification. The mini-FLOTAC method is said to be more accurate and precise, gives a better representation of the parasite load within the horse, and has a higher sensitivity to detect lower fecal egg counts (Noel et al., 2017). The McMasters and mini-FLOTAC techniques differ in how the fecal samples are prepared and formulas for quantification of fecal egg counts.

The Smith Lever Act in 1914 created the Cooperative Extension Service to provide open communications between the agricultural research stations, designed by the Hatch Act in 1887,

and the public. Extension agents utilize the knowledge and research to introduce new practices and protocols to follow due to the changes and difficulties agriculture presents every day. Cooperative Extension has helped the community by providing information that has been passed down through research conducted by the school systems. The importance of information transfer is vital to sustaining constant production with imminent changes that occur through the years especially within animals and agriculture.

The aim of these studies is to determine if the mini-FLOTAC technique is more sensitive and precise than the modified McMasters technique in quantifying small strongyles, to determine if the modified McMasters and mini-FLOTAC techniques provide similar classifications to distinguish if a horse is a low, moderate, or high egg shedders in field test settings, and to gather information from horse owners in the state of Georgia on what parasite management practices are being performed and if the horse owners are incorporating fecal egg counts into their routines. If fecal egg counts are not being run on their horses, identify what kind of barriers prevent them from using fecal egg counts. The survey will assess where horse owners get their information regarding equine management practices and provide some knowledge to Extension agents and specialists on what would provide the best results to reaching out to the equine industry.

CHAPTER 2

LITERATURE REVIEW

Introduction

Within the state of Georgia, horse owners believe in different deworming practices for their farms. Extension agents help the public by offering new information that has been researched within their respected colleges pertaining to new practices with the help of the Extension specialists within their fields. Knowing the process of how knowledge transfer works and how the recipient takes in and responds to the new information is given will help the pass down of knowledge easier. Deworming practices have become a concern for the equine industry due to the increase of resistance to the anthelmintics being used. Knowledge about why the new practices are not being used and what concerns does the public have will help Extension agents and specialists figure out the necessary needs to help horse owners implement the new deworming practices.

History of the Land Grant System

In 1857, Justin Smith Morrill, a Vermont Representative, introduced the land-grant bill to Congress. The land-grant bill allowed for states to receive federal funding to establish training institutions for agriculture and industry (Comer et al., 2006). Southern representatives delayed the voting on this proposed bill for two years. Congress passed the bill when it came to vote, but President Buchanan vetoed the bill because he believed it breached policies of government. President Buchanan did not want to encroach upon each states' rights of policies for education. When the Civil War began two years later in 1861, Morrill reintroduced the bill with provisions

to include teaching military tactics along with agriculture (Comer et al., 2006). Since the Civil War began and the South was no longer within the Union, the new proposed bill passed with no trouble. The Morrill Act of 1862 was passed and signed by President Abraham Lincoln. The Morrill Act gave the states federal grants for land to establish at least one college to teach agriculture, mechanical arts, and military tactics. However, if any state was not a part of the Union will not receive any funding or grant money (Comer et al., 2006). The Hatch Act of 1887 contracted agricultural experiment research stations for the land-grant system. The Hatch Act authorized direct payment of federal grant funds to each state to establish an agricultural experiment station in connection with the state's land-grant institution (Ferleger, 1990). After the Civil War had ended, segregation was an ongoing problem especially in the Southern states. Black agricultural communities believed that the federally funded land grants were only for non-colored universities. In 1890, the Second Morrill Act was passed to recognize both groups of races and their universities as land grant colleges. To disseminate information gleaned from the experiment stations' research, the Smith-Lever Act of 1914 created a Cooperative Extension Service associated with each land-grant institution. This act authorized ongoing federal support for extension services, using a formula similar to the Hatch Act's to determine the amount of the appropriation (Ferleger, 1990). In 1994, the Equity in Education Land-Grant Status Act was passed to give federally funded land grants to 33 tribal colleges for Native Americans in the Western and Plain States (Shaffer).

Cooperative Extension is a tripartite system developed by the land grant system that it is funded by federal, state, and local governments. Extension agents help the community by providing information and training programs for local farmers wherever there is a need for help. Extension agents use their knowledge gained by the researchers at the college levels or ask

specialists in their respected fields if there is a problem in their area for agriculture. Cooperative Extension would not have come into fruition if the land-grant system was not established. Cooperative Extension has helped through many travesties in history. During World War I, extension helped with increasing wheat acreage from 47 million to 74 million in 1919, encourage farm production, marketing, and conserving of perishable products by canning, drying, and preserving, and helped to address war-related farm labor shortages at harvest time by organizing the Women's Land Army and the Boys' Working Reserve (Ramussen, 2002). Throughout the Great Depression, extension emphasized the need for farm management for individual farmers. Extension agents taught farmers about marketing their goods to the public. At the same time, extension home economists taught women good nutrition, surplus food canning, gardening, home poultry production, home nursing, furniture refinishing, and sewing. These skills helped many farm families survive the years of economic depression and drought. During World War II, the extension service again worked with farmers and their families, along with 4-H club members, to help out with the increase of demand for agriculture due to the war (Ramussen, 2002). Extension's role in extending new technologies to U.S. farmers and ranchers helped farm production increase dramatically. While the number of farms in the U.S. declined over the next 50 years from 5.4 million to 1.9 million, farm production dramatically increased creating more efficient farming. In 1950, one farmer supported the food needs of 15.5 people; in 1997, one farmer supported the food needs of almost 140 people (Ramussen, 2002). Over the last century, extension has adjusted to the changing times and landscapes to help the community to promote a sustainable future for agriculture. The land-grant system has revolutionized the way we pass the agricultural knowledge and techniques down to the community that we use today. Cooperative Extension has provided the necessary tools to provide the public with latest research for planting

crops, raising livestock, and any maintenance that your land might need. Agriculture thrives on the need for information for the changing times and new technological developments. The land-grant system has provided the underlying foundation and framework needed to help the communities provide a sustainable future for agriculture.

Knowledge Transfer

Knowledge transfer is the interactive process of exchanging knowledge between researchers and the public (Kiefer et al., 2005). Extension utilizes knowledge transfer to provide a quality service for the public in agriculture and production management. Extension receives scientific evidence and information passed down from the universities' specialists on different topics to distribute to the population. Knowledge transfer is dependent upon learning capacity, interpersonal relationships, and knowledge presentation (Reagans & McEvily, 2003).

Learning new information is the first phase within a successful transfer of knowledge. People find it easier to learn new concepts and ideas based on knowledge that builds upon what they already know and have previously learned (Reagans & McEvily, 2003). Associative learning between people that have common backgrounds and expertise in similar concepts makes the flow of information transfer with ease. In contrast, people with different backgrounds in an area outside of the knowledge being transferred can hinder the ability to learn the information being given. Common interests in the subject being taught can have a more positive response in the process of understanding and learning new information.

Interpersonal relationships can affect the ease of sharing knowledge between one another (Reagans & McEvily, 2003). People who communicate on a more frequent basis and have a bond between each other are more likely to share and trust the information being given (Reagans & McEvily, 2003). Extension builds these relationships using their people skills to an advantage

which provides a significant amount of trust to relay information needed for the public. The time to build these relationships can prove to be costly especially for a new agent starting their career and the knowledge transfer would be more difficult (Szulanski, 2000). If there is not a strong connection between the source and the recipient, the source may need to provide additional concrete information supporting the ideas being discussed (Szulanski, 2000). This lack of connection often leads to the recipient challenging and resisting the information being given by the source (Szulanski, 2000). Motivation is key to developing the bond between the source and the recipient, without the time and effort from the source, the recipient would not be as willing to receive the information. The relationships may be strong or weak, however, the information maintains its ability to be transferred through personal relations, or concrete evidence depending on the level of connection presented (Reagans & McEvily, 2003).

Knowledge presentation refers to the organization of ideas and concepts that can be useful for the recipient to comprehend more easily. If the information is presented in a manner of examples that relate to the recipient, the recipient may be more likely to understand and accept the knowledge being given by the source. There are many different forms of presentation that may be beneficial for the recipient to understand the information, considering many people learn in different ways, through auditory, visual, or tactile demonstration. When outsourcing new information to a group of people, orient the information into a daily routine to which the new information can be applied directly to the recipients' needs (Szulanski, 2000).

Understanding Decision Making and Persuasion

The decision-making process is beneficial for managers to understand when trying to introduce new information to a group of individuals. The understanding of how human information processing works and the relation between the source and the recipient is essential to

deducting the best approach among many different types of people. The parameters of this section encompass the understanding of the brain and psychological functions, the different mind sets that help people determine pre- and post- decisional streams of thought, reasons why people are reluctant to alter their affiliation, and how persuasion, social influence, and environmental factors correlate to decision making.

The brain consists of two hemispheres, the right and the left, where the left hemisphere is responsible for verbal and analytical thought processes and the right hemisphere controls spatial relations and intuition (Taggart & Robey, 1981). Studies have shown that most people and those particularly in management use both the right and left hemispheres of the brain during decision making, specifically, Carl Jung's study, where psychologists have concluded that there are two dimensions of human information gathering that are related to perception understanding and judgement (Taggart & Robey, 1981). Perception refers to the gathering of information which is based on sensation or intuition. Judgement is the actual processing of the information where an individual can process through thinking or feeling a certain way about the information given. Considering the aspect individuals whom are right or left hemispherical dominate, this yields four different processing styles for making decisions, which consists of each component of perception and judgement: sensation-thinking, intuition-thinking, sensation-feeling, and intuition-feeling (Taggart & Robey, 1981). Each of these distinguished styles focuses on facts or possibilities being the focus of attention, impersonal or personal analysis as a form of handling situations, general tendencies, and four different modes of expressing abilities. People who use the sensation-thinking process to form decisions are individuals who are analytical or left hemisphere dominate who base their decisions on fact, use impersonal analysis to handle situations, have practical and matter of fact tendencies, and express themselves through technical

skills with facts and objects (Taggart & Robey, 1981). Individuals who use intuition-thinking base their decisions on possibilities, objective evaluation, have logical and ingenious tendencies, and express themselves through theoretical and technical developments (Taggart & Robey, 1981). Sensation-feeling individuals base their decisions on facts, use personal warmth to handle situations, have sympathetic and friendly tendencies, and express themselves by helping people through being practical and providing services (Taggart & Robey, 1981). Individuals who use intuition-feeling processes to make their decisions based on possibilities, use personal warmth to handle situations, have enthusiastic and insightful tendencies, and express themselves through understanding and communicating with others (Taggart & Robey, 1981). These different styles of processing information are beneficial for managers to understand due to the ability to adapt to many different types of situations and knowing the most efficient way to connect to their recipient.

There are two states of mind that explains the process of assessment. These two states of mind are motivational and volitional states of mind that are based on pre-decisional or post-decisional streams of thought (Heckhausen & Gollwitzer, 1987). Every individual uses both pre-decisional and post-decisional streams of thought. The formation of a decision is processed through motivational streams of thoughts that focuses on incentives and outcomes, and once the decision has been made, the volitional stream of thought places emphasis on how implementation of the assessment achieves the outcomes and incentives (Heckhausen & Gollwitzer, 1987).

The mental composition of behavior, reasoning, and emotional characteristics determines why an individual can be resistant to change. Studies have concluded that there are four factors that are congruent with why people are resistant to change, these factors include routine seeking,

emotional reaction to imposed change, cognitive rigidity, and short-term focus (Oreg, 2003), meanwhile, each of these can also be used to the advantage of the source to convince the recipient to alter their assessment affiliation. Routines are based on the conditioning of behavioral skills and it is generally easier to have people submit to change if it can be intertwined in their daily routines (Oreg, 2003). When new information is introduced, those who are generally resilient to change have a preference for limited mental novelty and stimulation as well as unwilling to adapt to changing their habits because change emphasizes increased mental stimulation in the brain (Oreg, 2003). Emotional reactions to change are related to the individual's self-esteem, optimism, and perceived control over a situation (Oreg, 2003), as a result, this allows individuals to feel a certain way about new information being given. In organizational studies, it is encouraged that employee participation and involvement are essential in making transitions easier within the workforce. By allowing participation and involvement, it helps limit the stress of losing control because it is self-initiated instead of mandated (Oreg, 2003). Individuals who are more likely to alter their affiliation because they feel like they are admitting past practices were defective (Oreg, 2003). Cognitive rigidity is the function in the brain that limits a person's ability to empathize with another person's viewpoint. This function is based on personal experience and is often related to problem solving and the ease of changing one's mind (Wood, 2000). Studies have shown that those who are highly motivated rely on their judgement to make decisions and are generally select the best option except when the new information was too brief (Wood, 2000). When the new information is too brief, those who are highly motivated adapt to include other people's judgement positions on the topic and tend to rely on those judgements to conclude their own (Wood, 2000). Individuals who have moderate-to-high intercorrelations between factors reflects their outlook to resist change (Oreg, 2003).

These individuals are considered to be rigid and closed-minded making them less willing and able to adjust to new situations (Oreg, 2003). Short-term focus is related to the rational decisions based on immediate need, however, it does not account for the benefits of long-term focus that would be an affective reaction to change (Oreg, 2003). When changes are established within the workforce, many employees are assigned new tasks that require them to learn and adjust and as many individuals will be willing to endure this change either because they believe it will make a difference, while others are less likely to support the change and may resist because of the adjustment period is complex (Oreg, 2003).

Companies, managers, and employees that work in fields that require information exchange should be aware of applications of persuasion, social influence, and environmental factors that are directly related to persuade the decision-making process. These people who work directly with the public have to know the best ways to reach their recipients which is mostly through information campaigns (Verplanken & Wood, 2006). Persuasion has three different approaches to affect other individuals. When offering information the source can be accurate in giving information by giving the public the pros and cons to target issues and create a balanced representation of information that keeps a neutral attitude (Wood, 2000). When the source is trying to influence the public in a favorable position, the source is to align the information with what is congruent with that perspective (Wood, 2000). And lastly, when the source is influencing the public to disagree with some information, arguments that support the source's for their decision is argued to the recipients (Wood, 2000). These different approaches can relate to attitude changes consistent with open-mindedness process generation, impression generated on agreeable orientation, and defense motives creates a protective orientation that maintained existing judgements (Wood, 2000). Social influence is how the recipients can take the new

information that was given by the source and contextualize it with social interactions (Wood, 2000). For this reason, it is not uncommon that many recipients look for others and tend to share the same opinions. Although, information campaigns can be successful conveying information, it does not necessarily change consumers' behaviors because the recipient's routine most likely will predict that the information given from the source, may not be the best fit for the recipient (Verplanken & Wood, 2006). Environmental factors are linked to habits that are formed by recurring processes that take place at a certain time of day or location which leads to vulnerable positions in obtaining new information (Verplanken & Wood, 2006), because these restraints may limit the decision of the recipient.

Equine Parasites

A parasite is an organism that infects and lives on or in another organism's body of a different species, known as the host, where nutrients and sustenance are provided. Parasites can cause infection or harmful diseases to the host if not managed and treated properly. Horses obtain many parasites throughout their lifespan due to their consumption of grass, forage, and water, contact with fecal materials, and the prevalence of parasites throughout the environment. Ascarids, bots, pinworms, large and small strongyles, threadworms, and tapeworms are among the most common internal parasites that infect horses.

Parascaris equoram, known as an ascarid or roundworm, is a universal nematode parasite which inhabits the small intestine of young horses all over the world (Reinemeyer, 2012). Ascarids are normally 8 to 10 inches long and appear yellow and white in color. Ascarids cause most of their damage by the immature larvae migrating through the digestive, circulatory, and respiratory tracts causing pneumonia, intestinal blockage, and severe digestive upset (Stoltenow & Purdy, 2003). Once ascarid eggs are passed through the feces of the host, the eggs

require temperatures of 25 to 35 °C for 10 days to develop an infective stage larva within the egg. If the environmental conditions are not favorable, the eggs are protected by three layers of coating and can lay dormant in the ground for up to 10 years (Clayton, 1986). Infective eggs are ingested from the environment, hatched in the stomach, and the larvae burrow through the small intestine to enter the bloodstream heading towards the liver. From the liver, the larvae heads toward the lungs to be coughed up to return to the small intestine to lay eggs approximately 75 to 80 days after infection (Reinemeyer, 2012). Horses develop a strong immunity against ascarids around 12 to 15 months of age and infections rarely occur after the age of 24 months (Clayton, 1986).

Horse bots, *Gasterophilus spp*., are the larvae of flies that have become exceedingly specialized to horses. The horse bot is considered the most economically problematic insect affecting the equine industry. In 1965, the U.S. Department of Agriculture reported that horse bots caused economic losses of $40,000 annually in the Thoroughbred race horse production in Kentucky alone (Steelman, 1976). Female bot flies can lay up to 900 eggs in three hours (Stoltenow & Purdy, 2003). The eggs are laid normally laid on the hairs of the front legs and any hairs within the reach of the horse's muzzle. The eggs will remain on the hairs until the horse brushes them off with their lips. The warm and humid environment of the horse's lips stimulates the eggs to hatch and the larvae attaches itself to the mucous membranes in the mouth where they will stay for about six weeks. The larvae will migrate to the stomach and latch itself to the stomach lining mainly around the pyloric sphincter to mature and eventually will pass through in the horse's feces. Horse bots take 10 to 11 months to develop and if the infestation is severe, the horse will obtain serious damage to the stomach lining, irritation to the intestinal membranes,

and blockage of the normal passage of digesta which will lead to colic and sometimes death (Stoltenow & Purdy, 2003).

Pinworms, *Oxyuris equi,* is a common parasite that occupies the cecum, colon, and rectum of horses. Adult female pinworms can grow up to 15 cm long and can lay up to 60,000 eggs per cycle (Wolf et al., 2014). After mating, the females migrate toward the anus where they will secrete a yellowish white viscous streak of fluid infested with eggs around the perianal region. The fluid will harden and flake off releasing infective eggs into the environment around 4 to 5 days after secretion (Reinemeyer, 2012). Horses become infected after the ingestion of the eggs from food, grass, and bedding in the stalls. After 3 to 11 days' post infection, the eggs will hatch and the larvae will migrate toward the colon and cecum where they will reach sexual maturity around 150 days' post infection. Pinworms irritate the perianal area which causes mild discomfort and scratching and itching of the tail. The larvae cause mild erosions in the intestinal mucosa and causes an inflammatory response in heavy infestations (Wolf et al., 2014).

Equine strongyles are intestinal parasitic nematodes that produces a high level of concern due to the impact on horse's health (Traversa et al., 2007). Large strongyles, *Strongylus spp.*, are considered the most dangerous of the equine parasites because the adults are insatiable blood suckers that causes anemia, weakness, diarrhea, and substantial damage to the intestinal lining. The larvae of the large strongyles migrate through the mesenteric arteries causing irritation, damage, and may hinder blood flow causing the arteries to rupture and the internal bleeding will cause death (Stoltenow & Purdy, 2003; Traversa et al., 2007). Large strongyles have decreased significantly over the past several decades due to intense anthelmintic treatments, but large strongyles are still present and are rarely seen in clinical cases (Nielsen et al., 2008). Small strongyles, cyathostomins, are now recognized as the most common and prevalent nematodes in

horses. Nearly 100% of all grazing animals are infected with small strongyles, and account for practically 100% of helminth egg output (Traversa et al., 2007). Small strongyles can cause irritation of the intestinal walls, scours in foals, and in severe cases leads to a clinical syndrome called "larval cyathostominosis" (Stoltenow & Purdy, 2003; Traversa et al., 2007). This disease can cause a severe inflammatory enteropathy within the colon and cecum that can result in colitis, weight loss, diarrhea, subcutaneous edema, and a 50% fatality rate with prompt treatment (Traversa et al., 2007). Once the small strongyles eggs are ingested, the eggs hatch in the colon and cecum and populate in great numbers within the large intestine. Some small strongyle larvae become encysted within the intestinal wall when the population is too great, but can reemerge once the population starts to die down (Corning, 2009). The reemergence factor of the small strongyles has become a focus for researchers within the equine industry.

