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THE PROCEEDINGS
OF THE
HORSEMEN'S SHORT COURSE

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VPI&SU
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In Cooperation with the

Virginia Tech Animal Science Department,
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and The Horse Industry

Prepared By

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SELECTING AND CULLING BROODMARES

Charles A. Hutton
Extension Animal Scientist
University of Georgia

DA 4/27/81
There are many multipliers but few breeders of horses. The ability to consistently select and cull effectively is certainly one of the most vital abilities of the true breeder. This decision-making process has always been the basis of genetic improvement of livestock, but has never been quite as important as it is today. Our current economic crunch has increased production costs so much that there is no chance for profit in producing mediocre horses.

Great breeders place much emphasis on "mare power." The handful of progressive breeders who have realized true genetic improvement in their breeding programs--persons like Tesio, Bob Kleberg, Bull Hancock, Bazy Tankersley, Jess Hankins, John Dawson, Bud Warren, Dan Gainey, Hank Wiescamp--agree on the importance of good mares. Breeders like these also have in common a commitment to their breeding goals, and a unique determination to continue to work toward their vision of an ideal horse.

All breeders--large and small--must carefully choose and define their goals in order to have any chance of reaching them. Since the rate of genetic improvement is most rapid when the fewest number of traits is considered, the breeder must concentrate his efforts. Genetic progress is slow at best, so a clear and relatively simple set of goals must be used in selecting and culling in order for a person to see real change within their lifetime. Finally, the market will determine if any business enterprise can survive, so these goals must relate to improving the sale product.

A broodmare's true value depends on two factors:

- 1) Her ability to transmit desirable genetic material to her offspring.
- 2) Her efficiency of producing a marketable foal.

Selecting and culling requires the breeder to obtain decision-making information relevant to each of these factors. Since breeders usually face the problem of wanting better mares than they can afford, compromise is certain. Using the right information will assist the serious breeder in making wise decisions more often. Just as important, knowledge will help the conscientious breeder learn to admit his mistakes.

The following kinds of information can be used to predict genetic value:

- 1) Individual performance of mare,
- 2) Conformation,
- 3) Pedigree,
- 4) Performance of offspring,
- 5) Performance of other relatives.

For traits of high heritability (such as racing performance) the individual performance record of a filly has the highest predictive value to estimate her ability to produce. In other words, outstanding race mares are most likely to produce foals with outstanding racing class. Stakes winning mares are extremely expensive, however, and beyond the means of the average breeder. Which would be a better choice, then, a mare with a poor racing record but a black-type pedigree, or a mare of unfashionable pedigree but a hard-knocking race record? Assuming that the mares had an equal racing opportunity (a difficult assumption!), the mare with the better race record is a more likely prospect to become a producer.

In order for performance records to be useful they must be as objective as possible. This means that each tested individual should have an equal opportunity or a nearly standard environment. In practice this is extremely difficult to accomplish. The breeder should obtain the best records possible, but will still have to rely on good judgment to evaluate these records. In general, comparisons within a herd or stable are more valid than between-herd comparisons.

How important are pedigrees? This controversy is as old as the art of horse breeding. It is my belief that pedigrees can be used as a valuable selection tool, but they are misused and misinterpreted more often than not. To be useful, pedigrees must include meaningful records of performance and production. As a general rule ancestors more distant than grandparents are too remote to be of any value in decision making!

Family selection is a special use of pedigrees which offers considerable promise. A few horse breeders have built programs to the point that certain families have been developed for uniformity in certain specific traits.

In racing, a "speed family" mare might be crossed on a "distance" stallion in hopes of combining some of the best traits of both families. A few breeders of show and arena performance horses are also identifying strains or families that excel in muscular development and others that excel in refinement or quality. Certain families seem to consistently adapt to certain performance events or behavior modifications. Mating systems based on these principles have proven effective in improving other plant and animal species, but require much time and effort. Line-breeding can be used to increase homozygosity and prepotency within a line--provided that strict testing and culling is practiced. The "market product" resulting from crossing two in-bred lines should benefit from some heterosis or hybrid vigor as well as the selection pressure on the traits obtained from each family.

It is generally safer and wiser for small breeders to avoid inbreeding and complicated breeding system. The danger of uncovering undesirable recessives is real. Outcrossing of individuals that complement each other's strengths and weaknesses is the best system for most horsemen to follow.

I feel that more emphasis should be placed on conformation in selling and culling mares. Physical conformation does tend to be inherited and has great influence on both performance and soundness. Since conformation can be evaluated early in life, it is possible to save money by eliminating individuals with serious conformation faults before more time and money is invested in testing their performance and production. More consistent and

rigid selection based on the relationship of form to function is a tool for real improvement.

In addition to these genetic considerations I believe that a profitable broodmare must also be:

- 1) a good milker,
- 2) an easy keeper, and
- 3) highly fertile.

Consideration of these productive traits as culling criteria will be a real asset in improving profits in your breeding program. Low reproductive efficiency is still the biggest single problem facing the horse industry. Management can do much to improve the percent foal crop--but the most rapid improvement can be realized by eliminating "problem" mares. Culling shy and erratic breeders will do wonders for both the pocketbook and the disposition of the breeder.

Small breeders usually should not own a stallion. Their chances of success are higher if they concentrate their capital and effort on better mares. These mares can then be mated to a proven sire or a stallion carefully chosen to fit the individual mare. Better foals with more market appeal and name recognition are the desired result.

The chief drawback to this program is the high cost of mare transportation, service fees and board incurred. The resulting foals must bear these costs, so a high percent foal crop is an absolute necessity. Highly fertile, healthy and relatively young mares are much more likely to make profits in this type operation.

The Southeast has a unique opportunity to compete in horse production. We can lower production costs without sacrificing quality by emphasizing our competitive advantages based on the climate, land cost and capabilities, and forage production potential of our region. We can maintain a broodmare outdoors year round and produce marketable foals with a minimum of grain. Facility, feed and labor costs can be greatly reduced in a high forage system combining permanent and temporary grazing with minimal stored feed. Our mares need to be adapted to this environment!

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APPLIED HORSE PSYCHOLOGY

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I. Introduction

The basic behavior of the horse reflects the millions of years he lived on the open plains. Understanding his evolution and this relationship to how and why he acts is basic to knowing about and working with the horse. Man domesticated the horse some 5,000 years ago and modern horse evolved to his basic form about one million years ago. This process began 58 million years ago with a dog-like five toed animal which lived in a swamp-like environment. He gradually evolved or adjusted to his environment and developed the skeleton, physiology, size and intelligence to survive as a large, "one toed", grass eating, plains travelling animal with a great combination of speed and endurance. All aspects of his behavior are related in some way to protection of the individual and perpetuation of the species. The horse is a great animal valued for his athletic ability but he can be dangerous and should not be treated as a pet.

II. Self-Protective Behavior

As the horse evolved, his survival was constantly threatened by climatic changes, disease and predatory animals.

Protection from the Elements

Horses seek protection primarily from cold wind and cold rain. He will usually select a natural cover in preference to a stable as he is an outdoor athlete. He will graze with his tail to the wind and it is hard to ride a horse into a driving rain or snow storm. Horses use the elements and natural features to protect and increase their comfort. On cold mornings, the horse will stand broadside to the sun and conversely may line up with the sun on a hot day. He will use shade in hot weather and may seek out high places for a cool breeze which also helps to keep flies away. Man must provide for protection from the elements in most instances today.

Protection from Predators

The horse depends on speed and running endurance for protection and will usually only bite, kick or paw when cornered. The entire anatomy of the horse evolved for this protection. His feet (single digits) are designed for speed and agility. He has a strong urge to eat more or less continuously because it may be necessary to run distances without eating. He has well developed senses of hearing,

vision and smell to warn of potential dangers. The horse is fearful of confinement and restraint because this spells death. They are especially fearful of having their feet caught and held. The horse is especially fearful of having anything on his back as this is the act of a predator. Almost any young horse may buck under the right conditions. Most trainers try to never let a horse buck. Horses are stimulated to buck by the nerves in their back and by their eyes. Some horses may look at the rider while running off and this can be especially dangerous.

III. Eating Behavior

Anatomy and Eating

The primitive horse had low crowned teeth but modern horse developed high crowns for eating dry grass. As primitive horse grew to depend on speed, his legs grew longer as his head and neck had to become longer to allow him to graze. This process is not always perfect, for example, foals have difficulty in getting their heads to the ground. Horses prefer to graze up hill and there is usually no excess length of neck in many horses today. The lengthening of the head provided a space between the nippers and grinders (teeth) which allows man a place to place the bit. The horse uses the upper lip to gather food and seldom uses its tongue to gather food. Horses will paw through snow for food. Horses are not right or left handed as he must use both sides to equal advantage .

Eating Behavior

The horse has a blind spot out in front of his nose and cannot see what he eats. Horses are very selective in what they eat and prefer dry type grass-like plants which are also the safest foods for them to eat. When other foods such as lush clover grass, legume hays and grains are fed, caution must be used or founder may result. These foods were not used during evolution and are not the "natural" foods for the horse. Horses prefer tender grass and tend to overgraze certain areas as a result of this preference.