Threadworms, *Strongyloides westeri,* are parasites that affect foals at a very young age contracted via the mare's milk. Horses develop a very strong immunity against threadworms around 6 months of age. Threadworm eggs are not found in adult feces, but are usually present in foal feces at 15 days of age (Lyons et al., 1973). Since horses have this strong immunity for threadworms, mares may contract an infection from the environment with minimal amounts of threadworm larvae within the mammary glands around 4 to 40 days postpartum and will spread once the foal drinks the mare's milk (Lyons et al., 1973; Stoltenow & Purdy, 2003). Foals that are infected with threadworms may exhibit diarrhea, weight loss, indigestion, and bowel irritation (Stoltenow & Purdy, 2003)

Equine tapeworms, *Anoplocephala perfoliata*, were considered for many years to be non-threatening, rarely found upon postmortem examinations, and very seldom associated with any clinical disease (Proudman & Trees, 1999). Tapeworm infections are difficult to diagnose

because of the seldom shedding attributes and rare clinical symptoms. In the 1980's, many cases reported evidence of lesions around the ileocecal junction linking intestinal issues with tapeworms which led to the consideration that tapeworms are a more serious threat than people thought (Proudman & Trees, 1999). In 1992, 61% of 118 horses were infected with tapeworms in central Kentucky (Bello & Abell, 1999). Orabatid mites infected with cysticercoids of the tapeworms are ingested by horses from grazing and the parasite attaches to the intestinal mucosa of the ileocecal junction. Tapeworms matures to an adult in 6 to 10 weeks and grows to 5 to 8 cm in length. Equine colic and intestinal diseases are the detrimental risks involving tapeworm infestations (Proudman & Trees, 1999).

Anthelmintics and Resistance

Anthelmintics, known as dewormers, have been given arbitrarily to control the horse nematode population for over 40 years. The widespread use of anthelmintics has significantly reduced clinical disease, especially with the large strongyle species, but the high treatment frequency has created a problem of increased anthelmintic resistance and pressure for selection of different anthelmintics for cyathostomins and equine tapeworms (Matthews, 2014). The development of anthelmintic resistance is a complicated process that is affected by the host, parasite, and environmental factors. The host factors include their immune system and anthelmintic pharmacokinetics which determines the fate of a substance administered in a living organism. Parasite factors include genetics, population density, anthelmintic pharmacokinetics, and inheritance. Environmental factors include frequency of anthelmintics given and climate (Nielsen et al., 2014). The three main classes of anthelmintics being used today are benzimidazoles, tetrahydropyridines, and macrocyclic lactones.

Benzimidazoles have been considered as a true broad-spectrum anthelmintic when thiabendazole was created in 1961. Benzimidazoles were used as a low frequent dose for therapeutic deworming in horses (Lacey, 1990). Benzimidazoles have shown a very high resistance in goats, sheep, horses and is starting to develop a resistance in cattle. Thiabendazole showed early resistance within three years for sheep and horses after the anthelmintic was approved for veterinary use (Kaplan, 2004). Benzimidazoles inhibits microtubule formation to parasites within different hosts (Lacey, 1988). Benzimidazole resistance is acquired by β-tubulin mutations that interferes with drug binding (Wolstenholme et al., 2004). Oxibendazole still remains effective against benzimidazole resistant worms for 8 to 10 uses before effects significantly decrease (Kaplan, 2002). Due to the dose frequency of benzimidazoles, resistance was developed quickly by the parasites' ability to develop immunity against the anthelmintic (Lacey, 1990).

Tetrahydropyridines were developed in the 1970s as a nicotinic agonist to attack the synaptic and extra synaptic acetylcholine receptors on nematode muscle cells causing paralysis (Martin, 1997). Pyrantel used for horses did not experience any resistance until 1996 (Kaplan, 2004). Horse owners used pyrantel at sporadic intervals hoping to protect horses from infection and gave daily doses to horses with either high fecal egg counts or showing symptoms of infection which has helped the process of resistance prosper (Kaplan, 2004). Resistance appears to come from a mutation of the nicotinic acetylcholine receptors (Braziket al., 2006) . Pyrantel pamoate and pyrantel tartrate are the two anthelmintics of this class. Some farms in Georgia where pyrantel pamoate has been discontinued due to resistance, have started using pyrantel tartrate as a daily anthelmintic which suggests that cross-resistance may develop in the future (Brazik et al., 2006).

Macrocyclic lactones, known as the avermectins, were developed for animal use in the early 1980s as broad spectrum anthelmintics that are glutamate-gated chloride (GLUCL) receptor potentiators (Martin, 1997). These anthelmintics increases the parasite's muscle chlorine permeability which will affect the glutamate-gated channel directly and paralyze the nematode due to constant contraction of the pharyngeal muscle which prevents feeding (Shoop, Mrozik, & Fisher, 1995). Ivermectin, moxidectin, and praziquantel are the most commonly used within this class of anthelmintics. Resistance for ivermectin did not appear in horses until 19 years later after it was approved in 1981. Moxidectin resistance did not appear in horses until 8 years after it was approved in 1995 which draws some concern within the equine industry since this anthelmintic is the last line of defense against cyathostomins (Kaplan, 2004). Praziquantel is used to combat tapeworm infestations that still has a high efficacy rate around 100%, but could lead up to resistance if not properly used (Slocombe et al., 2007).

Equine Deworming Programs

Deworming programs have been created by researchers and veterinarians to prevent and attack parasite infestations to improve the horse's health and quality of life. Deworming programs have been changed and altered to the parasites being targeted. Deworming programs are often assessed due to change of efficacies of the anthelmintics being used and the resistances developed by the targeted parasites. The two deworming programs that are most known for today throughout the equine industry are the rotational and selective treatment programs.

In the 1960s, the equine industry relied on the rotational deworming program due the large strongyles causing many clinical cases and deaths (Nielsen et al., 2014). The rotational deworming program used many different anthelmintics every 4 months throughout the year. Researchers and veterinarians based the rotational deworming schedule on the lifecycle of the

large strongyle so that it would decrease the amount of eggs entering the environment thus killing off the population (Reinemeyer, 2009). The rotational deworming program succeeded in exterminating most of the large strongyles but caused the other populations of parasites to increase due to resistance causing a need to trend to toward the selective treatment program.

The selective treatment deworming program was proposed and implemented in the 1980s to decrease the amount of resistance caused by the overuse of current anthelmintics and the survival mechanisms of the remaining parasite populations (Herd et al., 1985). In the selective treatment program, fecal egg counts are incorporated to assess each individual horse's need to be dewormed (Nielsen et al., 2014). Determining classifications of horses due to their fecal egg counts have been observed and made known by the American Association of Equine Practitioners (AAEP). The three classifications are known as low, moderate, and high egg shedders. Low egg shedders have 200 EPG or less. Moderate egg shedders have 200 EPG to 500 EPG. High egg shedders have above 500 EPG (Nielsen et al., 2013) In a recent study, fecal egg counts have a high repeatability measure within each horse meaning high shedders are more than likely to be high shedders depending on if their environment does not change (Scheuerle et al., 2016). Around 50% of the population of horses are categorized as a low egg shedders, so taking fecal egg counts once or twice a year to prevent giving an anthelmintic would definitely decrease the amount being used (Nielsen et al., 2013).

Manure Management

Proper manure management is considered one of the most important practices to control the parasite population on a farm. Since all the parasite's lifecycles begin with passing eggs through the horse's feces, manure management is the key to prevent parasite infestations occurring at an equine facility. Stocking density and cleaning pastures can help reduce the

amount of parasite eggs within the environment. In the southeast, dragging pastures and exposing the eggs to the heat of the summer is an effective practice to decrease the amount of parasite eggs. Manure management helps with odors around the barn as well as horse's well-being and living conditions. Bedding and manure are the main components that need to be disposed when cleaning stalls. Two ways manure management can be handled by composting and stockpiling manure on the facility.

Composting is an effective process to eliminate odors, flies, and internal parasites within the manure to create a fertilizer for pasture management (Davis et al., 2002). Creating valuable soil amendment, reducing manure volume, stabilizing nitrogen, and eliminating cost for disposal are the benefits of composting manure (Smith & Swanson, 2009). Composting requires oxygen to decompose the manure into a usable product. If oxygen is not present, it will create an anaerobic environment that will create odors and slow down the decomposition process (Davis et al., 2002). Oxygen can be filtered through the pile by simply turning the pile over thoroughly within composting bins or having PVC pipes with holes to allow air to pass through the pile naturally (Smith & Swanson, 2009). The moisture content of the manure pile should be roughly about 50% because if it is too dry the pile may heat up above 160 degrees F and create ash or if the pile is too wet the pile may not heat up to decompose properly (Davis et al., 2002). Composting bins should provide twice the amount of space at the base as the height of the pile and temperatures should be taken by 36 inch long thermometers in order for the process to run smoothly (Smith & Swanson, 2009).

Stockpiling manure is another way for farms with a lot of land to dispose of their manure. Stockpiling manure takes less effort and time which conserves money for the farm. The main concern when stockpiling is the location the farm managers or owners decide to put the manure

on their property. When determining the location of the manure, odors and people's line of sight of the manure pile should be considered. The recommendation for the location of the manure pile is that the pile should be at least 50 feet from the property line, 200 feet from the business or residence, 100 feet from a drinkable water source, and 100 feet from a surface water source to prevent contamination (Davis et al., 2002). Farms with not enough land to satisfy these recommendations should consider having their manure picked up from the local disposal service.

Current Deworming Practices

Research on current deworming practices has been conducted throughout the world. Determining which practices are being used is an important piece of information to determine if knowledge transfer was successful being passed down from the researchers or veterinarians to implement new practices. Also, information concerning the practices or reasons farms do not implement the new practices can help everyone understand why the knowledge transfer failed or if there are any barriers preventing the farms to implement the new practices.

In Tennessee, 98% out of 130 horse owners responded to a telephone survey about parasite control practices. Fifteen percent of horse owners deworm foals (0-6 months) 3 times a year. Thirty-two percent of horse owners deworm weanlings (6-12 months) 3 times a year. Eighty-six percent and fifty-one percent of horse owners deworm yearlings (1-2 years) 3 to 4 times a year respectively. Fifty-six and twenty-four percent of horse owners deworm adults (above 2 years) 3 to 4 times a year respectively. Roughly around half of the owners still deworm every 3 months, and most (53 to 80%) of the owners used the same anthelmintics (Reinemeyer & Rohrbach, 1990).

Researchers in West Germany did a survey study on parasite control practices on 543 flocks of sheep in 1989. Ninety-five percent of the farmers used benzimidazole as their only

anthelmintic to treat their sheep. Treatment on ewes and lambs occurred about 2.5 to 2.8 times a year on average. There were major differences in the parasite control practices due to the type of flock the farmers owned. Pedigree flocks dewormed more times than the commercially owned flocks of sheep (Bauer & Failing, 1992).

Thoroughbred and Standardbred trainers completed a survey in New Zealand about parasite control practices. There were 234 usable surveys out of 284 surveys that were received. This survey looked at interval dosing meaning at a set interval, strategic dosing meaning at set times of the year, and targeted dosing meaning using fecal egg counts to determine whether they deworm or not. Interval dosing for thoroughbreds and standardbreds were 50.5% for both. Strategic dosing (every 6-8 weeks) for thoroughbreds and standardbreds were 46.7% and 37.8% respectively. Targeted dosing for thoroughbreds and standardbreds were 4.8% for both (Rosanowski et al., 2016).

There was a management survey given to the Arabian horse owners in Sweden in between 2010 to 2014. Deworming practices varied from the farms. Around 100 participants out 454 Arabian horse owners deworm more than once a year, around 50 owners used their judgement to deworm, 220 owners deworm according to fecal egg counts more than once a year, and around 80 owners deworm according to one or less fecal egg counts a year. At the time of this study 60% (n=272) of the horses had been dewormed within the past 6 month and 40% (n=89) of the horses had been dewormed within the past year (Larsson & Müller, 2017).

Previous research studies show there is an increase of anthelmintic resistance in the industry and the need to change from rotational deworming to the selective treatment deworming procedure(Herd et al., 1985; Kaplan & Nielsen, 2010). This thesis will compare two fecal egg counting techniques in quantifying small strongyles and provide information on which

deworming program is currently being used, where do horse owners receive information regarding new management practices, and what barriers prevent horse owners from using the selective treatment deworming protocol.

CHAPTER 3

A COMPARISON OF MCMASTERS VS. MINI-FLOTAC TECHNIQUES IN QUANTIFYING SMALL STRONGYLES IN EQUINE FECAL EGG ASSESSMENTS

Abstract

Fecal egg count techniques are commonly used in parasitological research and veterinary practice to assess intestinal parasite populations and anthelmintic resistance in many animal species. The McMasters procedure is the most commonly used fecal assessment technique in veterinary practice, however, the mini-FLOTAC procedure was introduced in the past decade as an alternative and potentially more sensitive method of parasite quantification. Cyathostomins, small strongyles, are the most widespread intestinal parasite observed in equine fecal egg assessments due to their high prevalence and increasing resistance to anthelmintics. The purpose of this study was to compare reliability and precision of McMasters and mini-FLOTAC methods in quantifying cyathostomins in field situations within the horse. Fecal samples were collected from 18 horses rectally at 3-time points (initial, wk 2, and wk 4) for 2 consecutive days at each time point. Four subsamples were created to assess using the McMasters and mini-FLOTAC methods. When data were fitted with a Poisson distribution, mini-FLOTAC results were significantly higher than those seen using McMasters technique ($P < 0.05$). When low shedding horses (FEC <50 epg) were eliminated from the data set (due to mini-FLOTAC having greater sensitivity and ability to detect low FEC where McMasters did not), variance between techniques was highly significant with mini-FLOTAC showing lower variance as compared with McMasters (0.34, 0.72, $P < 0.0001$). Results of this study indicate that the mini-FLOTAC

procedure provides more sensitivity and reliability in quantifying cyathostomins fecal egg counts in horses.

Introduction

The main goal of a successful deworming program is to reduce parasite infestations and improve health in individual horses while preventing the development of parasite resistance to available anthelmintics. Deworming programs must fit the parasites being targeted, and efficacy of anthelmintics should be evaluated to determine resistances developed by the targeted parasites. The two deworming programs that are most widely used today in the equine industry are the rotational and selective treatment programs.

In the 1960s, the equine industry relied on rotational deworming to target large strongyles which caused many clinical cases and deaths (Nielsen et al., 2014). Horse owners were recommended to rotate different anthelmintics of the benzimidazole class every 8 weeks throughout the year (Kaplan & Nielsen, 2010). In the 1970s and 80s, tetrahydropyridine and macrocyclic lactone classes of anthelmintics were introduced into the rotational schedule (Kaplan & Nielsen, 2010). Researchers and veterinarians based the rotational deworming schedule on the lifecycle of the large strongyles so that it would decrease the amount of eggs entering the environment thus killing off the population (Reinemeyer, 2009). Large strongyles have decreased significantly over the past several decades due to intense anthelmintic treatments from rotational deworming, but large strongyles are still present and are rarely seen in clinical cases. but caused the other populations of parasites to increase due to resistance to available dewormers (Nielsen et al., 2008).

The selective treatment deworming program was proposed and implemented in 1999 to decrease resistance caused by the overuse of current anthelmintics and the survival mechanisms

of the remaining parasite populations such as the small strongyles' ability to encyst itself into the intestinal lining (Corning, 2009). In the selective treatment program, fecal egg counts are incorporated to assess each individual horse's need to be dewormed (Nielsen et al., 2014). Horses are classified as low, moderate, or high egg shedders based on their fecal egg counts using a scale published by the American Association of Equine Practitioners (AAEP). Low egg shedders are defined as having 200 EPG or less. Moderate egg shedders have 200 EPG to 500 EPG. High egg shedders have above 500 EPG (Nielsen et al., 2013). Fecal egg counts have been shown to have a high repeatability within each horse, meaning high shedders are more likely to be high shedders regardless of environment and treatment (Scheuerle et al., 2016). The McMasters and mini-FLOTAC techniques have been used to quantify cyathostomins to categorize horses within the scale mentioned above.

The McMasters technique, developed in Australia in 1939, is the most widely used for quantifying small strongyles eggs in equine fecal samples and is currently recommended by the World Association for the Advancement of Veterinary Parasitology for determining anthelmintic effectiveness against parasites. However, the McMasters technique lacks sensitivity to detect lower fecal egg counts (Lester & Matthews, 2014). The mini-FLOTAC technique was developed in the past decade as a new alternative method for parasite quantification. The mini-FLOTAC method is said to be more accurate and precise, gives a better representation of the parasite load within the horse, and has a higher sensitivity to detect lower fecal egg counts (Noel et al., 2017). The McMasters and mini-FLOTAC techniques differ in how the fecal samples are prepared and formulas for quantification of fecal egg counts. The slide preparation is different where the fill-FLOTAC container (Naples, Italy) has a plunger to agitate the sample in the Feca-med sodium nitrate solution (Vedco Inc., Missouri) and an attached pipette to place the sample on the slide to

limit the amount of transfer and possibility to lose the small strongyle eggs in the transfer. whereas the McMasters technique uses an unattached pipette to transfer the sample with a higher probability of small strongyle eggs being lost in the transfer (Noel et al., 2017).

The aim of this study is to determine if the mini-FLOTAC technique is more sensitive and precise than the modified McMasters technique in quantifying small strongyles and to determine if the modified McMasters and mini-FLOTAC techniques provide similar classifications to distinguish if a horse is a low, moderate, or high egg shedders in field test settings.

Materials and Methods

Animals

This study utilized 18 stock-type horses (12 geldings and 6 mares, age 12.8 ± 3.5 yr housed at the UGA Livestock Arena. The horses were equally housed on two adjacent pastures which were 6 and 6.8 acres large. The stocking density for both pastures were 0.67 acres per horse and 0.76 acres per horse, respectively.

Collection and storage

Fecal samples were collected rectally while placed in stocks provided by the UGA Livestock Arena. Collection of fecal samples occurred at the following three-time points: the initial start of the trial, at the end of week 2, and at the end of week 4. At each time point, fecal samples were collected on two consecutive days (Figure 1). Samples were stored in a refrigerator (-4˚C) for no more than 120 hours to achieve optimal results (Nielsen et al., 2010). Once the samples are ready to be tested, each fecal sample is divided into 2 subsamples per technique creating 4 subsamples per horse to be assessed per time point by each technique.

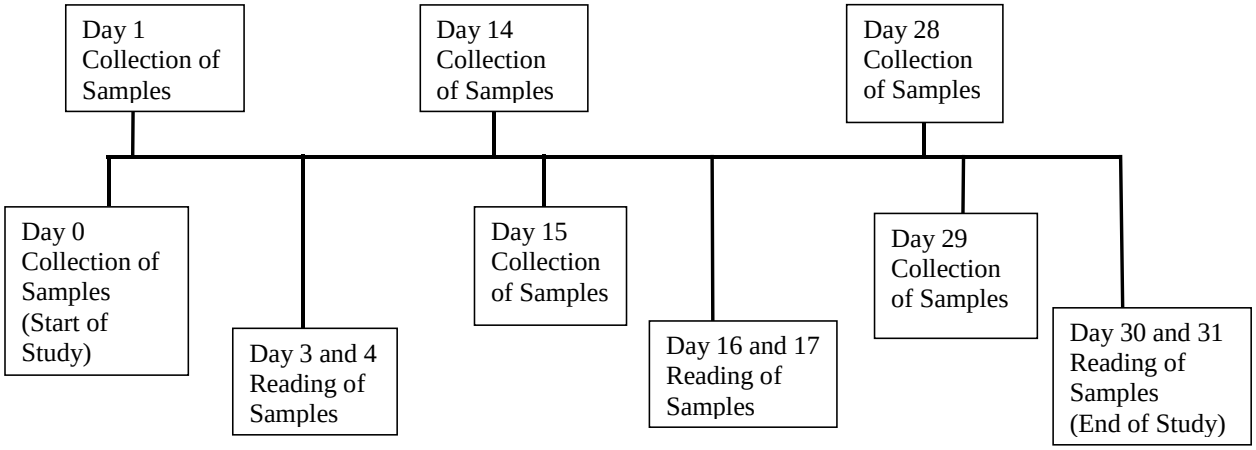

Figure 1: Timeline of study shows the collection of fecal samples occurred at the following three-time points: the initial start of the trial, at the end of week 2, and at the end of week 4. At each time point, fecal samples were collected on two consecutive days. Samples were stored in refrigerator until samples were analyzed 3 to 4 days later to achieve optimal results (Nielsen et al., 2010).

Modified McMaster Technique

Each subsample was created by measuring 2 grams of fecal sample with a Mettler-Toledo Bd202 weigh scale (Mettler-Toledo LLC., Columbus, Ohio).. The blue cylinder was removed from the JorVet Fecal Ova Floatation container (Jorgensens Laboratories Inc., Colorado). The subsample was placed in the smaller side of the blue cylinder. Once the blue cylinder with the subsample was placed back into fecal ova floatation container, 12 mL of Feca-Med sodium nitrate solution with a specific gravity of 1.200 (Vedco Inc., Missouri) was added to the container. The sample was agitated by inverting the container 10 times and left to rest for 10 minutes to allow the eggs to rise to the top of the solution. Using a pipette, the top of the solution was removed and placed into a two-chambered McMaster counting slide while making sure no air bubbles were present on the counting grid. The slide was placed underneath the Labomed binocular microscope (Labomed Inc., California) using a 10X objective lens the eggs were counted in each chamber. The fecal egg count was obtained by using the equation below:

(# of eggs in Chamber 1 + # of eggs in Chamber 2) X 20 = Fecal Egg Count

Mini-FLOTAC Technique

Each subsample was created by measuring 5 grams of fecal sample with a Mettler-Toledo Bd202 weigh scale (Mettler-Toledo LLC., Columbus, Ohio). The fill-FLOTAC container (Naples, Italy) was filled with 45mL of Feca-Med sodium nitrate solution with a specific gravity of 1.200 (Vedco Inc., Missouri). The conical collector on the lid of the fill-FLOTAC container was filled with the subsample and the surface was leveled. The lid with the subsample was screwed on the fill-FLOTAC container tightly. The subsample was agitated by lifting the plunger on the lid up and down while twisting until the subsample was completely homogenized with the sodium nitrate solution. The mini-FLOTAC slide's three parts were assembled by following manufacturer's instructions. The chambers were filled with the homogenized sample from the fill-FLOTAC with the pipette attached to the lid while holding the mini-FLOTAC assembly at an angle. The sample was then allowed to sit and rest for 10 minutes to allow the eggs to rise and adhere to the reading disc grids. Slides were then read using the 10X objective lens of a Labomed binocular microscope (Labomed Inc., California). The fecal egg count was obtained using the equation below:

(# of eggs in Grid 1 + # of eggs in Grid 2) X 5 = Fecal Egg Count

Statistical analysis

Fecal egg count data from each time point were statistically analyzed with SAS version 9.4 (SAS Institute Inc., North Carolina) and using the Poisson distribution with nested random effect. Paired t-tests from the rescaled data were statistically analyzed with JMP Pro 13 (SAS Institute Inc., North Carolina). Data with $P<0.05$ were considered statistically significant.

Results

Using the Poisson distribution with nested random effects between time and collections for all samples, the mini-FLOTAC technique (384.65 EPG) resulted in a higher fecal egg count as compared to the McMasters technique (95.74 EPG) at all time points ($P < 0.05$) as shown in Figure 2.

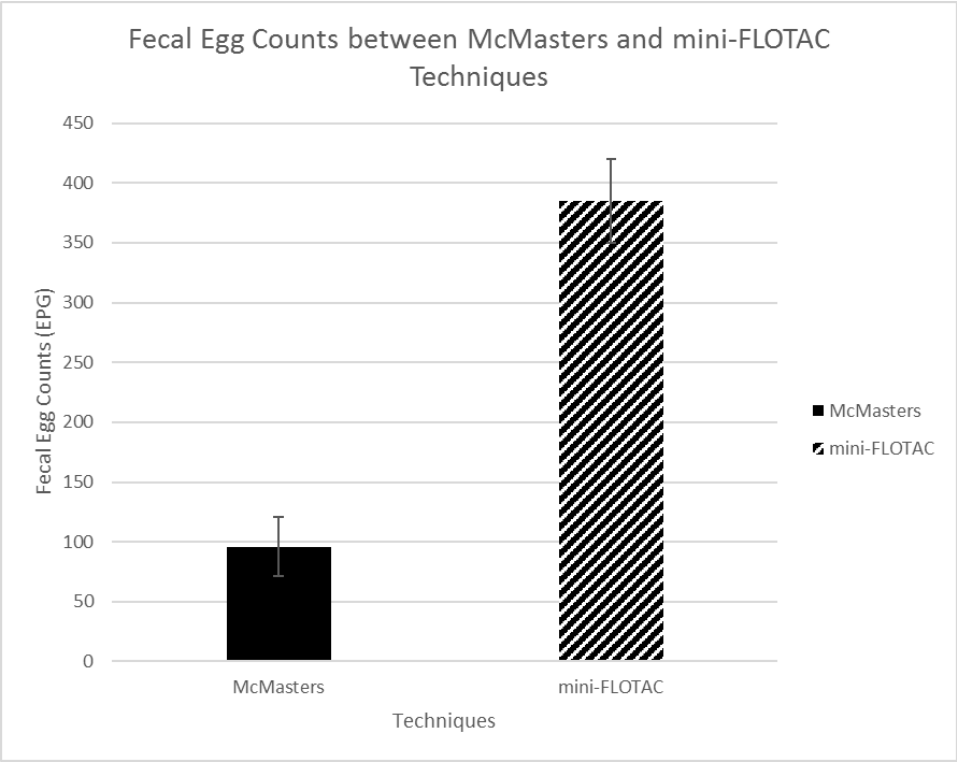

Figure 2: When both techniques were fitted with the Poisson Distribution with nested random effect, the mini-FLOTAC results were higher than the McMasters technique in detecting fecal egg counts due to higher sensitivity ($P<0.05$).

The averages of fecal egg counts for each horse collected at each time points were compared for both techniques (Figure 3). Averages of fecal egg counts of each horse were compared after rescaling the data by taking each fecal egg count and dividing by the highest fecal egg count per horse per technique for each collection. Paired t-tests comparing rescaled

data using both techniques at each time point showed no statistical difference between the mini-FLOTAC and the McMasters technique (P = 0.8591, P = 0.8686, P = 0.1484) (Figure 4).

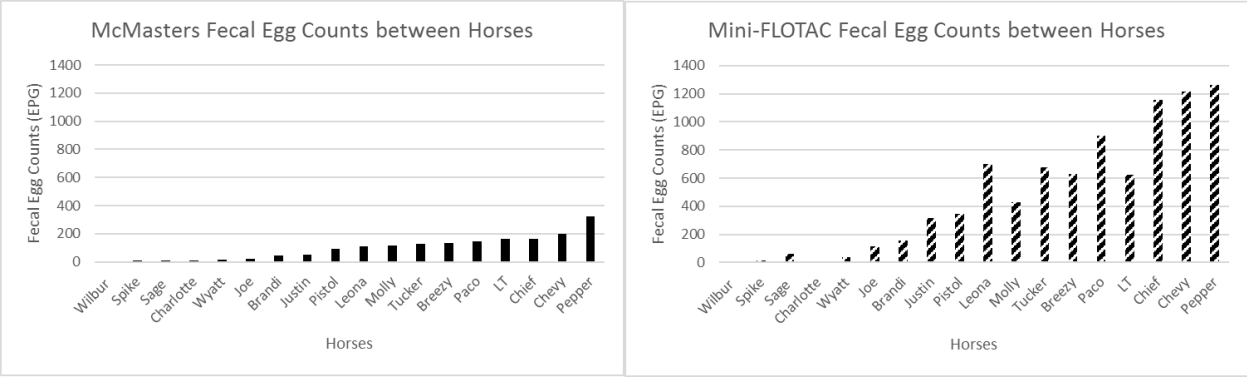

Figure 3: The average of fecal egg counts of all the horses were aligned from least to greatest for both techniques. Both techniques show a similar trend only with the mini-FLOTAC technique being on a larger scale than the McMasters technique.

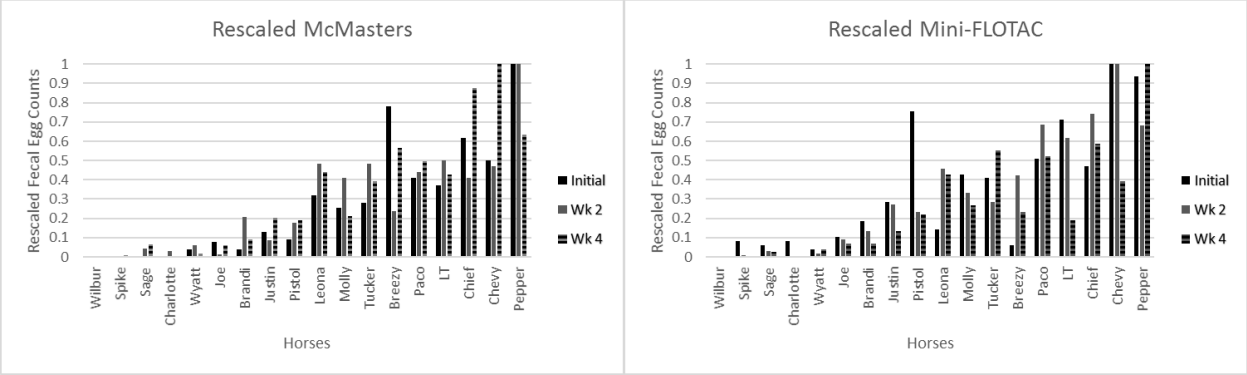

Figure 4: The fecal egg counts were rescaled by dividing all the fecal egg counts by the highest count of that time point. The results show that both techniques are similar in the dispersion of fecal eggs that are quantified. Paired t-tests were analyzed to prove there was not a statistical difference at initial (P=0.859), week 2 (P=0.868), and week 4 (P=0.148).

Both fecal egg assessment techniques were evaluated based on relative standard deviations to determine variations between both techniques. The relative standard deviation of the mini-FLOTAC (0.52) tended to have less variance than the McMasters (0.71) when all fecal egg counts were used (P=0.059). Since the McMasters technique has a lower sensitivity and cannot detect lower fecal egg counts, horses that were low shedders (FEC <50 epg) were removed from the analysis. This showed a stronger statistical significance with the mini-

FLOTAC having lower variance as compared to the McMasters technique (0.32, 0.72, P > 0.001) shown in Figure 5.

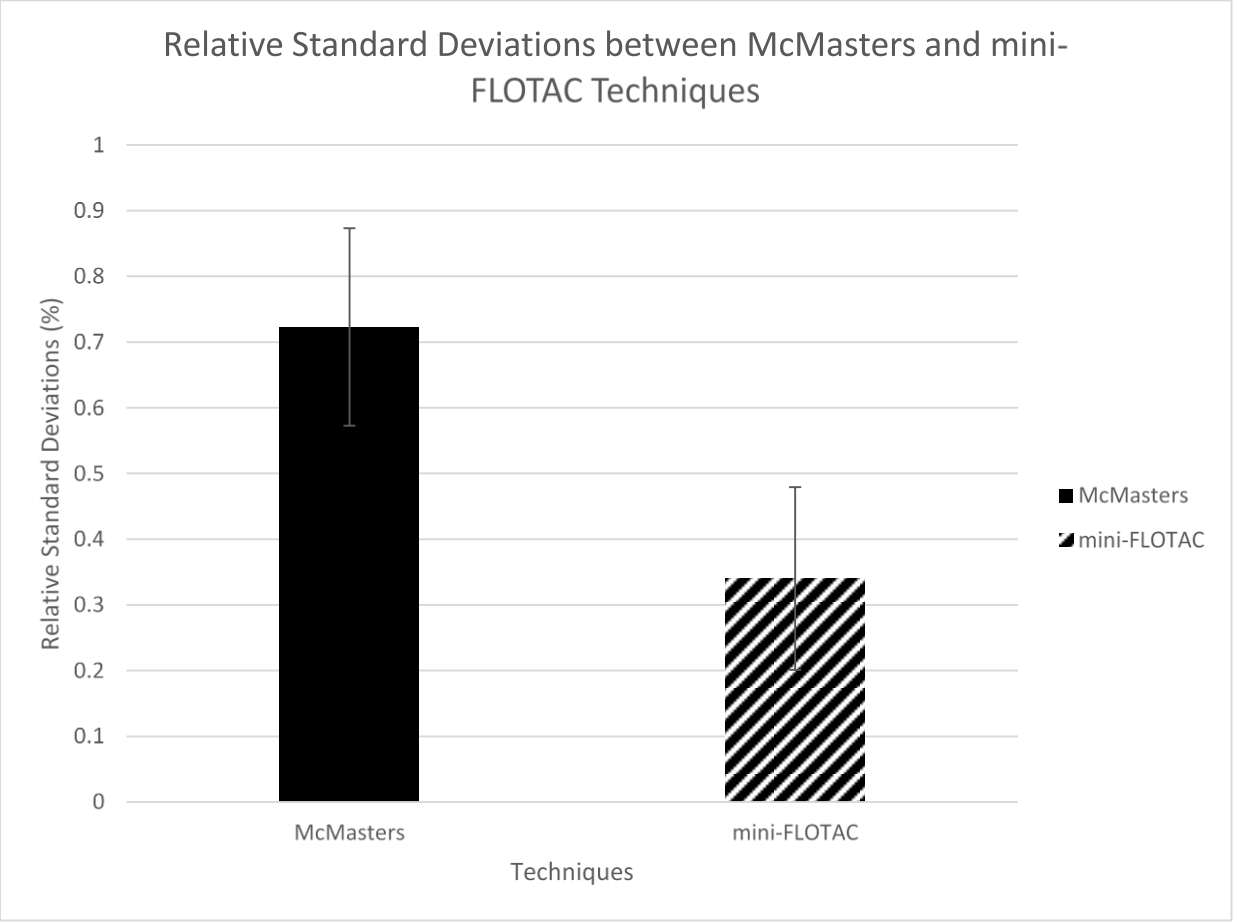

Figure 5: The relative standard deviations (%) between both techniques show that the McMasters technique has a higher variance (0.72) than the mini-FLOTAC technique (0.34) when low shedding horses (FEC<50 epg) were removed from the data set since the McMasters has a low sensitivity to detect lower fecal egg counts (P<0.001).

Discussion

This study examined the performances of the McMasters and mini-FLOTAC fecal egg counting techniques based on precision and levels of egg densities in field testing. According to the Poisson distribution, data supports the mini-FLOTAC technique will provide higher significant values than the McMasters technique. Due to the higher sensitivity, fecal egg counts provided higher ranges of egg densities than the McMasters technique. The data supports a recent study at the University of Kentucky where the sensitivity of the mini-FLOTAC is around 83% and the McMasters is around 56% (Scare et al., 2017). A study conducted in Italy using fecal samples from sheep showed the mini-FLOTAC technique produced an average of 90 EPG higher than the McMasters technique which was lower than the average of 385 EPG higher than the McMasters technique from this study using fecal samples from horses (Rinaldi et al., 2014). The difference could be due to the different modified McMasters techniques that were used in the studies. High sensitivity even at low egg counts is important when calculating parasite resistance to anthelmintics (Bosco et al., 2014). Since the mini-FLOTAC technique provides a higher sensitivity than the McMasters technique, the mini-FLOTAC will provide a more reliable method to calculate resistance in research.

The averages of the fecal egg counts for each horse shows a similar trend between the mini-FLOTAC and McMasters methods. When the data were rescaled, there was not any statistical differences between both techniques meaning both techniques classify horses in the same manner, but the mini-FLOTAC is on a higher scale when quantifying fecal egg counts. The high fecal egg counts are results due to the high sensitivity.

The McMasters technique has a higher variance when detecting fecal egg counts which can limit the amount of use detecting anthelmintic resistance or other research-based studies.

Apart from the different multiplication factors, the variances can be explained by the different methods in preparing the samples to be assessed from the way the sample is homogenized, transitioning the sample with the pipette used in the McMasters method, and the amount of solution read on the slides (Noel et al., 2017). The relative standard deviation is independent of the multiplication factors while the standard deviations are affected (Noel et al., 2017). The mini-FLOTAC technique has a lower variance and a higher sensitivity to detect lower fecal egg counts which gives more precise assessments of the small strongyle populations within the horse.

Accuracy of the techniques was not tested as a part of this study, but other studies tested the accuracy of the techniques by conducting a spiking test. Spiking tests use a spiked fecal sample with a known number of strongyle eggs and accuracy is measured by how close the eggs per gram are relative to the spiked sample (Scare et al., 2017). Results from one study conducted in Lexington, KY, showed the mini-FLOTAC had an accuracy of 64.5% and the McMasters had an accuracy of 21.7% when the spiking tests were performed (Scare et al., 2017). Another study's results from the spiking test showed the mini-FLOTAC had an accuracy of 42.5% and the McMasters had an accuracy of 23.5% (Noel et al., 2017). The accuracy and precision of the mini-FLOTAC would enhance the results for fecal count reduction tests to determine the efficacy of the anthelmintic being used.

Separate studies used alternative modified McMasters and Wisconsin techniques incorporating different types of flotation solutions and volume of sample mixture on the reading slides compared to the mini-FLOTAC technique (Maurelli et al., 2014; Silva et al., 2013). One study on dogs used sodium chloride and zinc sulphate flotation solutions because the solutions work the best for quantifying intestinal nematode eggs in dogs (Maurelli et al., 2014). Results from this study showed the mini-FLOTAC technique has a higher sensitivity than the Wisconsin

technique in quantifying intestinal nematode eggs in dogs (Maurelli et al., 2014). Another study compared different volumes of the sample mixture on the McMasters reading slides to the mini-FLOTAC quantifying *Eimeria* oocysts for coccidiosis in goats (Silva et al., 2013). The study used a 0.3mL reading volume with the McMaster grids and a 1mL reading volume with the McMaster chambers compared to the 1mL mini-FLOTAC chambers (Silva et al., 2013). Results from the study showed the amount of sample mixture volume affected the oocysts per gram quantification for the McMasters technique (Silva et al., 2013). The 0.3mL volume of sample mixture results were considerably higher than the 1mL volume of sample mixture (Silva et al., 2013). This study used the 0.3mL reading grid which could contribute to the higher variance of the McMasters technique. However, the mini-FLOTAC had a higher sensitivity than both volumes of the McMasters technique in Silva's study which concurs with this study (Silva et al., 2013).

The McMasters technique is the most common used practice for quantifying cyathostomins (Lester & Matthews, 2014) and efficient in field studies due to the quicker time it takes to run the technique. Times to run each method were analyzed and showed the mini-FLOTAC takes around 38 minutes to run 6 samples whereas the McMasters takes around 18 minutes (Noel et al., 2017). Veterinarians can use the McMasters method when diagnosing clinical issues without needing a precise fecal egg count. The mini-FLOTAC method would benefit being used in research studies and determining anthelmintic resistance.

Works Cited

Bosco, A., Rinaldi, L., Maurelli, M., Musella, V., Coles, G., & Cringoli, G. (2014). The comparison of FLOTAC, FECPAK and McMaster techniques for nematode egg counts in cattle. *Acta parasitologica*, *59*(4), 625-628.