The horse does not have a grazing or eating schedule and has a basic urge to eat continuously to keep the digestive tract full of food. The horse grazes and rests intermittently with more time spent at grazing. The horse does better if fed small amounts often rather than large amounts at one time.

Man must provide for food, salt and water for the horse today and horses do develop a schedule for hand feeding and this should be on a definite schedule. Improper feeding procedures may lead to wood chewing, weaving, kicking, etc. and digestive disturbances. Foals tend to nibble fresh feces and this may provide a method of inoculating the digestive tract with microorganisms. Ideally, the horse should be fed small amounts often but it is not usually practical to feed more than two or three times daily. Available hay can provide for nibbling and reduce boredom in confinement.

Feed can be used, in some cases, for reward in training. Hot horses should not be fed or watered until properly cooled and dried.

Drinking Behavior

Horses prefer to drink clean, clear water out of deep pools. They may lower their heads deep enough to cover the nostrils. They can meet their requirements by eating snow. It is best to use clean troughs or fountains to provide a fresh supply available at all times. Water is a cheap food requirement!

Eliminative Behavior

In pastures, horses tend to defecate and urinate in certain areas and graze in others. Stallions are very pronounced in this behavior in pastures and paddocks. This all may have evolved for stallions to mark his territory and for horses to provide some protection from parasites spread from droppings. In confinement, owners must use modern parasite prevention and control methods. Pastures should be rotated and not be overgrazed and horses should be fed in mangers rather than on the ground. Cattle and horses graze quite well together and jointly make better use of the pastures.

IV. Sexual Behavior

Evolution contributed to the fact that the horse is almost essentially a seasonal breeder. Birth, estrus and re-breeding occurred in spring and early summer when grazing nutrition was best for the wild horse. Sexual behavior is controlled by hormones which are influenced by many factors including length of daylight. Domestication has influenced the seasonal breeding pattern and perhaps the mare will become less seasonal in the future.

Mating Behavior of the Stallion

Courtship or teasing is an important part of mating behavior. Teasing or running a stallion with mares may be used to establish the estral cycle and result in breeding and conception. When led to a mare, the stallion usually will sound the mating call, nip her, smell her and determine if she is ready for service. The wise stallion will carefully approach the mare from the front.

Mating Behavior of the Mare

Mares show considerable variation in their sexual behavior. The average length of heat is about six days and ovulation usually occurs toward the end of the estral period. The average mare will start a new cycle every 19 to 21 days. When the mare is out of heat, she will fight the stallion with her ears back, kicking and squealling. When in heat, she may fight some but will be receptive, urinate, wink the vulva and be receptive to mating. Many mares will not be average and should be handled by a veterinarian or breeding specialist.

Training Stallions

It is important to teach young stallions when it is time to work or be ridden and the time to be used properly as a breeding stallion. He must be trained to this difference. Likewise, it is important to train for proper behavior as a breeding stallion.

Training Mares

The behavior of the mare in heat almost invariably creates a problem in training. The basic mating urge is hard to replace at the moment with a basic training maneuver. Often in the case of young mares, it may be best to postpone new training while the mare is in heat. In any event, understanding and patience will be required.

V. Social Behavior

Through evolution horses developed a need for company as an individual had more security in a group with more eyes, ears and nostrils and with order and leadership. Horses developed interesting behavior patterns and the need for company especially creates many problems in training and handling horses today.

Need for Company

The need for company is basic. The first time a horse is separated from his friends is a traumatic experience. The horse becomes nervous and is actually afraid for its life. Wild horses form small groups with a stallion, his mares and foals. Domestic horses may develop strong attachments for each other which appears to be a social need more than security. Horses are selective in friendship but in the absence of another horse may even develop affection for other animals. When a horse is kept alone, a dog or goat may be helpful as a friend.

Applied Significance of Need for Company

It is difficult to teach a horse anything until they have learned not to be so dependent on company. One technique for young horses might be to feed them separately in box stalls. Older horses require more work and some company spoiled horses may never completely settle down. Another technique would be to remove the horse to a separate area which is safe (fences, etc.). Some horses replace company safe with the barn as a source of security or becomes "barn sour". Barn sour horses are hard to ride away from the barn and may turn and run away back to the barn. In training young horses you may follow older horses away for the first few trips. Always it is good policy to ride at a walk away from the stable and return the last few hundred yards at the walk. Riding different routes may also be of assistance.

Riding groups should not move until all riders are mounted. Also, at least one rider should wait for another when stopping for emergency or closing gates, etc. A young horse which has never been alone by itself should not be taken from his group and placed in a separate area unless the area is safely fenced. It might be good to place him with another gentle horse for a few days and then remove him to a safe paddock or stall.

Social Order

Horses in groups develop a social order or order of dominance. This order varies in enforcement among members of the group. The wild horse social order was the breeding group including a stallion and several mares. These groups even developed a social order by groups. Geldings may vary toward behaving as a stallion or as a member of a domestic group. Some geldings become quite possessive about certain mares. Generally, geldings are less concerned with social order and fighting. Mature horses seldom fight a foal to establish dominance.

Leadership

In wild horses, the stallion was not the leader but was the defender. Usually, an older mare in good health assumes the leadership role and will usually be the dominant individual in any group including domestic groups. Dominance may be a factor to consider in group riding. Dominant horses tend to move to the front and passing by milder horses can be a safety problem. Dominance or leadership may also be a factor in the type of runner a race horse may be. For example, a follower may win if he starts and stays in the lead. Leadership and dominance can be detected by observing groups of young horses at play. In training, it is often helpful to ride a young horse behind an older one for a few times but eventually he must be made to go it alone.

Agonistic Behavior

Horses fight by degree to establish the social order. This creates a problem in introducing a strange horse to a new group. It might be of help to let him be introduced over a good fence for a few days or place one of the gentle horses from the group with him for a few days before throwing him into the social system. Spacing in trail rides is also important to avoid kicking, etc. Care must be noted when passing in group riding — remember that the leader is happy to be in front and changes should be carefully planned. It is best to keep horses separated by general age groups on farms. Mature stallions should not be kept together and should not be kept together with geldings. Farms must design and plan to keep mature stallions apart — fighting is dangerous and results in injury.

VI. Communication

Horses have an excellent communication system.

Voice Signals

1. Snort - warning sound
2. Neigh or Whinny - distress call
3. Nicker - greeting
4. Squeal - anger
5. Mating Call - stallion
6. Rolling Snort - pleasure
7. Mare Sounds - talk to foal

In training, a snort should tell the trainer that the horse is afraid of something. A good horseman listens to voice sounds to tell what his horses are doing.

Ear Signals

The ear signals can be detected quite readily by the trainer. Horses are good observers and the eyes and ears work together. The direction in which he is looking can be determined by the position of the ear. He can look and listen ahead with the right ear and back with the other pair.

1. Anger - Ears turned back and laid down on top of head
2. Interest - Both ears pointed forward, body relaxed

During periods of great stress, such as racing, the ears may be laid back in determination. Interest is a desirable trait. A young horse shows interest as to what is on his back. A responsive horse may keep one ear cocked for cues and one ear forward to focus on what is ahead. Spoiled horses may do the same to catch a careless rider with one eye and use the other to look for room to run.

3. Fear - Both ears ahead, body tense
4. Relaxed - Ears relaxed

Tail Signals

1. Kink - May be ready to buck. Also, a sign when playing with other horses.
2. Held High - Time to play. May also trot or canter with stiff legs.
3. Held Between Legs - Scared or ready to kick. Also, sign of capitulation in a fight.
4. Switching - Irritation. This can be habit forming.

Tail switching may indicate that you are annoying the horse.

Mouth and Lips

Lips

The horse may raise his head and lift the upper lip if something he is eating is distasteful. He may also do this when in pain from digestive disorders. The stallion lifts his lip to clarify odors.

Mouth

Foals and yearlings communicate their status to older horses by opening and closing their mouths and thus avoid social enforcement.

Eyes

A frightened horse will have his eyelids wide open.

Nostrils

A frightened horse will flare the nostril.

Play

Play is natural with all groups of horses.

VII. Investigative Behavior

Curiosity is closely related to fear and thus to self-protective behavior. All horses display investigative behavior. Curiosity is a process of learning for young horses; as he becomes older, he may become less curious and take it for granted that anything strange is dangerous. By riding age he is less curious and more afraid of strange objects and movements. He may even become scared of his own shadow. This overall behavior results in shying. Therefore, in training it is best to not introduce the horse to strange areas until he is well under control. Using a gentle horse to accompany a young horse for the first few rides is also helpful. Usually if a horse is made to smell something, he will lose his fear of it. Curiosity and alertness properly guided are desirable traits. It is a good idea to take a young show horse to a few events prior to entry to acquaint him with the sounds and commotion.