Corning, S. (2009). Equine cyathostomins: a review of biology, clinical significance and therapy. *Parasites & vectors*, *2*(2), S1.

Kaplan, R. M., & Nielsen, M. K. (2010). An evidence-based approach to equine parasite control: It ain't the 60s anymore. *Equine Veterinary Education*, *22*(6), 306-316.

Lester, H., & Matthews, J. (2014). Faecal worm egg count analysis for targeting anthelmintic treatment in horses: points to consider. *Equine veterinary journal*, *46*(2), 139-145.

Maurelli, M. P., Rinaldi, L., Alfano, S., Pepe, P., Coles, G. C., & Cringoli, G. (2014). Mini-FLOTAC, a new tool for copromicroscopic diagnosis of common intestinal nematodes in dogs. *Parasites & vectors*, *7*(1), 356.

Nielsen, M., Mittel, L., Grice, A., Erskine, M., Graves, E., Vaala, W., . . . Kaplan, R. (2013). AAEP Parasite Control Guidelines. American Association of Equine Practitioners. *Online at www. aaep. org (on 24.03. 13)*.

Nielsen, M., Pfister, K., & von Samson-Himmelstjerna, G. (2014). Selective therapy in equine parasite control—Application and limitations. *Veterinary parasitology*, *202*(3), 95-103.

Nielsen, M. K., Peterson, D. S., Monrad, J., Thamsborg, S. M., Olsen, S. N., & Kaplan, R. M. (2008). Detection and semi-quantification of Strongylus vulgaris DNA in equine faeces by real-time quantitative PCR. *International journal for parasitology*, *38*(3), 443-453.

Nielsen, M. K., Vidyashankar, A., Andersen, U. V., DeLisi, K., Pilegaard, K., & Kaplan, R. (2010). Effects of fecal collection and storage factors on strongylid egg counts in horses. *Veterinary parasitology, 167*(1), 55-61.

Noel, M. L., Scare, J. A., Bellaw, J. L., & Nielsen, M. K. (2017). Accuracy and precision of Mini-FLOTAC and McMaster techniques for determining equine strongyle egg counts. *Journal of Equine Veterinary Science, 48*, 182-187. e181.

Reinemeyer, C. R. (2009). *Controlling strongyle parasites of horses: a mandate for change.* Paper presented at the Proceedings 55th Annual Meeting of the AAEP.

Rinaldi, L., Levecke, B., Bosco, A., Ianniello, D., Pepe, P., Charlier, J., . . . Vercruysse, J. (2014). Comparison of individual and pooled faecal samples in sheep for the assessment of gastrointestinal strongyle infection intensity and anthelmintic drug efficacy using McMaster and Mini-FLOTAC. *Veterinary parasitology, 205*(1-2), 216-223.

Scare, J., Slusarewicz, P., Noel, M., Wielgus, K., & Nielsen, M. (2017). Evaluation of accuracy and precision of a smartphone based automated parasite egg counting system in comparison to the McMaster and mini-FLOTAC methods. *Veterinary parasitology, 247*, 85-92.

Scheuerle, M. C., Stear, M. J., Honeder, A., Becher, A. M., & Pfister, K. (2016). Repeatability of strongyle egg counts in naturally infected horses. *Veterinary parasitology, 228*, 103-107.

Silva, L., Vila-Viçosa, M., Maurelli, M., Morgoglione, M., Cortes, H., Cringoli, G., & Rinaldi, L. (2013). Mini-FLOTAC for the diagnosis of Eimeria infection in goats: an alternative to McMaster. *Small ruminant research, 114*(2), 280-283.

CHAPTER 4

AN EXAMINATION OF GEORGIA EXTENSION AGENTS' NEEDS REGARDING EQUINE DEWORMING PROGRAMS

Abstract

Horse owners throughout the state of Georgia were surveyed on their parasite management procedures and where they receive new information regarding equine management practices to provide Extension agents recommendations on how to approach information transfer to the equine industry. Anthelmintic resistance has become one of the leading problems in parasite management. Limiting the use of anthelmintics by incorporating fecal egg counts has been the solution to slow down resistance; however, 42% of the respondents are aware of anthelmintic resistance and are not trending toward this procedure. Respondents are not performing fecal egg counts because it is easier to deworm their horses as a preventative measure. Fifty percent of the respondents are not familiar with the county Extension program, but 85.4% would attend a clinic and 83.2% would watch an online seminar about equine parasite management through the Extension program if presented the opportunity.

Introduction

Cooperative Extension has helped the community by providing information that has been passed down through research conducted by the school systems. The importance of information transfer about new management practices is vital due to the changes that occur through the years especially within animals and agriculture. Interpersonal relationships can affect the ease of sharing knowledge between one another (Reagans & McEvily, 2003). People who communicate

on a more frequent basis and have a bond between each other are more likely to share and trust the information being given (Reagans & McEvily, 2003). Extension builds these relationships using their people skills to an advantage which provides a significant amount of trust to relay information needed for the public. The time to build these relationships can prove to be costly especially for a new agent starting their career and the knowledge transfer would be more difficult (Szulanski, 2000). If there is not a strong connection between the source and the recipient, the source may need to provide additional concrete information supporting the ideas being discussed (Szulanski, 2000). Knowledge presentation refers to the organization of ideas and concepts that can be useful for the recipient to comprehend more easily. If the information is presented in a manner of examples that relate to the recipient, the recipient may be more likely to understand and accept the knowledge being given by the source. There are many different forms of presentation that may be beneficial for the recipient to understand the information, considering many people learn in different ways, through auditory, visual, or tactile demonstration (Szulanski, 2000). Information transfer is essential to persuade people to change decisions based on new management practices Extension reveals to the public from the research facilities.

Anthelmintic resistance has been an evolving problem in the equine industry. Anthelmintics, known as dewormers, have been given arbitrarily to control the horse nematode population for over 40 years. The widespread use of anthelmintics has significantly reduced clinical disease, especially with the large strongyle species, but the high treatment frequency has created a problem of increased anthelmintic resistance and pressure for selection of different anthelmintics for cyathostomins and equine tapeworms (Matthews, 2014). The selective treatment deworming program was proposed and implemented to decrease the amount of resistance caused by the overuse of current anthelmintics and the survival mechanisms of the

remaining parasite populations. In the selective treatment program, fecal egg counts are incorporated to assess each individual horse's need to be dewormed (Nielsen et al., 2014). In the 1980s, the selective treatment program was proposed and implemented by the American Association of Equine Practitioners (AAEP) (Herd et al., 1985). Previous research shows many horse owners have not changed their management practices from the rotational deworming to the selective treatment program.

This study gathered information from horse owners in the state of Georgia on what parasite management practices are being performed and if the horse owners are incorporating fecal egg counts into their routines. If fecal egg counts are not being run on their horses, identify what kind of barriers prevent them from using fecal egg counts. This study will assess where horse owners get their information regarding equine management practices and provide some knowledge to Extension agents and specialists on what would provide the best results to reaching out to the equine industry.

Materials and Methods

Preliminary Interviews

Five participants were selected by the PI with different equine backgrounds to take part in the preliminary interviews as shown in Table 1. Participants had equine experience for over 10 years with distinct experience from owning a boarding facility, giving riding lessons, and training horses with different management practices to provide answers to be used in the creation of the survey. Participants signed a consent form understanding that the interview would be recorded with an audio recorder and the recording would be destroyed once the interview was transcribed. Once the interviews were completed, the interviews were transcribed, and audio

recordings were destroyed which were approved by the UGA IRB (Appendix A). Sample questions from the preliminary interview (Appendix B) are as follows:

What is your highest educational degree and your involvement with the equine industry?

What deworming program do you currently follow?

Do you believe fecal egg counts should be taken?

What kind of barriers prevent you from taking fecal egg counts?

Have you talked with any Extension agents to provide you with information about horses?

What would you think to be better way Extension agents can provide information out to the public?

Table 1.

Preliminary Interview Participants and Equine Backgrounds

Interview Participant	Background
#1	Been in the Equine Industry for 20 Years Obtained Bachelors Degree Barrel Racer and Gives Riding Lessons Owns Family Farm
#2	Been in the Equine Industry for 15 Years Obtained Bachelors Degree Owns a Boarding Facility
#3	Been in the Equine Industry for 20 Years Obtained an Associates Degree President of a Saddle Club Owns and Maintains Horses at Home
#4	Been in the Equine Industry for 27 Years Attended Some College Horse Trainer Owns Training Facility
#5	Been in the Equine Industry Over 15 Years Obtained a Doctorate Degree Owns and Maintains Horses at Home

Survey

Using the answers through the preliminary interviews, a 64-question survey was prepared using Qualtrics and delivered either in-person using an iPad, or a web link was sent online through the Extension agents and horse advisory committees' list serves. Potential survey respondents were located throughout the state of Georgia at local equine events and businesses through non-random sampling. The link was open for potential survey respondents to send the survey out through networking. Following the Dillman's Tailored Design Method, an introduction paragraph was created to included how much time it would take to complete and an IRB approved consent letter (Dillman, 2000). Different constructs and demographics were created for the different areas of the horse(s)' background, parasite management practices, and information transfer. Respondents' demographics were placed at the end of the survey, so it is easier for the respondent to complete since the harder questions are in the middle of the survey. The survey was conversational, so the respondents felt like they were guided through the survey from start to finish. The questionnaire was peer-reviewed to help prevent measurement error that would cause any misreading errors by the respondents. Sampling error was minimized by increasing the sample size. Coverage error was minimized by sending the questionnaire through list serves by knowing the respondents have internet and using an in-person interaction with the respondents. The survey was open for response on a 4-month study ending in December 2017.

Validity and Reliability of Constructs

The instrument that was created and used in this study was an original survey. The categories used in the constructs of the instrument were fecal egg count barriers, information transfer for equine practices, contacting county Extension agent barriers, clinic attendance barriers, and online seminar barriers. The reliability of each construct was determined by

Cronbach's Alpha presented in Table 2. The reliability of the constructs were statistically analyzed based on 102 responses out of the 115 responses collected. The validity of each construct was visually inspected once the reliability was assessed. The Cronbach's Alpha values of the fecal egg count barriers (0.821) and the contacting county Extension agent barriers (0.731) constructs were reliable and accurate based on the values being over 0.7. The other three constructs were not as reliable; however, the validity of the questions being asked within those constructs were accurate and needed to represent the overall objectives of this study. Overall, the instrument was reliable and precise for the objectives of this study.

Table 2.

Cronbach's Alpha Reliability of Constructs

Constructs	**Cronbach's Alpha**
Fecal Egg Count Barriers	0.821
Information Transfer for Equine Practices	0.609
Contacting County Extension Agent Barriers	0.731
Clinic Attendance Barriers	0.521
Online Seminar Barriers	0.631

Data Analysis

Survey results were analyzed using SPSS (v. 24). Data were analyzed using descriptive statistics (mean, median, and frequency), crosstabs, independent t-tests, and correlation and regression models with additional visual inspections of the dataset to note any outliers or abnormalities within the dataset. Statistical significance was set priori at $\alpha = 0.05$.

Results

A total of 115 surveys were collected in this study from a population of horse owners. Thirteen responses were removed from data analysis due to the lack of validity from completing the survey under 105 seconds (11), did not agree to take the survey (1), and not falling under the age requirement for IRB approval (1). A remaining total of 102 responses were used in statistical analysis. Some respondents did not answer all the questions in the survey that were used in the statistical analysis.

Demographics

Out of the 102 responses to this questionnaire, 9.6% were males (9) and 90.4% were females (85) with ages ranging from 18 to 72 (40.6±14.5 yrs.). Eighty-eight respondents (92.6%) live in the state of Georgia while the rest are from Louisiana (1), Ohio (1), South Carolina (4), and Wisconsin (1). When highest educational degree was analyzed, 13.8% (13) obtained a high school diploma or GED, 35.1% (33) attended some college, 30.9% (29) obtained a bachelors degree, and 20.2% (19) obtained a graduate degree. One respondent (1.1%) has been involved with the equine industry less than a year, 6 respondents (6.3%) has been involved from 1 to 5 years, 11 respondents (11.6%) has been involved 6 to 10 years, and 77 respondents (81.1%) have been involved for more than 10 years. Seven respondents did not answer how long they were involved with the equine industry. Twenty-two respondents (23.2%) manages an equine facility. Forty-four respondents (46.3%) owns a private equine facility or business. All personal demographics are shown in Table 3.

Table 3.

Personal Demographics

Category	Options	Number (n)	Percentage (%)
Gender	Female	85	90.4
	Male	9	9.6
State	Georgia	88	92.6
	Other	7	7.4
Educational Degree	High School Diploma or GED	13	13.8
	Attended Some College	33	35.1
	Bachelors Degree	29	30.9
	Graduate Degree	19	20.2
Involvement in the Equine Industry	Less than a Year	1	1.1
	1 to 5 years	6	6.3
	6 to 10 years	11	11.6
	More than 10 Years	77	81.1
Manage an Equine Facility	Yes	22	23.2
	No	73	76.8
Own a Private Equine Facility or Business	Yes	44	46.3
	No	51	53.7

Equine Demographics

Eighty-two respondents (80.4%) reside their horses at a privately-owned facility and 20 respondents (19.6%) board their horses at a commercially owned facility which consists of boarding and training facilities. Sixty-four respondents (63.4%) houses their horses on 10 acres or less of pasture and 37 respondents (36.6%) houses their horses on 11 acres or more of pasture. When analyzing stocking densities (how many acres per horse), 60 respondents (61.2%) has 2 acres or less per horse and 38 respondents (38.8%) has greater than 2 acres per horse. All equine demographics are shown in Table 4.

Table 4.

Equine Demographics

Category	Options	Number (n)	Percentage (%)
Equine Facility	Privately Owned	82	80.4
	Commercially Owned	20	19.6
Pasture Availability to Horses	10 Acres or Less	64	63.4
	11 Acres or More	37	36.6
Stocking Densities	2 Acres or Less per Horse	60	61.2
	Greater than 2 Acres per Horse	38	38.8

Manure Management

Thirty-three respondents (32.7%) do not use any manure management practice at the farm. Sixty-eight respondents (67.4%) use a form of manure management practice at the farm such as stock piling, composting, spreading across the pasture, or hauling away to another location. Eighty-three respondents (82.2%) do not remove manure from the pastures on the farm, five respondents (5%) are unsure, and thirteen respondents (12.9%) remove manure from the pastures on the farm. Out of the thirteen respondents that remove manure from the pastures, majority (53.8%) remove manure daily from the pastures. All manure management practices are shown in Table 5.

Table 5.

Manure Management Practices

Category	Options	Number (n)	Percentage (%)
Manure Management Practice Primarily Used	None	33	32.7
	Stock Piling	12	11.9
	Composting	15	14.9
	Spread Across the Pasture	27	26.7
	Hauling Away to Another Location	14	13.9
Manure Removed from Pastures	No	83	82.2
	Unsure	5	5
	Yes	13	12.9
How Often is Manure Removed	Daily	7	53.8
	Once Weekly	4	30.8
	Monthly	1	7.7
	Few Times a Year	1	7.7

Pasture Management

Fifty-three respondents (52.5%) do not rotationally graze the pastures throughout the year and forty-six respondents (45.5%) rotationally graze the pastures while two respondents (2%) is unsure. Seventeen respondents (37%) rotates the pasture monthly and sixteen respondents (34.8%) rotates the pastures a few times a year. Eighty-eight respondents (87.1%) do not rotationally graze the pastures with other animals other than horses. All pasture management practices are shown in Table 6.

Table 6.

Pasture Management Practices

Category	Options	Number (n)	Percentage (%)
Rotationally Grazing Pastures	No	53	52.5
	Unsure	2	2
	Yes	46	45.5
How Often Pastures Are Rotated	Daily	4	8.7
	Once Weekly	8	17.4
	Twice Weekly	1	2.2
	Monthly	17	37
	Few Times a Year	16	34.8
Rotationally Grazed with Other Animals Rather than Horses	No	88	87.1
	Yes	13	12.9

Parasite Management

Ninety-eight respondents (97%) deworm their horses, 2 respondents (2%) are unsure, and 1 respondent (1%) does not deworm their horses at all. Sixty-six respondents (65.3%) are aware of anthelmintic resistance within the equine industry, 11 respondents (10.9%) are unsure, and 24 respondents (23.8%) are unaware of anthelmintic resistance within the equine industry. Ninety-two respondents (91.1%) make the decisions regarding health and deworming programs for their horses. Twenty-seven respondents (27.8%) run fecal egg counts on their horses, 2 respondents (2.1%) are unsure, and 68 respondents (70.1%) do not run fecal egg counts on their horses. Sixty-eight respondents (67.3%) are aware of the Targeted Deworming treatment to obtain fecal egg counts on their horses and 33 respondents (32.7%) are unaware of the Targeted Deworming treatment. All parasite management practices are shown in Table 7.

Table 7.

Parasite Management Practices

Category	Options	Number (n)	Percentage (%)
Deworm Horses	Yes	98	97
	Unsure	2	2
	No	1	1
Awareness of Anthelmintic Resistance	Yes	66	65.3
	Unsure	11	10.9
	No	24	23.8
Make Decisions Regarding Health and Deworming Programs	Yes	92	91.1
	No	9	8.9
Perform Fecal Egg Counts	Yes	27	27.8
	Unsure	2	2.1
	No	68	70.1
Aware of Targeted Deworming Treatment	Yes	68	67.3
	No	33	32.7

Awareness of Anthelmintic Resistance vs. Running Fecal Egg Counts on Horses

In the crosstabulation, 41 of the 68 respondents that do not run fecal egg counts on their horses are aware of anthelmintic resistance in the equine industry. Twenty-one of the 27 respondents that run fecal egg counts on their horses are aware of anthelmintic resistance in the equine industry as shown in Table 8. Five respondents did not answer either question in the questionnaire.

Table 8.

Awareness of Anthelmintic Resistance vs. Running Fecal Egg Counts on Horses

		Are fecal egg counts run on your horse(s)?			
		No	Unsure	Yes	Total
Are you aware of anthelmintic resistance in the equine industry?	No	20 (20.6%)	2 (2.1%)	2 (2.1%)	24
	Unsure	7 (7.2%)	0	4 (4.1%)	11
	Yes	41 (42.3%)	0	21 (21.6%)	62
Total		68	2	27	97

Privately Owned vs. Commercially Owned Equine Establishments

Analyzing an independent t-test between privately owned and commercially owned equine establishments using running fecal egg counts as the dependent variable, there is a significant difference between both groups ($t = 2.453$, $p = 0.021$). Since the sample size is large enough, practical significance was analyzed by Cohen's d (0.651) and showed high practical significance for the population. When analyzing a correlation between privately owned/commercially owned establishments and running fecal egg counts, there is a statistical significance ($r = 0.269$, $p = 0.008$) that the type of establishment influences whether fecal egg counts are being run. The regression model (Tables 9 and 10) shows that fecal egg counts are being completed more in commercially owned establishments than privately owned establishments. The R square value of 0.072 shows that 7.2% of the higher completion of fecal egg counts are explained in commercially owned establishments by .595 than the privately-owned establishments. Regression was obtained by the equation below:

$y = 0.859 + 0.595x$

Table 9.

Anova Regression Model Between Privately Owned/Commercially Owned Establishments and Running Fecal Egg Counts

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.629	1	5.629	7.423	.008[b]
	Residual	72.041	95	.758		
	Total	77.670	96			

a. Dependent Variable: Are fecal egg counts run on your horse(s)?

b. Predictors: (Constant), PVTvsComEstablishments

Table 10.

Coefficient Regression Model Between Privately Owned/Commercially Owned Establishments and Running Fecal Egg Counts

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.859	.278		3.090	.003
	PVTvsComEstablishments	.595	.219	.269	2.725	.008

a. Dependent Variable: Are fecal egg counts run on your horse(s)?