VIII. Maternal Behavior

Mares are usually quiet and cranky during gestation. Just prior to foaling she will become restless and uneasy. Birth is quick and usually occurs at night. The mare will usually exhibit maternal behavior to the foal. After foaling the mare may become suspicious for a few days of anything which tries to approach her and the foal.

Imprinting

Mares prefer to foal away from other horses. This may relate to preservation and to imprinting of the foal with his correct mother. Foals can imprint on the wrong animal and thus starve. The mare identifies the foal first by odor but as time passes, sight is the principle means of recognition.

Foal Behavior

Foals get on their feet and are ready to travel very soon after birth. Horses stand from the prone position by raising the front end first. Foals will learn to nurse very shortly after birth. Foals spend a lot of time sleeping by lying flat on their sides. Older horses usually sleep in the upright position.

IX. Special Senses

Sight

Horses have monocular vision but can also focus both eyes ahead for binocular vision. The height and position of the head determines whether the horse is focusing on near or far objects. A horse with a high head with nose extended is dangerous to ride because he is not focusing on near objects. The horse has good vision but distance judging may be a problem. He can see over a wide area including all the way around behind without turning his head. The horse has good vision at night. Many sources maintain that the horse is color blind but this may not entirely be the case.

Hearing

The horse has a good sense of hearing and voice commands are useful in training. Early horse depended more on vision and smell than hearing for safety.

Smell

The horse developed an acute sense for smell and uses this sense to identify other horses and to identify their home range. Old friends greet first by smelling, nose to nose. Horses by smell may be able to detect fear in humans, which in turn, makes them excited and nervous. Stallions utilize smell for detecting heat in mares.

Touch

The horse has a well developed sense of touch. He is particularly sensitive about the nose, ears and eyes and the flank. He is also sensitive about the withers, and horses exchange massages in this area. The frog also serves as an organ of touch. The sense of touch is useful in training and riding. Care must be taken to insure the horse that you do not intend to hurt them through their sensitive and vital touch areas.

Head shy horses usually have been mistreated. The most critical area is around the ears. Touch is important in cueing horses via hands, legs and weight of rider. Horses can be schooled to respond lightly to light cues. Excessive cueing may cause the opposite result.

Homing Instinct

Horses definitely have a homing instinct and probably use their eyes to back track. This is a very useful sense.

X. Memory

The horse has an excellent memory. Often it seems that he remembers mostly the scary things but this is not the entire story. He will remember the source and location of fright. Memory is useful in the training process and early techniques learned can be called for and obtained in the future.

XI. Sleeping and Resting

Horses sleep soundly and may sleep up to seven hours per 24 hours. Adults usually sleep standing and alternate the use of each hind leg to carry his weight. Standing horses should be approached carefully because even the gentle horse may awake with a startle. At night horses alternate between sleeping and eating.

XII. Grooming

The horse grooms itself by rolling in the dirt.

Reference Source: Horse Behavior and Training, 1974, by Robert W. Miller.

APPLIED REPRODUCTION IN HORSES

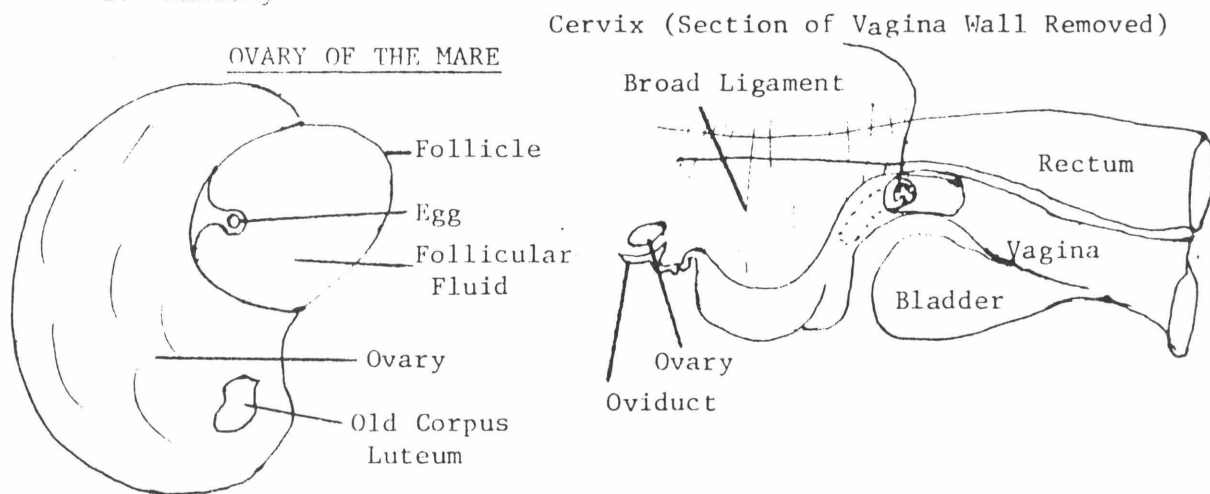
By: Dr. T. N. Meacham, VPI&SU

I. Patterns of Reproduction In Horses

A. Female

MARE REPRODUCTIVE TRACK

1. Anatomy



2. Physiology

- a. Puberty is around 18-24 months of age. Quite variable. Usually reached in spring of second year.
- b. Breeding season. Definite seasonal effect. Peak period of breeding efficiency is from mid April to July. Many tend to be in anestrus during winter.
- c. Estrous cycles
 - 1) Cycle length 18-24 days, av. 21. Estrous period averages 6 days with a range of 2-7. Longer, more irregular estrous periods early and late in the breeding season.
 - 2) There are four phases, proestrus (2 days), estrus (6 days), metestrus (2 days) and diestrus (12-13 days). Heat and ovulation take place during the 6 day estrus period.
- d. The cycle is controlled by several hormones, two from the pituitary and two from the ovary.

- 1) The follicle-stimulating-hormone (FSH) is released from the pituitary. It stimulates follicular growth in the ovary and estrogen production from the developing follicles. (Figure 1).
- 2) When the level of estrogen in the blood reaches a certain point, the behavioral pattern of estrus or heat are exhibited. Also, the uterus is preparing for a pregnancy under this estrogen environment. Uterine glands and blood vessels grow rapidly, fluid accumulates.
- 3) The high blood levels of estrogen act on the pituitary to bring about a sudden increase in the luteinizing hormone (LH) that is being released from the pituitary.
- 4) The surge of LH acts on the ripened follicle and causes it to break or ovulate and release the egg or ovum. This normally occurs during the last 1-2 days of the heat period. When the follicle breaks estrogen production declines rapidly. LH then causes the corpus luteum (CL) to form in the ovary.
- 5) The CL in turn produces progesterone. Progesterone maintains the uterus in a quiet, secretory state for pregnancy, and prevents further release of FSH and estrus, normally. If pregnancy is not established, the CL stops producing progesterone and a new cycle begins.

e. Fertilization

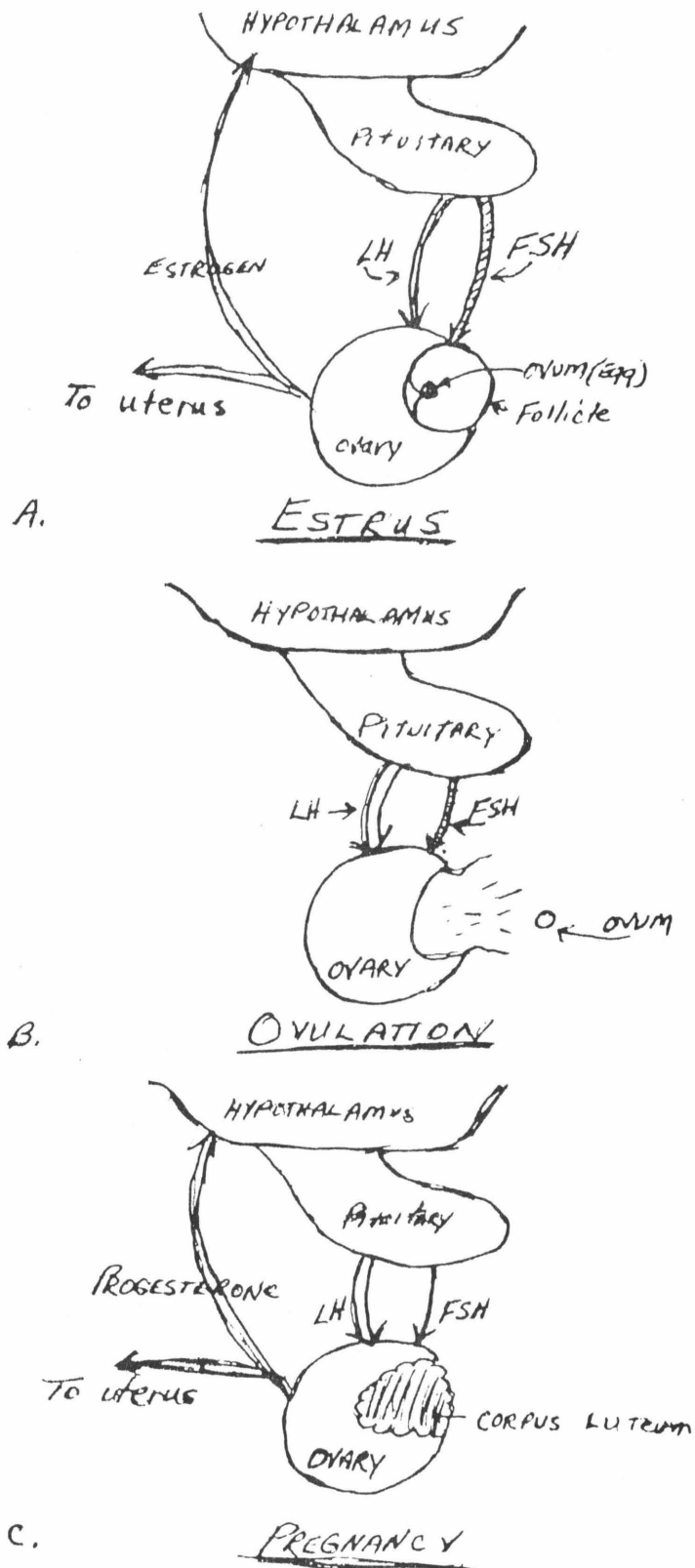
- 1) Fertilization takes place in the oviduct. Sperm are present in the oviduct when ovulation occurs, so fertilization is almost immediate.
- 2) Conception rates are reduced if sperm are not present when ovulation occurs. Ovum are viable for 6-12 hours and sperm about 24 hours. Must breed at the right time, just prior to ovulation.
- 3) Twin ovulations and fertilization occurs about 4-5% of the time. Few twins are born alive and normal.

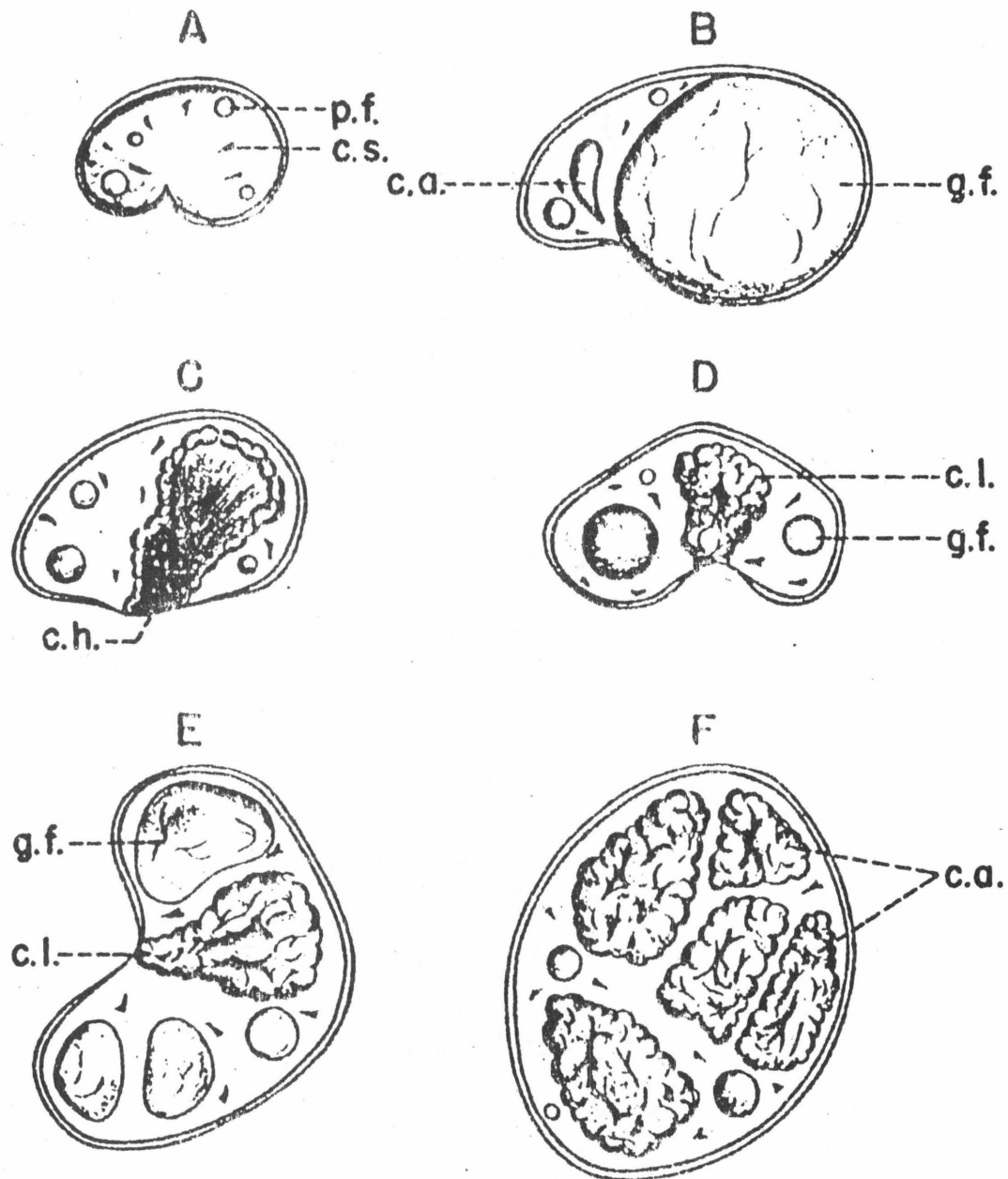
f. Implantation

- 1) Fertilized ovum, the embryo, migrates to the horn of the uterus in 4-6 days.
- 2) Embryo remains free in the lumen of the uterus for about 6 weeks--held in position by fluid pressure. At about 6 weeks of pregnancy the diffusion type of fetal nutrition begins to change to a fetal-capillary type (Chorio-

Figure 1

HORMONE CONTROL OF THE OVARY





Microdrawing of cross section of ovaries (drawn to scale) of the mare at different stages of reproduction.

A, Non-breeding season: the ovary is small and contains primary follicles (*p.f.*) and scars (*c.s.*) from degenerating corpora lutea.

B, Breeding season: during estrus, the ovary contains a mature Graafian follicle (*g.f.*) and corpus albicans (*c.a.*) from previous ovulation.

C, Three days after ovulation: the corpus hemorrhagica (*c.h.*) develops from the walls of ruptured Graafian follicle.

D, Ten days after ovulation: fully developed corpus luteum (*c.l.*). Graafian follicles (*g.f.*) start to develop for subsequent cycle.

E, Pregnancy—60 days: the corpus luteum of pregnancy (*c.l.*) is maintained and Graafian follicles (*g.f.*) develop as a result of circulating P.M.S.

F, Pregnancy—80 days: accessory corpora lutea (*c.a.*) develop from the unruptured follicles.

allantoic type). (This is when embryo is most likely to slip.) Attachment to the uterine wall is complete at about 100 days (14 weeks).

- 3) Around 45 days the uterus of the pregnant mare begins to produce the hormone called pregnant mare serum (PMS) which stimulates the development of accessory CL on the ovary. These provide additional progesterone to supplement the original CL until the placenta is formed and takes over the job of producing progesterone for the remainder of pregnancy.

*See plate 36.

- 4) During this period the embryo is nourished by secretions from the uterine glands (uterine milk).

g. Pregnancy Tests

- 1) Rectal palpation - an examination of the uterus through the rectal wall. Easiest, most rapid, most informative, and as accurate as other method.

a. Follow uterine horn from ovary down

- 1) 30 days - small, hard noticeable bulge size of walnut in lower third of horn of uterus
- 2) 40 days - bulge about size of orange and spherical in shape
- 3) 50 days - oval and size of grapefruit - starts to enter the body of uterus.
- 4) 60 days - size of football, 1/2 is in body of uterus
- 5) 90 days - whole uterus is enlarged and is abdominal and cannot be reached

2) Pregnant Mare Serum Test

a. 95% accurate between 45-100 days of pregnancy

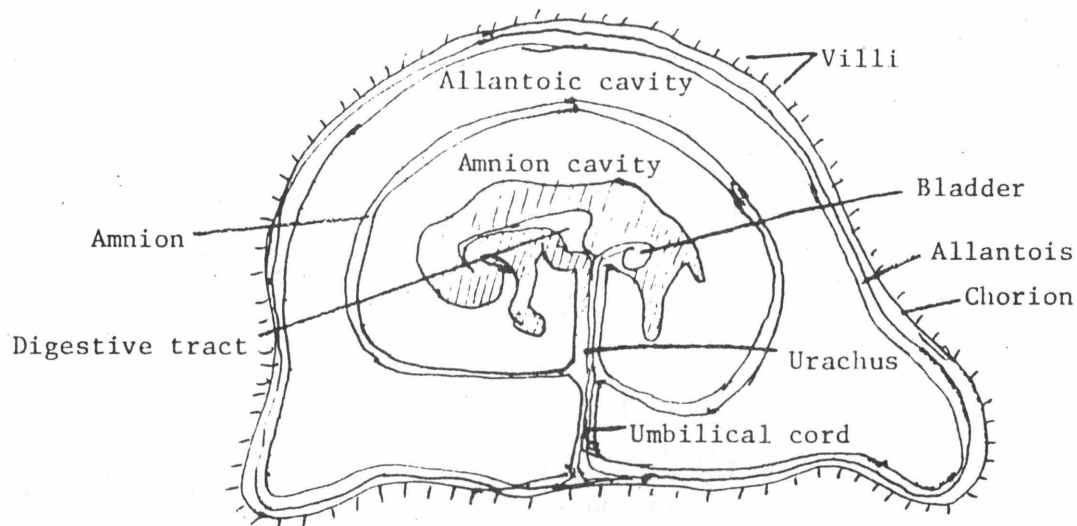
- 1) Inject 1 ml of mare's serum into immature female rat
- 2) 96 hours later the reproductive tract of the rat is examined. Enlargement of the ovary and uterus indicates pregnancy.

h. Placentation and Gestation

- 1) The placenta consists of 3 membranes

- a. Amnion - surrounds the fetus and is filled with fluid. This protects and cushions the fetus.
- b. Allantois - fetal waste receptical, fused with the chorion
- c. Chorion - outer most layer and contains the vascular system of the fetus. Arteries and veins from the fetus extend out through the embilical cord and branch through the chorion.