Regression Equation: $y = 0.859 + 0.595x$

Fecal Egg Count Barriers Construct

To assess the behavior on what prevents the respondents from using fecal egg counts, the respondents were given 7 questions with a 6-choice response from whether they completely disagree (1) to completely agree (6). Means were assessed to display which barrier is more likely to prevent the respondents from using fecal egg counts. The barriers used in this construct are high costs, easier to go ahead and deworm as a preventative, takes too much time, have too many

horses, do not know how to perform fecal egg counts, do not know to collect fecal samples, and do not know where to take the fecal samples. Table 11 provides the means for each barrier for the respondents who do not run fecal egg counts on their horses. Respondents agree that it is easier to go ahead and deworm horses as a preventative measure and do not know how to perform fecal egg counts. Respondents deworm their horses because they do not want their horse to obtain a parasite infestation; however, deworming as a preventative measure causes the increase of anthelmintic resistance.

Table 11.

Barriers from Performing Fecal Egg Counts Based on Non-Selective Treatment Respondents

Barriers	**Mean (Rank)**
Easier to Go Ahead and Deworm as a Preventative	4.93 (1)
Do Not Know How to Perform Fecal Egg Counts	3.81 (2)
High Costs	3.77 (3)
Do Not Know Where to Take Fecal Samples	3.49 (4)
Takes Too Much Time	3.45 (5)
Do Not Know How to Collect Fecal Samples	2.84 (T6)
Have Too Many Horses	2.84 (T6)

1=Completely Disagree	4=Slightly Agree
2=Mostly Disagree	5=Mostly Agree
3=Slightly Disagree	6=Completely Agree

1

Information Transfer for Equine Practices Construct

To assess the behavior on where the respondents receive information regarding equine management practices, the respondents were given 6 options with a 6-choice response from whether they completely disagree (1) to completely agree (6). Means were assessed to display

where respondents are more likely to receive their information regarding equine management practices. The options used in this construct are online, newsletters, people you know who have horses, Extension specialist or agent, veterinarian, and industry professionals. Table 12 provides the means for each option for all the respondents. Respondents agree that they receive information from people that the respondents trust such as a veterinarian, industry professional, and other people who have horses. Respondents mostly disagree getting information from an Extension agent or specialist.

Table 12.

Information on Equine Management Practices Received by All Horse Owners

Options	**Mean (Rank)**
Veterinarian	4.13 (1)
Industry Professionals (Farrier, Trainer, Etc.)	3.71 (2)
People You Know Who Have Horses	3.50 (3)
Online	3.23 (4)
Extension Specialist or Agent	2.37 (5)
Newsletter	2.10 (6)

1=Completely Disagree	4=Slightly Agree
2=Mostly Disagree	5=Mostly Agree
3=Slightly Disagree	6=Completely Agree

1

Contacting County Extension Agent Barriers Construct

Forty-eight respondents (50%) are not familiar with the County Extension Program and 73 respondents (76%) never go to a county Extension agent for information about horses. To assess the behavior on what prevents the respondents from requesting information regarding equine management practices from county Extension agents, the respondents were given 4 barriers with a 6-choice response from whether they completely disagree (1) to completely agree

(6). Means were assessed to display what prevents respondents from asking county Extension agents about information regarding equine management practices. The barriers used in this construct are not knowing my county Extension agent or Extension program, not knowing where or how to access information for Extension, our Extension agent does not specialize in horses, and talking with a veterinarian or people that I know who have horses is easier. Table 13 provides the means for each barrier for the respondents who never go to an Extension agent for information about horses. Respondents agree that they do not know their county Extension agent or Extension program. Respondents agree that talking to their veterinarian or people in the equine industry is easier than contacting county Extension agents.

Table 13.

Barriers from Contacting County Extension Agents

Barriers	**Mean (Rank)**
Talking with a Veterinarian or People that I Know Who Have Horses is Easier	5.47 (1)
Not Knowing My County Extension Agent or Extension Program	4.69 (2)
Not Knowing Where or How to Access Information for Extension	4.39 (3)
Our Extension Agent Does Not Specialize in Horses	4.08 (4)

1=Completely Disagree	4=Slightly Agree
2=Mostly Disagree	5=Mostly Agree
3=Slightly Disagree	6=Completely Agree

Clinic Attendance Barriers Construct

Eighty-two respondents (85.4%) would go to a clinic regarding new equine management practices if it was held by a county Extension agent or specialist and 14 respondents (14.6%)

would not go to a clinic. To assess the behavior on what prevents the respondents from attending a clinic regarding equine management practices from county Extension agents or specialists, the respondents were given 3 barriers with a 6-choice response from whether they completely disagree (1) to completely agree (6). Means were assessed to display what prevents respondents from attending a clinic put on by county Extension agents about information regarding equine management practices. The barriers used in this construct are not enough time, not knowing where or how to access information on clinics being held by the county and trusting information from an unknown source. Table 14 provides the means for each barrier for the respondents who would not attend a clinic put on by an Extension agent or specialist for information about horses. Respondents agree that they do not have enough time in order to attend a clinic.

Table 14.

Barriers from Attending Clinics Conducted by Extension Agents or Specialists

Barriers	**Mean (Rank)**
Not Enough Time	4.29 (1)
Trusting Information from an Unknown Source	3.50 (2)
Not Knowing Where or How to Access Information on Clinics Being Held by the County	2.93 (3)

1=Completely Disagree	4=Slightly Agree
2=Mostly Disagree	5=Mostly Agree
3=Slightly Disagree	6=Completely Agree

1

Online Seminar Barriers Construct

Seventy-nine respondents (83.2%) would watch an online seminar regarding new equine management practices by an Extension agent or specialist and 16 respondents (16.8%) would not

watch an online seminar. To assess the behavior on what prevents the respondents from watching an online seminar regarding equine management practices from county Extension agents or specialists, the respondents were given 4 barriers with a 6-choice response from whether they completely disagree (1) to completely agree (6). Means were assessed to display what prevents respondents from watching an online seminar put on by county Extension agents about information regarding equine management practices. The barriers used in this construct are not enough time, not knowing where or how to access information on clinics being held by the county, trusting information from an unknown source, and limited access to a reliable internet source. Table 15 provides the means for each barrier for the respondents who would not watch an online seminar put on by an Extension agent or specialist for information about horses. Respondents agree that they do not know where or how to access information on seminars held by the Extension program due to many respondents do not know of the Extension program or agents.

Table 15.

Preventions from Watching Online Seminars Conducted by Extension Agents or Specialists

Barriers	**Mean (Rank)**
Not Knowing Where or How to Access Information on Clinics Being Held by the County	3.67 (1)
Trusting Information from an Unknown Source	3.50 (2)
Not Enough Time	3.19 (3)
Limited Access to a Reliable Internet Source	3.13 (4)

1=Completely Disagree	4=Slightly Agree
2=Mostly Disagree	5=Mostly Agree
3=Slightly Disagree	6=Completely Agree

1

Discussion

The respondents were a representative sample of the population targeting horse owners in the state of Georgia by using non-random sampling because the demographics match the researchers' population of interest for this study. Majority of the horse owners lived in the Georgia and have been involved with the equine industry for over 10 years. Twenty-three percent manage an equine facility and 46.3% own a private horse farm. Eighty percent of horse owners have their horses living on a privately-owned farm and 19.6% have their horses living at a boarding or training facility.

Some horse owners do not use any type of manure management for the farm which can contribute to the increase of the parasite contamination of the pastures and the population loads in the horse. Previous studies show the prevalence of pasture contamination is based on how often manure is removed from the pastures and recommends manure should be removed from the pasture at least one time a week (Herd, 1986; Nielsen et al., 2010). Majority of horse owners do not remove manure from the pastures which increases pasture and herd contamination. Roughly 15% of horse owners compost their manure which is ideal since the temperature will kill any internal parasites passed in the feces (Davis et al., 2002). Some horse owners spread the manure across the fields without composting will contaminate the pastures with internal parasites. Low stocking densities (horse per acre) can create increased parasite contamination of the pastures (Proudman & Matthews, 2000), and majority of horse owners have 2 acres or less per horse increasing parasite contamination substantially.

Horse owners (97%) were aware that their horses should be dewormed throughout the year, and the majority (65.3%) of horse owners in the sample were aware of anthelmintic resistance in the equine industry. The data showed that 27.8% of horse owners run fecal egg

counts which is higher than the study conducted in New Zealand which only 4.8% use the targeted deworming program on their standardbred and thoroughbred horses (Rosanowski et al., 2016; Rogers & Bolwell, 2016). However, 70.1% do not run fecal egg counts to limit this problem of anthelmintic resistance which is higher than a study conducted in Sweden where 33.9% of Arabian horse owners do not run fecal egg counts (Larsson & Müller, 2017). According to the data in a crosstabulation, 41 respondents were aware of anthelmintic resistance and still do not run fecal egg counts on their horses. According to the fecal egg count barriers construct, the top three barriers were: it is easier to deworm as a preventative, not knowing how to perform fecal egg counts, and high costs.

The data showed that running fecal egg counts are influenced by the type of establishment the horses reside whether it be a privately-owned facility or a commercially owned business such as a boarding or training facility. Looking at the regression model, a prediction can be made that knowing the type of establishment, an explanation of 7.2% of whether fecal egg counts are performed or not. Commercially owned businesses are predicted to have a 0.595 higher fecal egg count score than privately-owned facilities. According to the USDA National Health Monitoring Systems' Equine 2006 study on *Vaccination Practices on U.S. Equine Operations*, 74.9% of privately-owned horses were vaccinated in the past year while 96.8% boarding/training facilities vaccinated their horses in the past year which indicates that commercially owned facilities are more inclined to use current management practices from a business perspective. Commercially owned businesses may have a greater liability to perform fecal egg counts or can incorporate fecal egg counts into the boarding costs. Further research into why commercially owned businesses run fecal egg counts more than privately-owned facilities

would be recommended. Extension agents could focus on privately-owned facilities for reaching out and addressing the importance of performing fecal egg counts and how it affects the industry.

The data collected from the survey suggests that the respondents is relatively unaware of the Extension program in Georgia and the services Extension provides for the community. The respondents will trust people who they know within the industry and professionals such as veterinarians, farriers, and horse trainers which coincides with the ease of information transfer who have similar backgrounds and common interests (Szulanski, 2000). Horse owners mainly receive their information from their veterinarian, industry professionals, and people they know who have horses. Veterinarians have developed interpersonal relationships due to the similar backgrounds of horse experience and trust with their clients to create successful lines of communication (Levin & Cross, 2004; Mitton et al., 2007; Szulanski, 2000). According to the USDA National Animal Health Monitoring Systems' Equine 2015 study on *Information Sources for and providers of Equine Health Care*, 78.9% of horse owners get their information from a veterinarian, 65.2% from the farrier, and 34.6% from other horse owners. Extension agents were not even on the list to offer as a source of information. The data shows that the top two barriers from contacting county Extension agents is that talking with a veterinarian or people that they know who have horses is easier and not knowing about county Extension agents or the Extension program.

Implications

Horse owners are more than willing to learn from the Extension program, and recommendations to help the spread the word about the Extension program would be to advertise and present seminars at local equine events, ride along with veterinarians for a day if possible, and provide recorded online seminars that horse owners can watch at any time. The data shows

that 85.4% of horse owners would attend a clinic and 83.2% would watch an online seminar regarding new equine practices. Horse owners are not understanding that they are contributing to the anthelmintic resistance problem by trying to protect their horses from parasite infestations, but unintentionally allowing the parasites to adapt and evolve to the anthelmintics given. Information transfer to the equine industry from an outside source such as the Extension program will be an obstacle at first, but the more Extension agents make their presence known and build interpersonal relationships with horse owners, the easier it will be to pass down information about new equine management practices (Szulanski, 2000). Not knowing how to perform fecal egg counts and high costs can be minimized through the Extension program. Presenting at local equine events and recording an online seminar on how to perform fecal egg counts would reduce the costs, increase the horse owner's knowledge, and provide a significant reduction to anthelmintic resistance.

Overall, this study gave some important information regarding how Extension agents should approach the problem of anthelmintic resistance and information transfer to the equine industry. Some problems occurred while attending one of the local equine events with having poor internet quality and using the iPad which is a possible explanation from some of the responses that were removed due to completing the survey under 105 seconds. A recommendation would to bring a mobile Wi-Fi hotspot or use your phone while attending these events to reduce the amount of difficulty finding an area where internet is reliable.

Works Cited

Davis, J. G., Swinker, A. M., & Smith, C. (2002). *Horse manure management*: Colorado State University Cooperative Extension.

Dillman, D. A. (2000). Mail and web-based survey: The tailored design method. *NY: John Wiley & Sons*.

Herd, R. (1986). Epidemiology and control of equine strongylosis at Newmarket. *Equine veterinary journal, 18*(6), 447-452.

Herd, R., Willardson, K., & Gabel, A. (1985). Epidemiological approach to the control of horse strongyles. *Equine veterinary journal, 17*(3), 202-207.

Levin, D. Z., & Cross, R. (2004). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. *Management science, 50*(11), 1477-1490.

Matthews, J. B. (2014). Anthelmintic resistance in equine nematodes. *International Journal for Parasitology: Drugs and Drug Resistance, 4*(3), 310-315.

Mitton, C., Adair, C. E., McKenzie, E., Patten, S. B., & Perry, B. W. (2007). Knowledge transfer and exchange: review and synthesis of the literature. *Milbank Quarterly, 85*(4), 729-768.

Nielsen, M., Pfister, K., & von Samson-Himmelstjerna, G. (2014). Selective therapy in equine parasite control—Application and limitations. *Veterinary parasitology, 202*(3), 95-103.

Nielsen, M. K., Fritzen, B., Duncan, J., Guillot, J., Eysker, M., Dorchies, P., . . . LUSSOT-KERVERN, I. (2010). Practical aspects of equine parasite control: a review based upon a workshop discussion consensus. *Equine veterinary journal, 42*(5), 460-468.

Proudman, C., & Matthews, J. (2000). Control of intestinal parasites in horses. *In Practice-London-British Veterinary Association-, 22*(2), 90-97.

Reagans, R., & McEvily, B. (2003). Network structure and knowledge transfer: The effects of cohesion and range. *Administrative science quarterly, 48*(2), 240-267.

Rosanowski, S., Scott, I., Sells, P., Rogers, C., & Bolwell, C. (2016). Cross-sectional survey of parasite control practices on Thoroughbred and Standardbred training yards in New Zealand. *Equine veterinary journal, 48*(3), 387-393.

Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness. *Organizational behavior and human decision processes, 82*(1), 9-27.

CHAPTER 5

CONCLUSION

Anthelmintic resistance will be a continuing problem with a constant rate of change in the future. The uses of different parasite quantification methods will help in various ways depending on the situation. The mini-FLOTAC method will be useful in helping researchers establish the amount of resistance the parasites have against the different types of anthelmintics being used due to having low variance and high sensitivity for detection. The McMasters method will help veterinarians in the field for diagnosis due to giving results quicker and having the ability to still classify moderate to high egg shedders. Horse owners can easily be taught by Extension agents on how to perform these methods to slow down the accelerating rate of anthelmintic resistance.

The Extension program is not known by many respondents from the survey and there is not a connection from information passed down the universities out to the horse owners in the population. Interpersonal relationships need to be built to allow Extension to branch out to the horse owners in the equine industry. Putting on clinics at equine events and recording online seminars about parasite management will help to establish these relationships. The disconnect between knowing about awareness of anthelmintic resistance and not performing fecal egg counts because it is easier to go ahead and deworm as a preventative measure will allow this problem to keep growing. The influence of people presenting information and successful information transfer will help control parasite resistance instead of accelerating it in the equine industry.

REFERENCES

Bauer, C., & Failing, K. (1992). Use of anthelmintics for nematode control in sheep in West Germany: results of a survey. *DTW. Deutsche tierarztliche Wochenschrift, 99*(9), 365-370.

Bello, T. R., & Abell, J. E. (1999). Are equine tapeworms an emerging disease? A retrospective study. *Journal of Equine Veterinary Science, 19*(11), 723-727.

Bosco, A., Rinaldi, L., Maurelli, M., Musella, V., Coles, G., & Cringoli, G. (2014). The comparison of FLOTAC, FECPAK and McMaster techniques for nematode egg counts in cattle. *Acta parasitologica, 59*(4), 625-628.

Brazik, E. L., Luquire, J. T., & Little, D. (2006). Pyrantel pamoate resistance in horses receiving daily administration of pyrantel tartrate. *Journal of the American Veterinary Medical Association, 228*(1), 101-103.

Clayton, H. M. (1986). Recent Advances. *Veterinary Clinics of North America: Equine Practice, 2*(2), 313.

Comer, M. M., Campbell, T., Edwards, K., & Hillison, J. (2006). Cooperative Extension and the 1890 land-grant institution: The real story. *Journal of Extension, 44*(3), 1-6.

Corning, S. (2009). Equine cyathostomins: a review of biology, clinical significance and therapy. *Parasites & vectors, 2*(2), S1.

Davis, J. G., Swinker, A. M., & Smith, C. (2002). *Horse manure management*: Colorado State University Cooperative Extension.

Dillman, D. A. (2000). Mail and web-based survey: The tailored design method. *NY: John Wiley & Sons*.

Ferleger, L. (1990). Uplifting American Agriculture: Experiment Station Scientists and the Office of Experiment Stations in the Early Years after the Hatch Act. *Agricultural History, 64*(2), 5-23.

Heckhausen, H., & Gollwitzer, P. M. (1987). Thought contents and cognitive functioning in motivational versus volitional states of mind. *Motivation and emotion, 11*(2), 101-120.

Herd, R. (1986). Epidemiology and control of equine strongylosis at Newmarket. *Equine veterinary journal, 18*(6), 447-452.

Herd, R., Willardson, K., & Gabel, A. (1985). Epidemiological approach to the control of horse strongyles. *Equine veterinary journal, 17*(3), 202-207.

Kaplan, R. M. (2002). Anthelmintic resistance in nematodes of horses. *Veterinary Research, 33*(5), 491-507.

Kaplan, R. M. (2004). Drug resistance in nematodes of veterinary importance: a status report. *Trends in parasitology, 20*(10), 477-481.

Kaplan, R. M., & Nielsen, M. K. (2010). An evidence-based approach to equine parasite control: It ain't the 60s anymore. *Equine Veterinary Education, 22*(6), 306-316.

Kiefer, L., Frank, J., Di Ruggiero, E., Dobbins, M., Manuel, D., Gully, P. R., & Mowat, D. (2005). Fostering evidence-based decision-making in Canada: examining the need for a Canadian population and public health evidence centre and research network. *Canadian Journal of Public Health/Revue Canadienne de Sante'e Publique, 96*(3), I1-I19.

Lacey, E. (1988). The role of the cytoskeletal protein, tubulin, in the mode of action and mechanism of drug resistance to benzimidazoles. *International journal for parasitology*, *18*(7), 885-936.

Lacey, E. (1990). Mode of action of benzimidazoles. *Parasitology Today*, *6*(4), 112-115.

Larsson, A., & Müller, C. E. (2017). Owner reported management, feeding and nutrition-related health problems in Arabian horses in Sweden. *Livestock Science*.

Lester, H., & Matthews, J. (2014). Faecal worm egg count analysis for targeting anthelmintic treatment in horses: points to consider. *Equine veterinary journal*, *46*(2), 139-145.

Levin, D. Z., & Cross, R. (2004). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. *Management science*, *50*(11), 1477-1490.

Lyons, E. T., Drudge, J. H., & Tolliver, S. C. (1973). On the Life Cycle of Strongyloides westeri in the Equine. *The Journal of Parasitology*, *59*(5), 780-787. doi:10.2307/3278405

Martin, R. (1997). Modes of action of anthelmintic drugs. *The Veterinary Journal*, *154*(1), 11-34.