Fetus of horse within the placenta

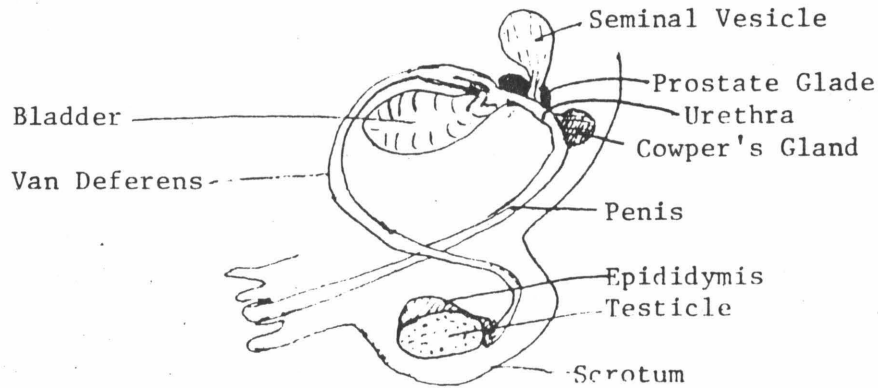


- 2) Placentation is complete and attachment to uterus has occurred at approximately 100 days. Small villi projections on the surface of the chorion penetrate into crypts of the uterine lining. Capillaries of maternal circulation and those of the fetal circulation are located adjacent in these crypts. The exchange of nutrients and waste products take place at this point. The two systems are not connected but diffuse from one to the other during gestation.
- 3) Gestation period lasts about 11 months (320-360 days). Considerable variation.

B. Male

1. Anatomy

STALLION REPRODUCTIVE TRACK



2. Physiology

- a. Puberty, the age when the colt is capable of reproduction, is around 18-24 months. This is quite variable.
- b. Sexual maturity does not occur until 3-4 years of age.
- c. Spermatogenesis takes place in the semeniferous tubules of the teste. This process is stimulated by a gonadotrophic hormone (FSH) from the pituitary gland. Testosterone, a hormone produced by the testes is also needed for spermatogenesis. This process is initiated at the time of puberty.
- d. Sperm are stored in the epididymis, the vas deferens and ampulla for ejaculation.
- e. The pituitary also secretes a hormone (LH) which stimulates the Leydig cells in the teste to produce testosterone. Testosterone is responsible for the secondary sex characteristics, libido, etc. causes the secondary sex glands (seminal vesicles and prostate) to secrete the fluid portion of the semen.
- f. Semen production and libido are continuous once puberty is reached. Some variation in semen production, lower during winter months. Average ejaculate is 125 ml and contains 8 billion sperm.

II. Breeding Management

A. Breeding systems

1. Pasture breeding
 - a. Stallion turned out with group of mares.
 - b. Most efficient in terms of pregnancy rates.
 - c. Minimum amount of labor required.
 - d. Best system for hard-to-settle mares. Leaves all the heat detection problems to the stallion.
 - e. The number of mares covered in a season is limited. Band of 30-40 is about all for the season.
 - f. Much greater chance of injury to stallion and mares.
 - g. Accurate breeding dates hard to get.
2. Hand breeding
 - a. Mares teased and brought to the stallion for mating under controlled conditions.
 - b. Can breed more mares in a season - 50-100.
 - c. Can take precautions to protect mare and stallion from injury.
 - d. Increases labor and time needed to check mares and get them bred.
 - e. Greater chance for personnel injuries.
 - f. Requires well qualified help.
 - g. Can accommodate "outside" mares easily.
3. Artificial insemination
 - a. Greatest efficiency in terms of numbers of mares bred/stallion.
 - b. Little danger of injuries.
 - c. Can reduce spread of disease.
 - d. Breed associations vary in their rules on registering A.I. sired foals. These rules may change.
 - e. With the use of frozen semen, A.I. offers quite a bit to the horse breeder who is not concerned with registered horses.

B. Management of breeding stock

1. Mares and fillies

- a. Physical condition is critical - get maximum conception with females in good thrifty gaining condition. Not fat, not poor.
- b. Health of the mare is extremely important. Make sure there are no infections (clean culture) in open mares. Many stallion owners insist on a "clean culture" before breeding outside mares.
- c. The best reproductive performance is obtained during the period from April-July or August. Try to breed during this time, the normal breeding season for mares.
- d. Fillies are usually bred for the first time in their third year, depending on their use (racing, showing, etc.). By this age, they are approaching physical maturity.
- e. When hand breeding or artificial breeding, make sure the female is in true heat.
 - 1) "Agressively permissive"
 - 2) Showing all the symptoms
 - 3) Responding to teasing
- f. Use necessary restraining procedures to insure safety of and holders.
- g. The female should be covered (bred) every 36-48 hours during the heat period. The number of covers can be reduced by palpating follicle and mating when follicle is ready to break.
- h. Foal heat breeding. A debatable subject. Foal heats occur 7-11 days after foaling; quite dependable. If the mare had no trouble foaling and all is well it is often done. If any doubt about it, don't breed on foal heat.
- i. Tease mares for two cycle lengths (42-44 days) after breeding to insure conception.
- j. Pregnancy test all mares bred 40-60 days after breeding.

2. Stallions

- a. Maintain stallions in hard, thrifty condition with proper feeding and exercise programs.

- b. When hand breeding, stallions must be well mannered and controlled. Proper discipline and training critical in the young stallion.
 - c. Older stallions with experience are best for pasture breeding. Young stallions can get hurt.
 - d. Use young stallions to a limited extent and carefully. Don't get them hurt. Train them on gentle mares that stand well and are definitely in heat.
 - e. Stallions should be handled by qualified people only, not by children or inexperienced people.
 - f. Try to space out your breedings so that the stallion is not used more than once a day. If necessary to double up, a day of rest should follow. Lots of variation in stallions capabilities.
 - g. Routine semen evaluation before and during the breeding season is recommended.
 - h. Many stallions that are sluggish breeders are not in shape. "Cut the feed in half and double the exercise."
3. Accurate records of all parts of the breeding program are very important.
- a. Teasing and breeding records
 - b. Palpation records
 - c. Foaling records
 - d. Health records
 - e. Stallion use records
 - f. Histories on all mares and stallions
4. Health programs for the breeding operation are very critical for good reproduction. These programs should be worked out in cooperation with your veterinarian.

BREEDING PROCEDURES AND PROBLEMS

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A very necessary part of any horse breeding program is a good system of records. These are necessary if you are handling 5 mares a season or 100 mares. It is very difficult for any person to keep all of the pertinent data concerning a horse breeding operation in his head. At the same time, if records are going to be kept, they need to contain certain material and they also need to be easy to keep. A complicated system of record keeping will discourage someone from keeping them up to date.

Many times the kind of information desired on a record of a mare will depend upon the type of breeding operation, size of the operation, value of the animals involved, and whether the breeding farm has close veterinary supervision. Some information which would be of value on an animal's record is:

1. Owner's name and address
2. Identification of animal - tattoo, brand (lip or hoof), name, numbers on halter
3. Insurance status of animal
4. Herd history of disease
5. Individual history of disease
6. Immunization record
7. Past breeding record
8. Last heat date
9. Parasite treatment record
10. Past treatments for fertility
11. Physical exam and reproductive system exam
12. Teasing record

Another bit of information which should be noted is the presence of any scars, cuts, lameness, etc. If any of these are present at the time of arrival of an animal, they should be brought to the owner's attention and placed on the animal's record. This may prevent an embarrassing situation at a later date.