Matthews, J. B. (2014). Anthelmintic resistance in equine nematodes. *International Journal for Parasitology: Drugs and Drug Resistance*, *4*(3), 310-315.

Maurelli, M. P., Rinaldi, L., Alfano, S., Pepe, P., Coles, G. C., & Cringoli, G. (2014). Mini-FLOTAC, a new tool for copromicroscopic diagnosis of common intestinal nematodes in dogs. *Parasites & vectors*, *7*(1), 356.

Mitton, C., Adair, C. E., McKenzie, E., Patten, S. B., & Perry, B. W. (2007). Knowledge transfer and exchange: review and synthesis of the literature. *Milbank Quarterly*, *85*(4), 729-768.

Nielsen, M., Mittel, L., Grice, A., Erskine, M., Graves, E., Vaala, W., . . . Kaplan, R. (2013). AAEP Parasite Control Guidelines. American Association of Equine Practitioners. *Online at www. aaep. org (on 24.03. 13)*.

Nielsen, M., Pfister, K., & von Samson-Himmelstjerna, G. (2014). Selective therapy in equine parasite control—Application and limitations. *Veterinary parasitology, 202*(3), 95-103.

Nielsen, M., Reinemeyer, C., Donecker, J., Leathwick, D., Marchiondo, A., & Kaplan, R. (2014). Anthelmintic resistance in equine parasites—Current evidence and knowledge gaps. *Veterinary parasitology, 204*(1), 55-63.

Nielsen, M. K., Fritzen, B., Duncan, J., Guillot, J., Eysker, M., Dorchies, P., . . . LUSSOT-KERVERN, I. (2010). Practical aspects of equine parasite control: a review based upon a workshop discussion consensus. *Equine veterinary journal, 42*(5), 460-468.

Nielsen, M. K., Peterson, D. S., Monrad, J., Thamsborg, S. M., Olsen, S. N., & Kaplan, R. M. (2008). Detection and semi-quantification of Strongylus vulgaris DNA in equine faeces by real-time quantitative PCR. *International journal for parasitology, 38*(3), 443-453.

Nielsen, M. K., Vidyashankar, A., Andersen, U. V., DeLisi, K., Pilegaard, K., & Kaplan, R. (2010). Effects of fecal collection and storage factors on strongylid egg counts in horses. *Veterinary parasitology, 167*(1), 55-61.

Noel, M. L., Scare, J. A., Bellaw, J. L., & Nielsen, M. K. (2017). Accuracy and precision of Mini-FLOTAC and McMaster techniques for determining equine strongyle egg counts. *Journal of Equine Veterinary Science, 48*, 182-187. e181.

Oreg, S. (2003). Resistance to change: developing an individual differences measure. *Journal of applied psychology, 88*(4), 680.

Proudman, C., & Matthews, J. (2000). Control of intestinal parasites in horses. *In Practice-London-British Veterinary Association-*, *22*(2), 90-97.

Proudman, C., & Trees, A. (1999). Tapeworms as a cause of intestinal disease in horses. *Parasitology Today, 15*(4), 156-159.

Ramussen, W. D. (2002). *Taking the university to the people: Seventy-five years of cooperative extension*: Purdue University Press.

Reagans, R., & McEvily, B. (2003). Network structure and knowledge transfer: The effects of cohesion and range. *Administrative science quarterly, 48*(2), 240-267.

Reinemeyer, C., & Rohrbach, B. (1990). A survey of equine parasite control practices in Tennessee. *Journal of the American Veterinary Medical Association, 196*(5), 712-716.

Reinemeyer, C. R. (2009). *Controlling strongyle parasites of horses: a mandate for change.* Paper presented at the Proceedings 55th Annual Meeting of the AAEP.

Reinemeyer, C. R. (2012). Anthelmintic resistance in non-strongylid parasites of horses. *Veterinary parasitology, 185*(1), 9-15.

Rinaldi, L., Levecke, B., Bosco, A., Ianniello, D., Pepe, P., Charlier, J., . . . Vercruysse, J. (2014). Comparison of individual and pooled faecal samples in sheep for the assessment of gastrointestinal strongyle infection intensity and anthelmintic drug efficacy using McMaster and Mini-FLOTAC. *Veterinary parasitology, 205*(1-2), 216-223.

Rosanowski, S., Scott, I., Sells, P., Rogers, C., & Bolwell, C. (2016). Cross-sectional survey of parasite control practices on Thoroughbred and Standardbred training yards in New Zealand. *Equine veterinary journal, 48*(3), 387-393.

Scare, J., Slusarewicz, P., Noel, M., Wielgus, K., & Nielsen, M. (2017). Evaluation of accuracy and precision of a smartphone based automated parasite egg counting system in comparison to the McMaster and mini-FLOTAC methods. *Veterinary parasitology, 247*, 85-92.

Scheuerle, M. C., Stear, M. J., Honeder, A., Becher, A. M., & Pfister, K. (2016). Repeatability of strongyle egg counts in naturally infected horses. *Veterinary parasitology, 228*, 103-107.

Shaffer, T. J. The Land-Grant System and Graduate Education: Reclaiming a Narrative of Engagement.

Shoop, W. L., Mrozik, H., & Fisher, M. H. (1995). Structure and activity of avermectins and milbemycins in animal health. *Veterinary parasitology, 59*(2), 139-156.

Silva, L., Vila-Viçosa, M., Maurelli, M., Morgoglione, M., Cortes, H., Cringoli, G., & Rinaldi, L. (2013). Mini-FLOTAC for the diagnosis of Eimeria infection in goats: an alternative to McMaster. *Small ruminant research, 114*(2), 280-283.

Slocombe, J. O. D., Heine, J., Barutzki, D., & Slacek, B. (2007). Clinical trials of efficacy of praziquantel horse paste 9% against tapeworms and its safety in horses. *Veterinary parasitology, 144*(3), 366-370.

Smith, C., & Swanson, C. A. (2009). Horse Manure Management.

Steelman, C. D. (1976). Effects of external and internal arthropod parasites on domestic livestock production. *Annual review of entomology, 21*(1), 155-178.

Stoltenow, C. L., & Purdy, C. H. (2003). Internal Parasites of Horses. NDSU Extension Service, North Dakota State University Agr. *Appl. Sci, 543*.

Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness. *Organizational behavior and human decision processes, 82*(1), 9-27.

Taggart, W., & Robey, D. (1981). Minds and managers: On the dual nature of human information processing and management. *Academy of Management Review, 6*(2), 187-195.

Traversa, D., Iorio, R., Klei, T. R., Kharchenko, V. A., Gawor, J., Otranto, D., & Sparagano, O. A. (2007). New method for simultaneous species-specific identification of equine

strongyles (Nematoda, Strongylida) by reverse line blot hybridization. *Journal of clinical microbiology*, *45*(9), 2937-2942.

Verplanken, B., & Wood, W. (2006). Interventions to break and create consumer habits. *Journal of Public Policy & Marketing*, *25*(1), 90-103.

Wolf, D., Hermosilla, C., & Taubert, A. (2014). Oxyuris equi: lack of efficacy in treatment with macrocyclic lactones. *Veterinary parasitology*, *201*(1), 163-168.

Wolstenholme, A. J., Fairweather, I., Prichard, R., von Samson-Himmelstjerna, G., & Sangster, N. C. (2004). Drug resistance in veterinary helminths. *Trends in parasitology*, *20*(10), 469-476.

Wood, W. (2000). Attitude change: Persuasion and social influence. *Annual review of psychology*, *51*(1), 539-570.

APPENDICES

APPENDIX A

IRB APPROVAL

Phone 706-542-3199

Office of the Vice President for Research
Institutional Review Board

APPROVAL OF PROTOCOL

November 30, 2016

Dear Kari Turner:

On 11/30/2016, the IRB reviewed the following submission:

Type of Review:	Initial Study- Exempt 2
Title of Study:	An Examination of Georgia Extension Agents' Needs Regarding Equine Deworming Programs
Investigator:	Kari Turner
IRB ID:	STUDY00004229
Funding:	None
Documents Reviewed:	Recruitment and Consent for Interviews, Interview Protocol

The IRB approved the protocol for the interview procedural stage of this study from 11/30/2016 to 11/29/2021. Prior to surveying participants, a modification must be submitted and approved by the IRB.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103).

Sincerely,

Dr. Gerald E. Crites, MD, MEd
University of Georgia
Institutional Review Board Chairperson

Phone 706-542-3199

Office of the Vice President for Research
Institutional Review Board

APPROVAL OF PROTOCOL

July 25, 2017

Dear Kari Turner:

On 7/25/2017, the IRB reviewed the following submission:

Type of Review:	Modification
Title of Study:	An Examination of Georgia Extension Agents' Needs Regarding Equine Deworming Programs
Investigator:	Kari Turner
IRB ID:	MOD00004826
Funding:	None
Modifications Reviewed:	Updated Recruitment and Consent Documents, Addition of Survey

The IRB approved the protocol from 7/25/2017 to 11/29/2021.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103).

Sincerely,

Brooke M. Harwell
University of Georgia
Human Subjects, IRB Analyst II

APPENDIX B

INTERVIEW GUIDE

Interviewer Guide and Questioning Route- Interviews (Equine Professionals)

An Examination of Georgia Extension Agents' Needs Regarding Equine Deworming Programs

Interviewer reads: Hello and welcome to our session today. Thank you for taking the time to join our discussion about Georgia Extension agent's needs regarding equine deworming programs. My name is Anthony Britt and I am a Masters student at the University of Georgia.

Before we begin, let me share some things that will make our discussion easier. There are no right or wrong answers. Please feel free to share your point of view. Please speak up and clearly. We are recording the session because we do not want to miss any of your comments. The tape will not be heard by anybody other than myself and the other members of the research team. Once the tapes have been transcribed, the audio recording will be destroyed. We will be on a first-name basis, and in our later reports your name will not be attached to the reported comments. You may be assured of your confidentiality.

My role here is to ask questions and listen. I will be asking around ## questions. Our session will last about one hour. Please turn off your cell phone. Let's begin.

Introductory Information

Interviewer reads: Let's find out some more about you. Please share your name, highest educational degree, your history, and involvement in the equine industry.

Equine Facility Information and Knowledge of Equine Deworming Programs

Interviewer reads: My thesis research project I am working on in the Animal and Dairy Science Department is centered on equine professionals. Since you are an equine professional, I would like to ask you a few questions about your horse(s)' equine facility and your knowledge of deworming programs in the equine industry.

- What kind of equine facility does your horse(s)' currently reside?
  - Probe: Where is the equine facility located?
  - Probe: Does the facility provide pasture, paddocks, or both? If so, how many acres does the facility provide for the pasture/paddocks?
  - Probe: How long is your horse(s)' turnout period?
  - Probe: What kind of manure management does the equine facility provide?
  - Probe: Who makes the decisions regarding health and deworming protocols for your facility?
- What deworming program does your equine facility currently follow?
  - Probe: Why did you choose your current deworming program?
  - Probe: Who provided you with the information on your current deworming program?
- Which anthelmintics (dewormers) are used with your current deworming program?

- Are you aware of any other deworming programs within the equine industry?
    - Probe: What are your thoughts on the other deworming programs?
- Does your equine facility incorporate fecal egg counts in their deworming program?
    - Probe: Do you believe fecal egg counts should be taken for the herd? Why or why not?
- How do you learn about new practices and information within the equine industry?
    - Probe: What suggestions would you make to help improve communication about new practices within the equine industry?

Concluding Discussion

Interviewer reads: We've talked today about your horse(s)' facility and knowledge of equine deworming programs. I am now going to try to summarize the main points from today's discussion (*Interviewer lists the key messages and broad ideas that developed from the discussion).*

- Is this an adequate summary?

Interviewer reads: As we explained at the beginning of the session, the purpose of this interview is to gather information related to your experiences and knowledge of equine deworming programs. Your comments today will aid future programs to help researchers, veterinarians, and Extension agents to provide knowledge to the equine industry in Georgia.

- Have we missed anything or are there any other comments you would like to add?

Interviewer reads: Thank you for taking time out of your day to share your opinions. Your participation is greatly appreciated and has provided valuable information. Thanks so much for

participating in our interview today!

APPENDIX C

SURVEY COMMUNICATIONS

Survey Consent Letter

Dear Survey Participant:

I am a graduate student under the direction of Dr. Kari Turner in the Department of Animal and Dairy Sciences at The University of Georgia. I invite you to participate in a research study entitled "An Examination of Georgia Extension Agents' Needs Regarding Equine Deworming Programs". The purpose of this study is to assess the transfer of information and the need for training in equine deworming programs. Participants are **required** to be 18 years of age or older to complete this survey.

Your participation will involve completing a survey and should only take about 15 minutes of your time. Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled.

All surveys will be answered anonymously and there is not any record linking responses to participants to secure your confidentiality. The results of the research study may be published, but your name or any identifying information will not be used. In fact, the published results will be presented in summary form only.

The findings from this project may provide information on enhancing information transfer on management practices throughout the equine industry in the state of Georgia.

If you have any questions about this research project, please feel free to call me Anthony Britt at (706) 340-7742 or send an e-mail to abritt@uga.edu. Questions or concerns about your rights as a research participant should send an email to irb@uga.edu.

By completing this questionnaire online, you are agreeing to participate in the above described research project.

Thank you for your consideration! Please keep this letter for your records.

Sincerely,

Anthony Britt

In Person Recruitment Message

Hello, my name is Anthony Britt and I am a Masters student working under the direction of Dr. Kari Turner who is a professor with the Animal and Dairy Science Department of the University of Georgia. I will be conducting research on deworming programs throughout the state of Georgia. Will you be interested in participating in taking a survey to assess the transfer of information and the need for training in deworming and management programs regarding the equine industry? The survey and take approximately 15 minutes of your time. All surveys will be answered anonymously and there is not any record linking responses to participants to secure your confidentiality. There will be no risk to you if you choose to participate. If you choose not to participate, I appreciate your time and I hope you have a wonderful day!

Survey Email

Dear Horse Owner,

My name is Anthony Britt and I am a Masters student of Animal and Dairy Science at the University of Georgia. To complete my thesis, I am undertaking a study of measuring the knowledge and information transfer about deworming and management programs throughout the state of Georgia.

As part of that study, you have been selected to participate in a survey that will help us enhance information transfer about these programs; it is my hope that you will agree to be part of this study. In this email, I have provided a website link to that survey. It should take around 15 minutes to complete the survey. Participation in this study is voluntary and all responses will be kept anonymous.

Here is the website link for the survey.

https://ugeorgia.qualtrics.com/jfe/form/SV_1Zm41dvS9FNnZhb

Thank you again for your time.

Sincerely,
Anthony Britt
Masters Student
Department of Animal and Dairy Sciences
University of Georgia
abritt@uga.edu

Survey Follow Up Email

Dear Horse Owner:

You received an e-mail message asking you to assist us in assessing the knowledge and information transfer regarding deworming and management practices throughout the state of Georgia by filling out a web-based survey. If you have filled out the survey, thank you!

If you have not had a chance to take the survey yet, I would appreciate your reading the message below and completing the survey. This survey should take no more than 15 minutes to complete. This message has gone to everyone in the selected sample population. Since no personal data is retained with the surveys for reasons of confidentiality, we are unable to identify whether you have already completed the survey.

* To take the web-based survey, click on:

https://ugeorgia.qualtrics.com/jfe/form/SV_1Zm41dvS9FNnZhb

Thank you for your time!

Sincerely,

Anthony Britt Anthony Britt
Masters Student
Department of Animal and Dairy Sciences
University of Georgia
abritt@uga.edu

APPENDIX D

SURVEY QUESTIONS AND ANSWERS

Having read the above, do you agree to proceed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	102	100.0	100.0	100.0

What type of establishment does your horse(s) reside?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Non-commercial Facility (Privately owned)	82	80.4	80.4	80.4
	Boarding Facility	16	15.7	15.7	96.1
	Training Facility	4	3.9	3.9	100.0
	Total	102	100.0	100.0	

How many horses on the farm are ridden or worked very seldom? (If 0, leave blank)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	17	16.7	16.7	16.7
	1	23	22.5	22.5	39.2
	2	21	20.6	20.6	59.8
	3	12	11.8	11.8	71.6
	4	6	5.9	5.9	77.5
	5	3	2.9	2.9	80.4
	6	4	3.9	3.9	84.3
	7	4	3.9	3.9	88.2
	8	1	1.0	1.0	89.2
	9	1	1.0	1.0	90.2
	10	3	2.9	2.9	93.1
	12	1	1.0	1.0	94.1
	14	1	1.0	1.0	95.1
	15	1	1.0	1.0	96.1
	20	1	1.0	1.0	97.1
	More than 20	3	2.9	2.9	100.0
	Total	102	100.0	100.0	

How many horses on the farm are used as performance horses? (If 0, leave blank)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	43	42.2	42.2	42.2
	1	6	5.9	5.9	48.0
	2	16	15.7	15.7	63.7
	3	11	10.8	10.8	74.5
	4	7	6.9	6.9	81.4
	5	1	1.0	1.0	82.4
	6	2	2.0	2.0	84.3
	7	2	2.0	2.0	86.3
	10	4	3.9	3.9	90.2
	13	1	1.0	1.0	91.2
	14	2	2.0	2.0	93.1
	15	2	2.0	2.0	95.1
	16	1	1.0	1.0	96.1
	18	1	1.0	1.0	97.1
	More than 20	3	2.9	2.9	100.0
	Total	102	100.0	100.0	

How many horses on the farm are used as breeding horses? (If 0, leave blank)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	89	87.3	87.3	87.3
	1	5	4.9	4.9	92.2
	2	4	3.9	3.9	96.1
	3	1	1.0	1.0	97.1
	4	1	1.0	1.0	98.0
	5	1	1.0	1.0	99.0
	More than 20	1	1.0	1.0	100.0
	Total	102	100.0	100.0	

How many acres does the facility use for pasture? (For example if you have 15 acres, simply type in 15)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	2.9	3.0	3.0
	2	8	7.8	7.9	10.9
	3	10	9.8	9.9	20.8
	4	8	7.8	7.9	28.7
	5	9	8.8	8.9	37.6
	6	4	3.9	4.0	41.6
	7	5	4.9	5.0	46.5
	8	5	4.9	5.0	51.5
	9	2	2.0	2.0	53.5
	10	10	9.8	9.9	63.4
	12	4	3.9	4.0	67.3
	13	1	1.0	1.0	68.3
	14	1	1.0	1.0	69.3
	15	7	6.9	6.9	76.2
	18	1	1.0	1.0	77.2
	20	8	7.8	7.9	85.1
	21	1	1.0	1.0	86.1
	22	1	1.0	1.0	87.1
	25	1	1.0	1.0	88.1
	30	2	2.0	2.0	90.1
	40	3	2.9	3.0	93.1
	50	1	1.0	1.0	94.1
	55	1	1.0	1.0	95.0
	60	1	1.0	1.0	96.0
	125	1	1.0	1.0	97.0
	135	1	1.0	1.0	98.0
	1000	1	1.0	1.0	99.0
	100222	1	1.0	1.0	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

Stocking Density

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.13	2	2.0	2.0	2.0
	.25	2	2.0	2.0	4.1
	.33	3	2.9	3.1	7.1
	.60	1	1.0	1.0	8.2
	.63	2	2.0	2.0	10.2
	.67	2	2.0	2.0	12.2
	.80	2	2.0	2.0	14.3
	.83	1	1.0	1.0	15.3
	1.00	16	15.7	16.3	31.6
	1.11	1	1.0	1.0	32.7
	1.17	1	1.0	1.0	33.7
	1.20	1	1.0	1.0	34.7
	1.40	4	3.9	4.1	38.8
	1.43	1	1.0	1.0	39.8
	1.50	7	6.9	7.1	46.9
	1.60	1	1.0	1.0	48.0
	2.00	13	12.7	13.3	61.2
	2.14	1	1.0	1.0	62.2
	2.25	1	1.0	1.0	63.3
	2.33	1	1.0	1.0	64.3
	2.50	6	5.9	6.1	70.4
	2.67	1	1.0	1.0	71.4
	2.86	2	2.0	2.0	73.5
	3.00	7	6.9	7.1	80.6
	3.33	2	2.0	2.0	82.7
	3.50	2	2.0	2.0	84.7
	3.75	1	1.0	1.0	85.7
	4.00	4	3.9	4.1	89.8
	5.00	6	5.9	6.1	95.9
	6.67	2	2.0	2.0	98.0
	9.17	1	1.0	1.0	99.0
	10.50	1	1.0	1.0	100.0
	Total	98	96.1	100.0	
Missing	System	4	3.9		

Total	102	100.0		

What is the average stocking density (horse per acre) of the pastures? (For example if you have 4 horses on 10 acres of pasture, simply type 4/10)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	2.0	2.0	2.0
	1	1	1.0	1.0	2.9
	1 in front, 2 in the back	1	1.0	1.0	3.9
	1/1	4	3.9	3.9	7.8
	1/2	4	3.9	3.9	11.8
	1/3	3	2.9	2.9	14.7
	1/5	1	1.0	1.0	15.7
	10/10	2	2.0	2.0	17.6
	10/12	1	1.0	1.0	18.6
	10/14	1	1.0	1.0	19.6
	10/15	2	2.0	2.0	21.6
	11/11	1	1.0	1.0	22.5
	15/2	1	1.0	1.0	23.5
	15/50	1	1.0	1.0	24.5
	16/10	1	1.0	1.0	25.5
	2/0.5	1	1.0	1.0	26.5
	2/10	3	2.9	2.9	29.4
	2/2	2	2.0	2.0	31.4
	2/21	1	1.0	1.0	32.4
	2/3	3	2.9	2.9	35.3
	2/4	3	2.9	2.9	38.2
	2/5	4	3.9	3.9	42.2
	2/6	2	2.0	2.0	44.1
	2/7	2	2.0	2.0	46.1
	2/8	2	2.0	2.0	48.0
	2/large paddocks	1	1.0	1.0	49.0
	20/40	1	1.0	1.0	50.0
	3 on 7 acres	1	1.0	1.0	51.0
	3/1	3	2.9	2.9	53.9
	3/10	1	1.0	1.0	54.9
	3/15	1	1.0	1.0	55.9
	3/2	1	1.0	1.0	56.9
	3/20	2	2.0	2.0	58.8
	3/8	1	1.0	1.0	59.8

	35/22	1	1.0	1.0	60.8
	4/.5	1	1.0	1.0	61.8
	4/1	1	1.0	1.0	62.7
	4/10	1	1.0	1.0	63.7
	4/12	1	1.0	1.0	64.7
	4/20	1	1.0	1.0	65.7
	4/4	2	2.0	2.0	67.6
	4/9	1	1.0	1.0	68.6
	5/10	4	3.9	3.9	72.5
	5/15	1	1.0	1.0	73.5
	5/20	2	2.0	2.0	75.5
	5/3	1	1.0	1.0	76.5
	5/4	2	2.0	2.0	78.4
	5/5	2	2.0	2.0	80.4
	5/7	3	2.9	2.9	83.3
	5/8	1	1.0	1.0	84.3
	6/12	1	1.0	1.0	85.3
	6/15	1	1.0	1.0	86.3
	6/4	1	1.0	1.0	87.3
	6/5	1	1.0	1.0	88.2
	6/55	1	1.0	1.0	89.2
	6/6	1	1.0	1.0	90.2
	6/7	1	1.0	1.0	91.2
	6/9	1	1.0	1.0	92.2
	7/10	1	1.0	1.0	93.1
	7/15	1	1.0	1.0	94.1
	7/20	2	2.0	2.0	96.1
	8/12	1	1.0	1.0	97.1
	8/30	1	1.0	1.0	98.0
	8/8	1	1.0	1.0	99.0
	9/10	1	1.0	1.0	100.0
	Total	102	100.0	100.0	

How much turnout on average do most of your horse(s) receive in a day?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than an hour	2	2.0	2.0	2.0
	1 to 2 hours	7	6.9	6.9	8.8
	3 to 5 hours	4	3.9	3.9	12.7
	Half a day	19	18.6	18.6	31.4
	All day	70	68.6	68.6	100.0
	Total	102	100.0	100.0	

For most of your horse(s), are they turned out individually or with a group of horses?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Individually	21	20.6	20.6	20.6
	Group	78	76.5	76.5	97.1
	Neither	3	2.9	2.9	100.0
	Total	102	100.0	100.0	

What manure management practice does your facility primarily use?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	33	32.4	32.7	32.7
	Stock piling	12	11.8	11.9	44.6
	Composting	15	14.7	14.9	59.4
	Manure spreading across the pastures	27	26.5	26.7	86.1
	Hauling away to another site by dumpster, trailer, etc.	14	13.7	13.9	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

Is manure removed from the pastures?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	83	81.4	82.2	82.2
	Unsure	5	4.9	5.0	87.1
	Yes	13	12.7	12.9	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

How often is manure removed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Daily	7	6.9	53.8	53.8
	Once weekly	4	3.9	30.8	84.6
	Monthly	1	1.0	7.7	92.3
	Few times a year	1	1.0	7.7	100.0
	Total	13	12.7	100.0	
Missing	System	89	87.3		
Total		102	100.0		

Are pastures rotationally grazed, so that pastures are rested at the same time others are being grazed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	53	52.0	52.5	52.5
	Unsure	2	2.0	2.0	54.5
	Yes	46	45.1	45.5	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

How often are the pastures rotated?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Daily	4	3.9	8.7	8.7
	Once weekly	8	7.8	17.4	26.1
	Twice weekly	1	1.0	2.2	28.3
	Monthly	17	16.7	37.0	65.2
	Few times a year	16	15.7	34.8	100.0
	Total	46	45.1	100.0	
Missing	System	56	54.9		
Total		102	100.0		

Are pastures rotationally grazed by any other animals rather than horses?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	88	86.3	87.1	87.1
	Yes	13	12.7	12.9	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

How often are pastures rotated between the different animals?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	2	2.0	15.4	15.4
	Once weekly	1	1.0	7.7	23.1
	Monthly	2	2.0	15.4	38.5
	Few times a year	3	2.9	23.1	61.5
	Horses and other animals are grazed on the same pasture at the same time.	5	4.9	38.5	100.0
	Total	13	12.7	100.0	
Missing	System	89	87.3		
Total		102	100.0		

Do you have cattle grazing the pastures as well as horses?

		Frequency	Percent
Missing	System	102	100.0

Do you have goats grazing the pastures as well as horses?

		Frequency	Percent
Missing	System	102	100.0

Do you have sheep grazing the pastures as well as horses?

		Frequency	Percent
Missing	System	102	100.0

Do you have donkeys grazing the pastures as well as horses?

		Frequency	Percent
Missing	System	102	100.0

Do you have any other animals not listed above grazing the pastures as well as horses?

		Frequency	Percent
Missing	System	102	100.0

Are your horse(s) dewormed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	1.0	1.0	1.0
	Unsure	2	2.0	2.0	3.0
	Yes	98	96.1	97.0	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

Are you aware of anthelmintic (dewormer) resistance at the facility?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	70	68.6	69.3	69.3
	Unsure	12	11.8	11.9	81.2
	Yes	19	18.6	18.8	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

Are you aware of anthelmintic (dewormer) resistance in the equine industry?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	24	23.5	23.8	23.8
	Unsure	11	10.8	10.9	34.7
	Yes	66	64.7	65.3	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

Do you make the decisions regarding health and deworming practices for your horse(s)?

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	No	9	8.8	8.9	8.9
	Yes	92	90.2	91.1	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

Which deworming program does your adult (3 years and older) horse(s) currently follow?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Interval Treatment (at selected intervals, e.g. every 3 months)	33	32.4	33.0	33.0
	Strategic Treatment (at specific times of the year, e.g. Fall and Spring)	47	46.1	47.0	80.0
	Product Treatment (as often as recommended on deworming product)	5	4.9	5.0	85.0
	Convenience Treatment (at a time preferred by the facility or deemed necessary)	3	2.9	3.0	88.0
	Targeted Treatment (based on fecal egg counts)	12	11.8	12.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		

Are you aware of the Targeted Treatment deworming program where fecal egg counts are obtained and individual horses are dewormed according to the results?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	33	32.4	32.7	32.7
	Yes	68	66.7	67.3	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

Where did you learn about the Targeted Treatment deworming program?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Veterinarian	37	36.3	56.1	56.1
	Online	8	7.8	12.1	68.2
	County Extension Program	3	2.9	4.5	72.7
	School/University	8	7.8	12.1	84.8
	Industry professionals (farriers, trainers, etc.)	3	2.9	4.5	89.4
	Magazines/Trade publications	4	3.9	6.1	95.5
	Other	3	2.9	4.5	100.0
	Total	66	64.7	100.0	
Missing	System	36	35.3		
Total		102	100.0		

If selected "Other", please describe the source you heard about the Targeted Treatment deworming program from.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		99	97.1	97.1	97.1
	Aj Britt	1	1.0	1.0	98.0
	Friend	1	1.0	1.0	99.0
	Someone who offers the egg count service	1	1.0	1.0	100.0
	Total	102	100.0	100.0	

Are fecal egg counts run on your horse(s)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	68	66.7	70.1	70.1
	Unsure	2	2.0	2.1	72.2
	Yes	27	26.5	27.8	100.0
	Total	97	95.1	100.0	
Missing	System	5	4.9		
Total		102	100.0		

Please select whether you disagree or agree with the statements below about fecal egg counts. - High cost prevents me performing fecal egg counts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	23	22.5	24.0	24.0
	Mostly Disagree	8	7.8	8.3	32.3
	Slightly Disagree	17	16.7	17.7	50.0
	Slightly Agree	15	14.7	15.6	65.6
	Mostly Agree	25	24.5	26.0	91.7
	Completely Agree	8	7.8	8.3	100.0
	Total	96	94.1	100.0	
Missing	System	6	5.9		
Total		102	100.0		

Please select whether you disagree or agree with the statements below about fecal egg counts. - Easier to go ahead and give dewormer as a preventative measure than performing fecal egg counts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	9	8.8	9.3	9.3
	Mostly Disagree	7	6.9	7.2	16.5
	Slightly Disagree	3	2.9	3.1	19.6
	Slightly Agree	26	25.5	26.8	46.4
	Mostly Agree	20	19.6	20.6	67.0
	Completely Agree	32	31.4	33.0	100.0
	Total	97	95.1	100.0	
Missing	System	5	4.9		
Total		102	100.0		

Please select whether you disagree or agree with the statements below about fecal egg counts. - Performing fecal egg counts takes too much time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	24	23.5	24.7	24.7
	Mostly Disagree	17	16.7	17.5	42.3
	Slightly Disagree	17	16.7	17.5	59.8
	Slightly Agree	24	23.5	24.7	84.5
	Mostly Agree	10	9.8	10.3	94.8
	Completely Agree	5	4.9	5.2	100.0
	Total	97	95.1	100.0	
Missing	System	5	4.9		
Total		102	100.0		

Please select whether you disagree or agree with the statements below about fecal egg counts. - I have too many horses to perform fecal egg counts individually

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	42	41.2	43.3	43.3
	Mostly Disagree	12	11.8	12.4	55.7
	Slightly Disagree	10	9.8	10.3	66.0
	Slightly Agree	18	17.6	18.6	84.5
	Mostly Agree	7	6.9	7.2	91.8
	Completely Agree	8	7.8	8.2	100.0
	Total	97	95.1	100.0	
Missing	System	5	4.9		
Total		102	100.0		

Please select whether you disagree or agree with the statements below about fecal egg counts. - I do not know how to perform fecal egg counts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	36	35.3	37.1	37.1
	Mostly Disagree	8	7.8	8.2	45.4
	Slightly Disagree	7	6.9	7.2	52.6
	Slightly Agree	10	9.8	10.3	62.9
	Mostly Agree	15	14.7	15.5	78.4
	Completely Agree	21	20.6	21.6	100.0
	Total	97	95.1	100.0	
Missing	System	5	4.9		
Total		102	100.0		

Please select whether you disagree or agree with the statements below about fecal egg counts. - I do not know how to collect fecal samples

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	53	52.0	54.1	54.1
	Mostly Disagree	14	13.7	14.3	68.4
	Slightly Disagree	4	3.9	4.1	72.4
	Slightly Agree	10	9.8	10.2	82.7
	Mostly Agree	5	4.9	5.1	87.8
	Completely Agree	12	11.8	12.2	100.0
	Total	98	96.1	100.0	
Missing	System	4	3.9		
Total		102	100.0		

Please select whether you disagree or agree with the statements below about fecal egg counts. - I do not know where I can take my horse(s)' fecal samples to have a fecal egg count taken

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	50	49.0	51.0	51.0
	Mostly Disagree	4	3.9	4.1	55.1
	Slightly Disagree	6	5.9	6.1	61.2
	Slightly Agree	12	11.8	12.2	73.5
	Mostly Agree	7	6.9	7.1	80.6
	Completely Agree	19	18.6	19.4	100.0
	Total	98	96.1	100.0	
Missing	System	4	3.9		
Total		102	100.0		

What other limitations not listed above would prevent you from performing fecal egg counts?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		81	79.4	79.4	79.4
	Barn management	1	1.0	1.0	80.4
	Cost only	1	1.0	1.0	81.4
	Did counts about 5 years ago, all low shedders. Just deworm twice a year.	1	1.0	1.0	82.4
	Don't have time	1	1.0	1.0	83.3
	Ease of test	1	1.0	1.0	84.3
	Easier to buy a 12 dollar wormer then pay vet.	1	1.0	1.0	85.3
	Frequency of vet visits	1	1.0	1.0	86.3
	Having owners that won't pay for it	1	1.0	1.0	87.3
	I don't have the equipment to do it myself, so it is prohibitively expensive.	1	1.0	1.0	88.2
	I don’t want to	1	1.0	1.0	89.2
	Local regulations	1	1.0	1.0	90.2
	None	2	2.0	2.0	92.2
	Requiring a separate vet visit or trip to a vet's office.	1	1.0	1.0	93.1
	Schedule conflicts between work and office hours of clinic (i.e., I can't collect a sample before work & drop it off on my way)	1	1.0	1.0	94.1
	The hassle of having to collect fecals and send off to be looked at vs buying dewormer and deworming when the horse due.	1	1.0	1.0	95.1
	Time	2	2.0	2.0	97.1
	Too busy	1	1.0	1.0	98.0
	vet reschedualing appointment	1	1.0	1.0	99.0

	Vets office is too far to drop off samples	1	1.0	1.0	100.0
	Total	102	100.0	100.0	

How often are your horse(s) dewormed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 6 weeks	2	2.0	2.0	2.0
	Every 6 to 8 weeks	7	6.9	7.1	9.2
	Every 3 to 4 months	37	36.3	37.8	46.9
	Once a year	2	2.0	2.0	49.0
	Twice a year	38	37.3	38.8	87.8
	Depending on fecal egg count results	12	11.8	12.2	100.0
	Total	98	96.1	100.0	
Missing	System	4	3.9		
Total		102	100.0		

Where do you seek your advice or information concerning new equine management practices? - Online

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	6	5.9	6.4	6.4
	Rarely	11	10.8	11.7	18.1
	Occasionally	42	41.2	44.7	62.8
	Often	25	24.5	26.6	89.4
	All the time	10	9.8	10.6	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

Where do you seek your advice or information concerning new equine management practices? - Newsletters

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	35	34.3	37.2	37.2
	Rarely	22	21.6	23.4	60.6
	Occasionally	31	30.4	33.0	93.6
	Often	5	4.9	5.3	98.9
	All the time	1	1.0	1.1	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

Where do you seek your advice or information concerning new equine management practices? - People you know who have horses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	2.0	2.1	2.1
	Rarely	13	12.7	13.8	16.0
	Occasionally	31	30.4	33.0	48.9
	Often	32	31.4	34.0	83.0
	All the time	16	15.7	17.0	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

Where do you seek your advice or information concerning new equine management practices? - Extension Specialist or Agent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	31	30.4	32.6	32.6
	Rarely	25	24.5	26.3	58.9
	Occasionally	19	18.6	20.0	78.9
	Often	13	12.7	13.7	92.6
	All the time	7	6.9	7.4	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Where do you seek your advice or information concerning new equine management practices? - Veterinarian

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	1.0	1.1	1.1
	Rarely	4	3.9	4.3	5.3
	Occasionally	15	14.7	16.0	21.3
	Often	36	35.3	38.3	59.6
	All the time	38	37.3	40.4	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

Where do you seek your advice or information concerning new equine management practices? - Industry professionals (farrier, trainer, etc.)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	2.0	2.1	2.1
	Rarely	8	7.8	8.5	10.6
	Occasionally	27	26.5	28.7	39.4
	Often	35	34.3	37.2	76.6
	All the time	22	21.6	23.4	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

Are you familiar with the County Extension Program?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	48	47.1	50.0	50.0
	Yes	48	47.1	50.0	100.0
	Total	96	94.1	100.0	
Missing	System	6	5.9		
Total		102	100.0		

How often do you go to your County Extension Agent for information about horses?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	73	71.6	76.0	76.0
	Once a year	13	12.7	13.5	89.6
	Twice a year	6	5.9	6.3	95.8
	3 or more times a year	4	3.9	4.2	100.0
	Total	96	94.1	100.0	
Missing	System	6	5.9		
Total		102	100.0		

What prevents you from contacting your County Extension Agent for management information within the equine industry? - I do not know my County Extension Agent or what Extension does for my county

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	23	22.5	24.5	24.5
	Mostly Disagree	7	6.9	7.4	31.9
	Slightly Disagree	4	3.9	4.3	36.2
	Slightly Agree	8	7.8	8.5	44.7
	Mostly Agree	15	14.7	16.0	60.6
	Completely Agree	37	36.3	39.4	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

What prevents you from contacting your County Extension Agent for management information within the equine industry? - Not knowing where or how to access information for Extension

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	27	26.5	28.4	28.4
	Mostly Disagree	10	9.8	10.5	38.9
	Slightly Disagree	4	3.9	4.2	43.2
	Slightly Agree	8	7.8	8.4	51.6
	Mostly Agree	13	12.7	13.7	65.3
	Completely Agree	33	32.4	34.7	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

What prevents you from contacting your County Extension Agent for management information within the equine industry? - Our Extension Agent does not specialize in horses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	18	17.6	20.5	20.5
	Mostly Disagree	4	3.9	4.5	25.0
	Slightly Disagree	14	13.7	15.9	40.9
	Slightly Agree	21	20.6	23.9	64.8
	Mostly Agree	12	11.8	13.6	78.4
	Completely Agree	19	18.6	21.6	100.0
	Total	88	86.3	100.0	
Missing	System	14	13.7		
Total		102	100.0		

What prevents you from contacting your County Extension Agent for management information within the equine industry? - Talking to a veterinarian or people that I know who have horses is easier

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	3	2.9	3.2	3.2
	Mostly Disagree	1	1.0	1.1	4.2
	Slightly Disagree	2	2.0	2.1	6.3
	Slightly Agree	8	7.8	8.4	14.7
	Mostly Agree	29	28.4	30.5	45.3
	Completely Agree	52	51.0	54.7	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Would you go to a clinic or seminar regarding new management practices if it was held in your county by your County Extension Agent or Extension Specialist?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	14	13.7	14.6	14.6
	Yes	82	80.4	85.4	100.0
	Total	96	94.1	100.0	
Missing	System	6	5.9		
Total		102	100.0		