It is without question that in a successful breeding operation there are two very necessary things required, a mare and a stallion. One is just as important as the other. Since the physiology of reproduction in horses has been discussed with you, we will start with trying to determine the time that the mare should be bred. The time of breeding is very important in operations that are practicing hand breeding, "corral" breeding or artificial insemination. If a breeding program simply consists of turning the stallion in with a band of mares and leaving him, this timing is taken care of by the stallion. Several methods of determining this time of breeding are teasing, speculum examination, and ovary palpation. These methods require a person with training, skill, and experience.

Teasing is probably the most accurate and significant procedure of the three. A successful breeding operation cannot be carried on without a good system of teasing, close observation during teasing, and good records of the results. Teasing is the process of taking a mare to a teaser animal, a stud or gelding usually, and observing her response. The length of her estrus cycle and estrus period can be determined by the response. A mare that is in heat will try to back up to the stud, hold her tail up, "throw off" or urinate slightly, and "wink" or "blink" the vulva, while if not in heat she will fight, kick, and squeal at the teaser. With experience you will observe there are all sorts of variations between these two extremes. There are some mares which never seem to tease in but on palpation of the ovaries a follicle has developed and will ovulate. This is when the other methods, speculum exam and ovary palpation, are used.

The teasing procedure is done in many ways and there are advantages and disadvantages to all of them. The animals may be exposed to one another over a stall door, across a fence, across a teasing rail, in the field, or in a teasing chute. As I said before, the method is not as important as the observation. Most mares should be teased every other day until they start to tease in and then every day until they tease out. If the animal is bred she should continue to be teased every second or third day until she has passed over at least one cycle and preferably two.

Now we have a mare that has had a physical and breeding exam and her estrus period has been determined. The question that now may arise concerns whether she is "clean" or infected in regard to bacterial, mycotic, and viral contamination in her reproductive tract. This is determined by the process of cervical or uterine culture. At the present time a fairly accurate determination of bacterial and mycotic organisms present in the tract can be made. The best time to culture a mare is during her heat period because a sterile swab or instrument can be introduced into the uterus at this time. This swab is then taken to a laboratory where qualified people perform bacteriological procedures for culture, isolation, identification, and if requested an antibiotic sensitivity on any organisms present. It should be emphasized that the utmost sterility and sanitation must be observed if any significant results are to be obtained. The pros and cons of culturing will be discussed during the lecture.

As we stated before, the actual breeding may be done using several different systems such as handbreeding, corral breeding, pasture breeding, or artificial insemination. With corral breeding the mare is turned with the stallion when she is in heat and after being bred she is taken away. This may be done several times during her heat period. This method is more risky for the animals, with less labor and risk for the human. In hand breeding or artificial insemination the mare is restrained in a breeding chute, or with hobbles, or by tying up a front leg. Then the stud is brought to the mare and allowed to breed her and then taken away or the mare is inseminated artificially. With this system the stud must be manageable and a competent stud manager is invaluable. If artificial insemination is to be used with the present regulations and techniques, it is very important that the stud be able to be collected artificially. Pasture breeding systems rely on mother nature, chance, and luck. No attempt at sanitation can be made and the risk of injury to both the mare and stallion is greater than with the other systems. Needless to say, many times the results of this system are better than with the others. In many instances Mother Nature cannot be improved on.

The question of sanitation in the breeding operation is very important. It seems to increase in importance as the value of the animals involved increase, although it is just as important with a \$100 mare or stud as it is with one worth 10 or 20 times as much. Before breeding, the mare should have her tail wrapped with a clean sterile bandage or tail wrap, vulva and surrounding area washed thoroughly with mild soap and water, and then rinsed with clear water and dried. Just prior to this the mare should be teased in order for any material in the vagina to be expelled before the washing. After breeding the mare should be rinsed again and many times this is done with cold water. The cold water appears to cause the mare to contract the reproductive tract somewhat. While the mare is being cleaned up the stud can be teased lightly. This will cause an erection and protrusion of his penis from the sheath, at which time the penis can be washed and rinsed. A stud may react unfavorably the first few times this is done but he will get so he enjoys it. Be sure the water is not too hot or cold and also do not try and do this in an open area when the wind is blowing very hard. After breeding, the penis of the stud should be rinsed.

If artificial insemination is used, these same procedures should be used on the mare and also on the stud whether he is collected with an artificial vagina or some other method. These procedures can be followed with a few exceptions in corral breeding systems.

With hand breeding the stud should be made to approach the mare quietly. This is simply a matter of training and letting the stud know who is boss. I will admit this is difficult with many studs and may require a lot of work and patience but an unmanageable stud should not have a place in any breeding operation. He should not be allowed to mount until the penis is erect. If the penis has to be guided into the vulva and vagina, do this with a guiding motion and not by grabbing the penis. Many times if the penis is grabbed the stud will dismount and lose the erection. Also be careful that he does not strike you with his front feet when he mounts and also when he dismounts. After he enters the mare he should be observed for the presence or absence of ejaculation. This can be determined by a characteristic flagging of his tail and a throbbing sensation which can be felt at the base of his penis. When the stud dismounts, move him away from the mare's hindquarters immediately. This reduces the possibility of either of you getting kicked. If the stud has a tendency to bite the mare's withers, a muzzle may be necessary.

The number of services per heat period will vary with different breeding operations. The breed of horse involved, the value of the stud, the size of the stallion's book, and the system of mating used are a few of the factors which determine the number of services per heat. If the stallion is allowed more than one service during a heat period, he should breed the mare at least every other day. We will cover some of these factors in more detail during the discussion period.

In any discussion of breeding the question of breeding at the "foal heat" or "9-day heat" must be considered. This is the heat period which occurs around the eighth to fourteenth day after foaling. There are many opinions on this question and while some recommend it, others condemn it. It is recommended only if the foaling was without difficulty, the foal normal, placenta weight was 12-14 lbs. and was expelled within 4 hours, and there has been no discharge from the mare's reproductive tract. Even if these conditions can be met there

is still a low conception rate and an increased abortion rate with "foal heat" breeding. Many times economics, time of the year, and other factors make the breeding justify the risks.

In the fall and winter months many of the problem mares of the preceding spring which are barren or not in foal are examined. If the cause of their infertility can be determined, treatment is started if necessary, with the purpose of having them in breeding condition early the next breeding season. Mares can be classified into several groups: foaling mares, pregnant mares, maiden mares and barren mares.

Before discussing pregnancy determinations and stallion care, a list of some of the conditions which may cause breeding problems in mares are listed for your information. No attempt will be made to discuss these conditions in detail because of our time element.

1. Abnormal estrus
 - a) long heat cycles
 - b) short heat cycles
 - c) irregular estrus
 - d) anestrus
2. Nymphomania
3. Inflammation and infection
 - a) pneumovagina
 - b) difficult foaling
 - c) retained placenta
 - d) microorganisms
4. Abortion
 - a) embryonic resorption
 - b) foal heat breeding
 - c) bacterial
 - d) viral
 - e) hormonal
 - f) twins

Two main methods of determining pregnancy in a mare other than a cessation of heat are rectal palpation of the uterus and a biological test using the blood serum of the mare. Rectal examinations for pregnancy are done with good accuracy between 40-60 days after breeding, by persons with the necessary skill and experience. An unskilled person can do considerable damage to a horse and could cause an abortion to occur with rough, faulty palpation.

The importance of the stallion in a breeding operation is very evident and he is just as important as the mare. With a properly managed and handled stallion there are not as many problems as there are with mares. If he is kept in a box stall it should be roomy, well lighted, and ventilated. He should be allowed to exercise every day either running loose in a paddock, on a lead line, hitched to a jog cart or riddled. Good grooming and proper nutrition is a must, not only for the stallion but also for the mare.

The number of mares offered a stud during a season varies with the age of the stud. With hand breeding the following guide can be used: 2 year old, 10-15 mares; 3 year old, 20-40 mares; 4 year old, 30-60; mature horse, 80-100. As a general rule a stallion should not be used more than once a day and if it is necessary to use him more often, he should be allowed sufficient rest time after the extra breeding.

A semen examination should be done before the start of the breeding season and at least every three weeks during the season. In many instances if there is a microscope present the semen is checked every day. This is done by examining a sample of dismount semen; this is the semen which can be collected after the stallion dismounts from the mare. If the sample looks good you can feel safe but if it is poor, do not jump to any conclusions. A bad dismount sample does not mean the stallion has poor semen. Many times with a dismount sample you get the poorest fraction of the ejaculation.

Some of the causes of lack of libido and/or semen quality in the stallion are:

1. hormonal deficiency
2. nutritional deficiency
3. localized infection and/or inflammation
4. systemic or generalized infection
5. masturbation

Masturbation is quite a problem with some stallions and to correct this condition stallion rings or cages are necessary. These devices should be of the proper size and applied properly in order to control this condition and not cause other damage.

The end result of a good breeding program is foaling. This is the time when the results of a year's planning, work, and waiting is rewarded. One of the first things to remember is not to get in a hurry, have patience, and do not be too eager to help. Provide the mare with a large, dry, well lighted stall but don't necessarily keep all the lights on. If the mare has been sutured, be sure she has been opened up. The mare should have her tail wrapped and her rear quarters washed.

The normal presentation of the foal is front feet first, with heels down, and nose close behind. If there is anything different than this, call for competent professional help immediately. If the foal is coming normal, don't immediately grab the feet and pull, but be sure the nostrils are clear and then let it alone. After the foal arrives, allow the mare and foal to lie quietly. Do not break the umbilical cord. Watch to be sure the mare does not injure the foal when she first arises.

Apply iodine to the umbilical stump of the foal when the cord breaks. The foal should be up within 30 minutes and nursing in 1 hour. Be sure the foal nurses because the first milk or colostrum is very important. In some cases the foals are given tetanus antitoxin, antibiotics, and an enema in the first 24 hours.

The mare should clean or pass all of the placenta within 30 minutes to one hour. If she retains the placenta more than 8 hours, call your veterinarian because a retained placenta can cause serious troubles in a mare. Weigh the placenta and save it for your veterinarian to examine. It should weigh 21-14 pounds.

Give the mare a warm bran mash and some lukewarm water. Take about 7-10 days to get the mare on full feed. Examine the mammary glands several times a day for any swelling or unusual heat. Watch the mare for signs of colic.

Be sure the foal continues to nurse, have bowel movements, and is active and alert.

PACKING DEMONSTRATION

T. N. Meacham
Animal Science Department
VPI & SU

I. Packing Equipment

A. Pack Animals

1. Horses - mules.
2. 850-1100 lbs. - 14-14.3 hands.
Stocky conformation with good withers.
3. Broke - lead well and tie up well. No kickers.

B. Pack Saddles

1. Sawbuck type most common.
2. Well constructed with sound rigging.
3. Cinches in good condition and clean.

C. Pads for Pack Saddles

1. Use good pads and use enough. Must be large enough to cover rib area.
2. Must be clean and wrinkle-proof.

D. Panniers, Pack Boxes and Slings

1. Boxes
 - a. Protect crushable items.
 - b. With shelves, keep materials organized and easy to find in camp.
 - c. Restricted as to what will fit in box.
2. Panniers or Bags
 - a. More flexible; can handle odd-shaped materials.
 - b. Less protection for breakables.
 - c. Less chance of damage to equipment when hitting trees, etc.
3. Slings
 - a. Used for bedrolls, tents and other large items that need to be carried.
 - b. Not used as much as bags or boxes.

E. Other Equipment

1. Canvas cover (manti)
 - a. Stout canvas (no plastic)
 - b. Waterproof

2. Lash cinch and lash rope
 - a. Special cinch with ring on one end and hook on the other.
 - b. Lash rope - 3/8-1/2-inch rope/40 feet long.
 - c. Good rope with no knots.
 - d. Lash cinch and rope used to secure the pack boxes or bags and other equipment to the pack saddle.
3. Strong halters with extra-long lead ropes, 10-12 feet long.
4. Hobbles or picket rope.

II. What and how much to pack??

A. Difficult to answer specifically.

1. If you have plenty of pack animals and pack outfits available, you can travel first class, complete with large tents, cots, and stoves. If you have a limited number of pack animals, you have to be more selective in what you take. Ideally, for a week's pack trip, a pack animal for each person is nice. You can get along, however, with one pack animal for every two people. For a 2-3-day trip, one animal for every 3 people will get the job done.
2. Each horse can carry a 150-200-lb. load. We need to keep in mind that on a three day ride, we will be hauling initially about 20 lbs. of grain for every horse (5-10 lbs./horse/day). This means that, for a group of 5 horses, 100 lbs. of grain is needed. This is one-half the load for one horse. Distance traveled/day, type of terrain (mountainous, flat), and length of trip all influence how much of a load the horse can handle.

B. Food

1. Don't underestimate the amount of food needed. The trip is no fun if you are hungry.
2. Try to take food that will not spoil or crush. Dried beans, rice, dried fruit, biscuit or pancake mix are examples. Canned meats, stews, etc., are good, but are heavy if you have a lot. Frozen foods will last about 24 hours if insulated and handled carefully. There is available now a wide assortment of freeze-dried foods that are very light and keep well but are expensive. If weight is critical, they should be considered.
3. Plan the menu carefully, so you take only what is needed. If possible, consult with the people ahead of time in case there are any dietary problems to take into account. The old-timers always figured on one extra person, in case you were delayed, had company, etc.

C. Equipment

1. Cooking.
 - a. Pots, pans, utensils, grate, plates, cups. The aluminum cook kits that nest together are good. If there is room, cast iron frying pans and griddles are preferred.

- b. Paper towels and aluminum foil are convenient.
- c. Soap and scouring pads are essential.

2. Other Equipment

- a. Tarps to cover tack and equipment.
- b. Light axe, folding shovel and saw are needed.
- c. Tents, if space is available.
- d. Light rope (haystring, nylon cord, etc.)
- e. Lanterns are sure nice to have.
- f. A first aid kit for people and for horses, along with spare horseshoes and tools should be included for the group.

3. Personal Items

- a. Bed rolls, clothes, flashlights, pocket knives, cameras, etc.
- b. If sufficient numbers of pack horses are not available, these can be carried in saddle bags on saddle horses. Be careful about the weight and bulk.

III. How to pack.

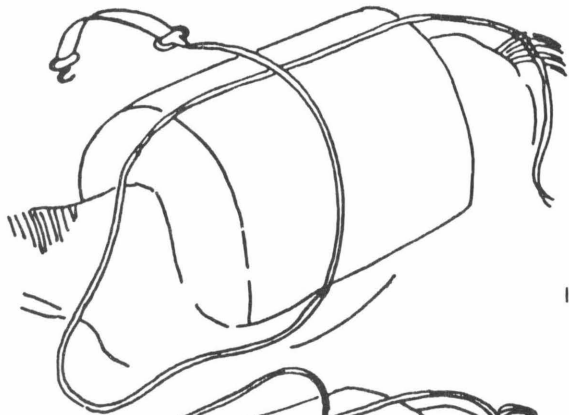
A. Major points to remember.

- 1. Balance the total weight of each bag or box. Balance the weight front to rear in each bag, also.
- 2. Keep the heavy items in the bottom of the pack, to get the center of gravity as low as possible.
- 3. The basic idea is to keep the pack from swaying when the animal is in motion.
- 4. Make sure the pack saddle is cinched tightly before loading.
- 5. Be careful that no sharp objects are packed against the side of the horse.

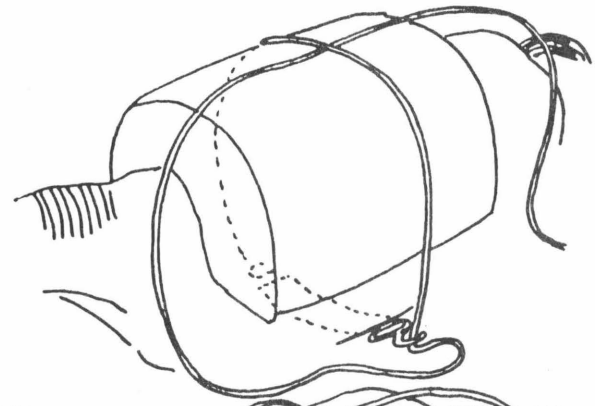
B. Procedures

- 1. Lay out supplies and equipment to be packed.
- 2. Pack both bags or boxes at the same time, placing items of equal weight in each. Place heavy items (canned goods, etc.) in the bottom. Small items can be packed in small cardboard boxes prior to loading.
- 3. When the bags or boxes are packed, weigh them to see if the loaded equally. Place them on the pack saddle.
- 4. The top load is packed on top of the bags or boxes. This load should be light, bulky items (sleeping bags, clothing, extra canvas or tents). This load should be balanced also.
- 5. Place the canvas pack over the load.

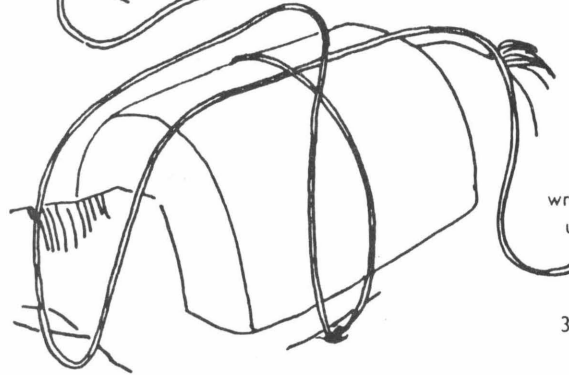
6. With the lash rope and clinch, tie the load down securely. A diamond hitch is used because it will allow some movement of the load without becoming loose. Directions for tying this hitch are shown in the attached series of diagrams.
 7. Once the pack is secured, the shovel or axe is tied on the outside. Initially, this is tied in the middle of the pack. After traveling a short distance, it may be necessary to tie this to one side or the other, so that the load rides square on the animal's back.
 8. The load must be balanced. If it is not, it will shift and also put uneven pressure on the animal's back. The only solution is to repack the load and get it balanced properly.
- C. The pack horse is carrying "dead weight", in contrast to the saddle horse with a rider. This dead weight, of course, is harder on the pack animal. The packs should be loaded the last thing before leaving camp and unloaded the first thing at the next camp.