What would prevent you from attending a clinic or seminar provided by your County Extension Agent or Extension Specialist? - Not enough time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	15	14.7	15.6	15.6
	Mostly Disagree	5	4.9	5.2	20.8
	Slightly Disagree	10	9.8	10.4	31.3
	Slightly Agree	37	36.3	38.5	69.8
	Mostly Agree	16	15.7	16.7	86.5
	Completely Agree	13	12.7	13.5	100.0
	Total	96	94.1	100.0	
Missing	System	6	5.9		
Total		102	100.0		

What would prevent you from attending a clinic or seminar provided by your County Extension Agent or Extension Specialist? - Not knowing where or how to access information on clinics being held in the county

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	12	11.8	12.8	12.8
	Mostly Disagree	8	7.8	8.5	21.3
	Slightly Disagree	8	7.8	8.5	29.8
	Slightly Agree	28	27.5	29.8	59.6
	Mostly Agree	19	18.6	20.2	79.8
	Completely Agree	19	18.6	20.2	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

What would prevent you from attending a clinic or seminar provided by your County Extension Agent or Extension Specialist? - Trusting information coming from an unknown source

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	25	24.5	26.6	26.6
	Mostly Disagree	13	12.7	13.8	40.4
	Slightly Disagree	18	17.6	19.1	59.6
	Slightly Agree	21	20.6	22.3	81.9
	Mostly Agree	10	9.8	10.6	92.6
	Completely Agree	7	6.9	7.4	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

What other issues not listed above would prevent you from attending a clinic or seminar provided by your County Extension Agent or Extension Specialist?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		78	76.5	76.5	76.5
	Cost	1	1.0	1.0	77.5
	Depend on my schedule and when clinic is offered as well as costs associated.	1	1.0	1.0	78.4
	fulltime employment and family responsibilities in evening	1	1.0	1.0	79.4

	I dont drive in the evenings	1	1.0	1.0	80.4
	I usually ask by word of mouth or experience what my friends or trainer has done in the past for information I may need, as well as research.	1	1.0	1.0	81.4
	I work full time so it would have to be in evening.	1	1.0	1.0	82.4
	I've never heard of this before	1	1.0	1.0	83.3
	Idk	1	1.0	1.0	84.3
	Mostly, the gov agents have no idea what they are talking about.	1	1.0	1.0	85.3
	My travel schedule	1	1.0	1.0	86.3
	None	3	2.9	2.9	89.2
	Not a convenient location	1	1.0	1.0	90.2
	Not enough seminars are offered	1	1.0	1.0	91.2
	Our county agent knows nothing about horses	1	1.0	1.0	92.2
	Our County Extension Agent does not specialize in horses or put on any equine programs.	1	1.0	1.0	93.1
	time is the biggest factor	1	1.0	1.0	94.1
	Time, Don't drive at night if at all possible.	1	1.0	1.0	95.1
	topic not valuable to me	1	1.0	1.0	96.1
	Travel costs	1	1.0	1.0	97.1
	Unsure of quality of education/educator	1	1.0	1.0	98.0
	Work schedule	1	1.0	1.0	99.0
	would not know about clinic or seminar	1	1.0	1.0	100.0
	Total	102	100.0	100.0	

Would you watch an online seminar regarding new management practices provided by your County Extension Agent or Extension Specialist?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	16	15.7	16.8	16.8
	Yes	79	77.5	83.2	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

What would prevent you from participating in an online seminar regarding new management practices? - Not enough time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	25	24.5	26.6	26.6
	Mostly Disagree	13	12.7	13.8	40.4
	Slightly Disagree	16	15.7	17.0	57.4
	Slightly Agree	22	21.6	23.4	80.9
	Mostly Agree	10	9.8	10.6	91.5
	Completely Agree	8	7.8	8.5	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

What would prevent you from participating in an online seminar regarding new management practices? - Not knowing where or how to access information on clinics being held in the county

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	18	17.6	19.6	19.6
	Mostly Disagree	9	8.8	9.8	29.3
	Slightly Disagree	8	7.8	8.7	38.0
	Slightly Agree	27	26.5	29.3	67.4
	Mostly Agree	14	13.7	15.2	82.6
	Completely Agree	16	15.7	17.4	100.0
	Total	92	90.2	100.0	
Missing	System	10	9.8		
Total		102	100.0		

What would prevent you from participating in an online seminar regarding new management practices? - Trusting information coming from an unknown source

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	25	24.5	26.9	26.9
	Mostly Disagree	11	10.8	11.8	38.7
	Slightly Disagree	16	15.7	17.2	55.9
	Slightly Agree	23	22.5	24.7	80.6
	Mostly Agree	10	9.8	10.8	91.4
	Completely Agree	8	7.8	8.6	100.0
	Total	93	91.2	100.0	
Missing	System	9	8.8		
Total		102	100.0		

What would prevent you from participating in an online seminar regarding new management practices? - Limited access to reliable internet source

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Completely Disagree	52	51.0	55.3	55.3
	Mostly Disagree	7	6.9	7.4	62.8
	Slightly Disagree	8	7.8	8.5	71.3
	Slightly Agree	17	16.7	18.1	89.4
	Mostly Agree	2	2.0	2.1	91.5
	Completely Agree	8	7.8	8.5	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

What other issues not listed above would prevent you from participating in a online seminar regarding new management practices?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		86	84.3	84.3	84.3
	cannot think of any	1	1.0	1.0	85.3
	Government workers are not well informed, i.e., ignorant of good horse keeping.	1	1.0	1.0	86.3
	Hate computers	1	1.0	1.0	87.3
	I do not spend enough time online	1	1.0	1.0	88.2
	I prefer to be there in person vs it being online.	1	1.0	1.0	89.2
	I wouldn't enjoy an online seminar	1	1.0	1.0	90.2
	Idk	1	1.0	1.0	91.2
	If it was something I could view when I had time that would work.	1	1.0	1.0	92.2
	Just time...my days are so busy	1	1.0	1.0	93.1
	No good internet service where I live	1	1.0	1.0	94.1
	None	3	2.9	2.9	97.1
	The time that it is held	1	1.0	1.0	98.0
	time conflict is normally problem	1	1.0	1.0	99.0
	Time Limitations and length of seminar as well as cost	1	1.0	1.0	100.0
	Total	102	100.0	100.0	

Are you male or female?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	9	8.8	9.6	9.6
	Female	85	83.3	90.4	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

What was the year you were born? (For example, simply type 1991)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1945	1	1.0	1.1	1.1
	1947	1	1.0	1.1	2.2
	1948	1	1.0	1.1	3.2
	1950	2	2.0	2.2	5.4
	1952	1	1.0	1.1	6.5
	1953	1	1.0	1.1	7.5
	1956	1	1.0	1.1	8.6
	1957	1	1.0	1.1	9.7
	1958	4	3.9	4.3	14.0
	1959	2	2.0	2.2	16.1
	1960	2	2.0	2.2	18.3
	1961	2	2.0	2.2	20.4
	1962	1	1.0	1.1	21.5
	1963	1	1.0	1.1	22.6
	1964	4	3.9	4.3	26.9
	1965	2	2.0	2.2	29.0
	1966	1	1.0	1.1	30.1
	1967	2	2.0	2.2	32.3
	1969	2	2.0	2.2	34.4
	1970	3	2.9	3.2	37.6
	1972	1	1.0	1.1	38.7
	1973	1	1.0	1.1	39.8
	1974	2	2.0	2.2	41.9
	1975	2	2.0	2.2	44.1
	1976	2	2.0	2.2	46.2
	1977	1	1.0	1.1	47.3
	1978	3	2.9	3.2	50.5
	1979	2	2.0	2.2	52.7
	1980	4	3.9	4.3	57.0
	1982	2	2.0	2.2	59.1
	1983	3	2.9	3.2	62.4
	1984	1	1.0	1.1	63.4
	1985	3	2.9	3.2	66.7
	1987	3	2.9	3.2	69.9
	1989	4	3.9	4.3	74.2
	1990	7	6.9	7.5	81.7
	1991	3	2.9	3.2	84.9
	1992	1	1.0	1.1	86.0

	1993	1	1.0	1.1	87.1
	1994	3	2.9	3.2	90.3
	1995	4	3.9	4.3	94.6
	1996	2	2.0	2.2	96.8
	1998	2	2.0	2.2	98.9
	1999	1	1.0	1.1	100.0
	Total	93	91.2	100.0	
Missing	System	9	8.8		
Total		102	100.0		

Do you currently live in the state of Georgia?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	7	6.9	7.4	7.4
	Yes	88	86.3	92.6	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Which state do you currently reside?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Louisiana	1	1.0	14.3	14.3
	Ohio	1	1.0	14.3	28.6
	South Carolina	4	3.9	57.1	85.7
	Wisconsin	1	1.0	14.3	100.0
	Total	7	6.9	100.0	
Missing	System	95	93.1		
Total		102	100.0		

What is your highest educational degree?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High School Diploma/GED	13	12.7	13.8	13.8
	Some College	33	32.4	35.1	48.9
	Bachelors Degree	29	28.4	30.9	79.8
	Graduate Degree	19	18.6	20.2	100.0
	Total	94	92.2	100.0	
Missing	System	8	7.8		
Total		102	100.0		

How long have you been involved with the equine industry?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than a year	1	1.0	1.1	1.1
	1 to 5 years	6	5.9	6.3	7.4
	6 to 10 years	11	10.8	11.6	18.9
	More than 10 years	77	75.5	81.1	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Do you own or lease a horse?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	3	2.9	3.2	3.2
	Yes	92	90.2	96.8	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Do you ride horses?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	7	6.9	7.4	7.4
	Yes	88	86.3	92.6	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Do you train horses?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	40	39.2	42.1	42.1
	Yes	55	53.9	57.9	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Do you manage an equine facility as your profession?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	73	71.6	76.8	76.8
	Yes	22	21.6	23.2	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Do you own a private equine facility or business?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	51	50.0	53.7	53.7
	Yes	44	43.1	46.3	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Are you a farrier?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	91	89.2	95.8	95.8
	Yes	4	3.9	4.2	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Are you a veterinarian?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	93	91.2	97.9	97.9
	Yes	2	2.0	2.1	100.0
	Total	95	93.1	100.0	
Missing	System	7	6.9		
Total		102	100.0		

Thank you for your time and effort into completing this survey! If you have anything else to add or share, please feel free to add your comments below.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		91	89.2	89.2	89.2
	2 starvation rescue horses...private 12 x 12 stalls with 1/8 acre private attached paddock each and 1 acre common field	1	1.0	1.0	90.2
	At the time I had my samples done I owned 6 horses and all were found to be low shedders. This surprised me. The first few years a dewormed once a year and now I do twice a year.	1	1.0	1.0	91.2
	I am very interested in learning more about how to better care for our horses!!	1	1.0	1.0	92.2
	I live in SC only 15 miles from where I grew up in GA, I work at an equestrian facility and belong to a riding club based in GA, so I'm very interested in any information about horse care and management pertinent to my region. UGA has helped keep my horses healthy for over 42 years	1	1.0	1.0	93.1
	I use a daily dewormer-diatomaceous earth	1	1.0	1.0	94.1
	It would be beneficial for the extension agent to contact local veterinarians off icicles with updated information to pass along to clients with horses.	1	1.0	1.0	95.1
	My answers are due to	1	1.0	1.0	96.1

	the fact I have only 1 horse at my facility that does not leave the property.				
	Thanks, AJ, for the chance to participate. I would fully support and participate in an on-line seminar with our Extension Agent, and would encourage my boarders, who are all horse owners, to participate, too.	1	1.0	1.0	97.1
	Trust my Vet and my farrier to help me keep my horses sound.	1	1.0	1.0	98.0
	We are a 501 (c) non-profit rescue, rehab, retrain facility in business for nine years. We have 36 equid on property and manage them quite well without government intervention.	1	1.0	1.0	99.0
	You didn't ask what I worm with. And there wasn't an option to include fecal exams + 3-4 month worming. If you want it... Ivermectin fall and spring, quest winter and summer. Hope I've helped, good luck!!!! We love dr turner!!	1	1.0	1.0	100.0
	Total	102	100.0	100.0	

AgeCalculation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18	1	1.0	1.1	1.1
	19	2	2.0	2.2	3.2
	21	2	2.0	2.2	5.4
	22	4	3.9	4.3	9.7
	23	3	2.9	3.2	12.9
	24	1	1.0	1.1	14.0
	25	1	1.0	1.1	15.1
	26	3	2.9	3.2	18.3
	27	7	6.9	7.5	25.8
	28	4	3.9	4.3	30.1
	30	3	2.9	3.2	33.3
	32	3	2.9	3.2	36.6
	33	1	1.0	1.1	37.6
	34	3	2.9	3.2	40.9
	35	2	2.0	2.2	43.0
	37	4	3.9	4.3	47.3
	38	2	2.0	2.2	49.5
	39	3	2.9	3.2	52.7
	40	1	1.0	1.1	53.8
	41	2	2.0	2.2	55.9
	42	2	2.0	2.2	58.1
	43	2	2.0	2.2	60.2
	44	1	1.0	1.1	61.3
	45	1	1.0	1.1	62.4
	47	3	2.9	3.2	65.6
	48	2	2.0	2.2	67.7
	50	2	2.0	2.2	69.9
	51	1	1.0	1.1	71.0
	52	2	2.0	2.2	73.1
	53	4	3.9	4.3	77.4
	54	1	1.0	1.1	78.5
	55	1	1.0	1.1	79.6
	56	2	2.0	2.2	81.7
	57	2	2.0	2.2	83.9

	58	2	2.0	2.2	86.0
	59	4	3.9	4.3	90.3
	60	1	1.0	1.1	91.4
	61	1	1.0	1.1	92.5
	64	1	1.0	1.1	93.5
	65	1	1.0	1.1	94.6
	67	2	2.0	2.2	96.8
	69	1	1.0	1.1	97.8
	70	1	1.0	1.1	98.9
	72	1	1.0	1.1	100.0
	Total	93	91.2	100.0	
Missing	System	9	8.8		
Total		102	100.0		

TotalHorses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	4	3.9	3.9	3.9
	1	11	10.8	10.8	14.7
	2	20	19.6	19.6	34.3
	3	12	11.8	11.8	46.1
	4	7	6.9	6.9	52.9
	5	9	8.8	8.8	61.8
	6	4	3.9	3.9	65.7
	7	4	3.9	3.9	69.6
	8	4	3.9	3.9	73.5
	9	3	2.9	2.9	76.5
	10	1	1.0	1.0	77.5
	11	3	2.9	2.9	80.4
	12	2	2.0	2.0	82.4
	14	2	2.0	2.0	84.3
	15	3	2.9	2.9	87.3
	17	1	1.0	1.0	88.2
	18	1	1.0	1.0	89.2
	20	3	2.9	2.9	92.2
	21	1	1.0	1.0	93.1
	23	2	2.0	2.0	95.1
	24	1	1.0	1.0	96.1
	25	1	1.0	1.0	97.1
	39	1	1.0	1.0	98.0
	42	1	1.0	1.0	99.0

	44	1	1.0	1.0	100.0
	Total	102	100.0	100.0	

TH2Group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	79	77.5	77.5	77.5
	2	23	22.5	22.5	100.0
	Total	102	100.0	100.0	

Acres2groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	64	62.7	63.4	63.4
	2	37	36.3	36.6	100.0
	Total	101	99.0	100.0	
Missing	System	1	1.0		
Total		102	100.0		

PVTvsComEstablishments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	82	80.4	80.4	80.4
	2	20	19.6	19.6	100.0
	Total	102	100.0	100.0	

SD1and2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	60	58.8	61.2	61.2
	2	38	37.3	38.8	100.0
	Total	98	96.1	100.0	
Missing	System	4	3.9		
Total		102	100.0		

Duration (in seconds)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	260.00	1	1.0	1.0	1.0
	262.00	1	1.0	1.0	2.0
	283.00	1	1.0	1.0	2.9
	284.00	1	1.0	1.0	3.9
	295.00	2	2.0	2.0	5.9
	303.00	1	1.0	1.0	6.9
	312.00	1	1.0	1.0	7.8
	315.00	1	1.0	1.0	8.8
	322.00	1	1.0	1.0	9.8
	325.00	1	1.0	1.0	10.8
	327.00	1	1.0	1.0	11.8
	365.00	1	1.0	1.0	12.7
	372.00	1	1.0	1.0	13.7
	373.00	1	1.0	1.0	14.7
	383.00	2	2.0	2.0	16.7
	385.00	2	2.0	2.0	18.6
	389.00	1	1.0	1.0	19.6
	390.00	1	1.0	1.0	20.6
	393.00	1	1.0	1.0	21.6
	399.00	1	1.0	1.0	22.5
	401.00	1	1.0	1.0	23.5
	413.00	1	1.0	1.0	24.5
	415.00	2	2.0	2.0	26.5
	417.00	1	1.0	1.0	27.5
	419.00	2	2.0	2.0	29.4
	422.00	1	1.0	1.0	30.4
	428.00	1	1.0	1.0	31.4
	429.00	2	2.0	2.0	33.3
	437.00	1	1.0	1.0	34.3
	452.00	1	1.0	1.0	35.3
	455.00	1	1.0	1.0	36.3
	459.00	1	1.0	1.0	37.3
	461.00	1	1.0	1.0	38.2
	466.00	2	2.0	2.0	40.2
	471.00	2	2.0	2.0	42.2
	477.00	1	1.0	1.0	43.1
	502.00	1	1.0	1.0	44.1
	506.00	1	1.0	1.0	45.1

517.00	1	1.0	1.0	46.1
521.00	1	1.0	1.0	47.1
524.00	1	1.0	1.0	48.0
528.00	1	1.0	1.0	49.0
529.00	1	1.0	1.0	50.0
535.00	1	1.0	1.0	51.0
537.00	1	1.0	1.0	52.0
539.00	1	1.0	1.0	52.9
550.00	1	1.0	1.0	53.9
552.00	1	1.0	1.0	54.9
577.00	1	1.0	1.0	55.9
578.00	1	1.0	1.0	56.9
592.00	1	1.0	1.0	57.8
596.00	1	1.0	1.0	58.8
598.00	1	1.0	1.0	59.8
608.00	1	1.0	1.0	60.8
624.00	1	1.0	1.0	61.8
627.00	1	1.0	1.0	62.7
629.00	1	1.0	1.0	63.7
630.00	1	1.0	1.0	64.7
641.00	1	1.0	1.0	65.7
657.00	1	1.0	1.0	66.7
670.00	1	1.0	1.0	67.6
671.00	2	2.0	2.0	69.6
677.00	1	1.0	1.0	70.6
684.00	1	1.0	1.0	71.6
699.00	2	2.0	2.0	73.5
725.00	1	1.0	1.0	74.5
760.00	1	1.0	1.0	75.5
775.00	1	1.0	1.0	76.5
792.00	1	1.0	1.0	77.5
855.00	1	1.0	1.0	78.4
864.00	1	1.0	1.0	79.4
872.00	1	1.0	1.0	80.4
874.00	1	1.0	1.0	81.4
903.00	1	1.0	1.0	82.4
904.00	1	1.0	1.0	83.3
957.00	1	1.0	1.0	84.3
1040.00	1	1.0	1.0	85.3
1129.00	1	1.0	1.0	86.3
1183.00	1	1.0	1.0	87.3
1186.00	1	1.0	1.0	88.2

	1270.00	1	1.0	1.0	89.2
	1298.00	1	1.0	1.0	90.2
	1337.00	1	1.0	1.0	91.2
	1358.00	1	1.0	1.0	92.2
	1389.00	1	1.0	1.0	93.1
	1448.00	1	1.0	1.0	94.1
	1488.00	1	1.0	1.0	95.1
	1603.00	1	1.0	1.0	96.1
	1812.00	1	1.0	1.0	97.1
	2240.00	1	1.0	1.0	98.0
	8941.00	1	1.0	1.0	99.0
	54787.00	1	1.0	1.0	100.0
	Total	102	100.0	100.0	