1

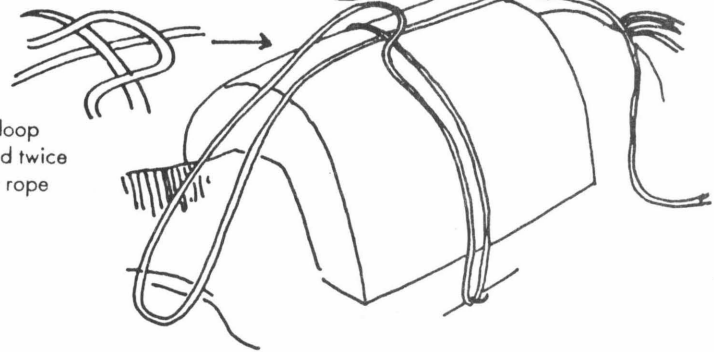


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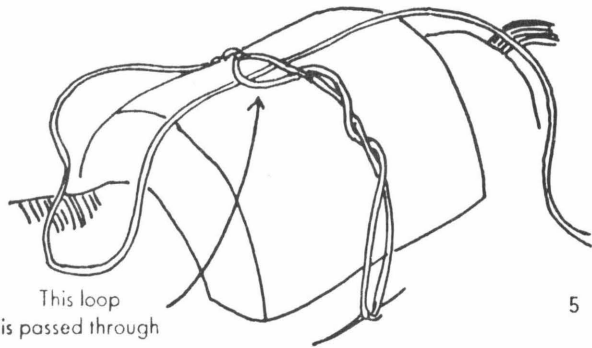


3

This loop
wrapped twice
under rope

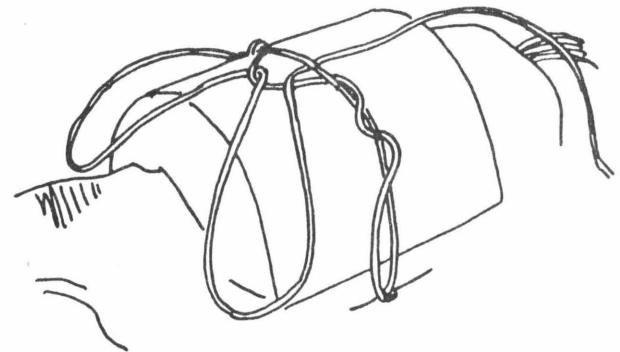


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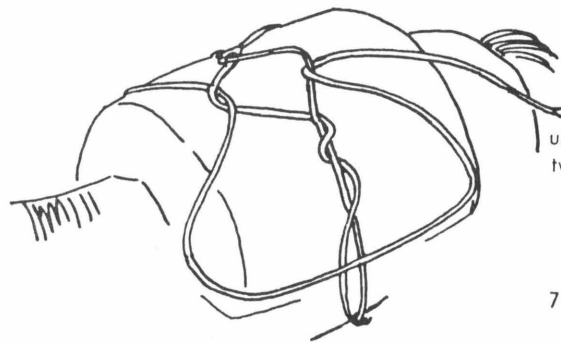


5

This loop
is passed through



6



7

This end
pulled tight
and tied
under pack with
two half hitches



8

The diamond hitch

ESTABLISHING AND MAINTAINING HORSE PASTURES

by Dr. Harlan E. White
Extension Specialist, Forages, VPI&SU

Pastures furnish horses and ponies with high quality, nutritious feed at a relatively low cost and help to maintain healthy animals by furnishing exercise, sunshine and fresh air.

Mature horses, and younger horses (perhaps well-developed yearlings) can be maintained on good pasture with little or no grain during a normal pasture season. Young animals, those doing medium to heavy work, or those being prepared for shows and contests need grain and hay along with pasture.

Virginia has the capability to produce high quality pastures and has the reputation for doing so. Total moisture availability is good, although poor summer distribution sometimes causes dry periods. Productive soils are also available. To take advantage of these pasture potentials, proper management is necessary.

This paper describes the plants best suited for horse pastures in Virginia and how to establish and manage them for greatest utilization. Pastures are described for each season so the horseman may have grazing available throughout most of the year.

Cool Season Permanent Pastures

The "cool season" perennial grasses and legumes do not have to be seeded each year and are most commonly used for horse pastures in Virginia. Such cool season plants as Kentucky bluegrass, tall fescue, orchardgrass, ladino clover, and white clover make most of their growth during spring and fall.

Brief descriptions of the commonly grown cool-season pasture plants will help in their identification and management:

Kentucky bluegrass - A low growing sod-forming grass. Its leaves are narrow and will reach a length of 7" with tips shaped like the bow of a boat. It has underground rhizomes (stems) which enable it to "heal" over areas where its turf becomes torn. This favorite grass for horses is well adapted for pastures in the Northern Piedmont and areas west of the Blue Ridge Mountains.

Tall fescue - A tall grass which forms a dense long-lasting sod. It is somewhat coarse in texture and has a dark, shiny green color. Its leaves are about 1/4" wide at the base and taper to a point. Tall fescue is less palatable than most forage grasses, but is adapted to a wider range of soil conditions in Virginia than any other grass in common use. It is fairly drought tolerant and is especially useful for heavily travelled areas or exercise lots.

Orchardgrass - A tall grass with a clump-type growth. It is widely adapted in Virginia, high in feed value, high yielding, and recovers well after cutting or grazing. Its leaves are dull green in color and are folded at the base. It grows very well with ladino clover. Orchardgrass does not persist as well as tall fescue in eastern and southern Virginia, and should be considered a semi-permanent pasture in these areas.

White clover - A low growing perennial legume common to all areas of Virginia. The leaves consist of 3 heart-shaped leaflets. The plant is shallow rooted and does best on fertile soils with good moisture holding capacity. It persists well under close grazing and because it is low growing, does very well with Kentucky bluegrass.

Ladino clover - A giant variety of white clover which resembles white clover in every respect except that it is much larger. It is used with the tall pasture grasses such as orchardgrass and tall fescue. Ladino is adapted to all areas of Virginia but does best on fertile soils with good water holding capacity.

Permanent Cool Season Mixture No. 1

Seeding Rate		
Mixture	Lbs./A	Region of Adaptation
Orchardgrass	3- 5	Northern Piedmont and West of Blue Ridge
Kentucky bluegrass	10-15	
White clover	1- 3	

This mixture may be grazed either continuously or rotationally. Under continuous grazing it will become a bluegrass-white clover pasture. The productive period of orchardgrass will be increased by rotational grazing, or grazing down to 1-1/2" to 2", then removing the horses to allow recovery growth to 5" to 10" before grazing again.

Certified seed of the Va. 70, Jackson, or Potomac varieties is recommended. High quality seed of Kentucky bluegrass should also be used.

Spring seedings should be sown from March 1 to April 15 and fall seedings should be made after the first good rain in August, but not later than September 15.

Permanent Cool Season Mixture No. 2

Seeding Rate		
Mixture	Lbs./A	Region of Adaptation
Ladino clover or white clover	1- 3	All sections of the state
Tall fescue	10-14	

This mixture is widely adapted and is suitable for moderately to poorly drained soils, as well as moderately droughty soils. Grazing may be continuous if the pasture is not overgrazed to the point where the plants are kept grazed down closer than 2".

Certified seed of Tillman ladino clover or high quality white clover seed should be used. Certified Kentucky 31 is the recommended variety of tall fescue.

Seeding dates are the same as for permanent cool season mixture no. 1.

State Region	Spring Seeding	Fall Seeding
Northern Piedmont and West of Blue Ridge	March 1 to April 15	After 1st good rain in August to Sept. 15
Middle and Southern Piedmont	February 1 to April 1	After 1st good rain in August to Sept. 15
Eastern Virginia	February 1 to March 15	After 1st good rain in August to Oct. 15

Permanent Cool Season Mixture No. 3

<u>Mixture</u>	<u>Lbs./A</u>	<u>Region of Adaptation</u>
Ladino clover or white clover	1- 3	All sections of the state though it does not persist in Eastern and Southern Virginia
Orchardgrass	8-12	

This mixture provides high quality pasture which yields very well. It is only moderately drought tolerant and should be placed on well-drained soils. For best utilization, graze down to from 1-1/2" to 2", then remove the horses to allow recovery to 5" - 10" before grazing again. Close, continuous grazing will reduce the stand and yield. Excess spring growth may be cut for hay in the early heading stage of maturity.

Certified seed of Tillman ladino or high quality white clover seed should be used. Use Certified Va. 70, Jackson or Potomac.

Seeding dates are the same as for permanent cool season mixture no. 2.

Management of Cool Season Permanent Pastures

Should the existing permanent pasture be completely reseeded?

Often an older perennial pasture can be "renovated" or reseeded without plowing the old sod. If the existing pasture has a 50% stand of desirable plants, it can be improved by liming and fertilizing according to soil test, disking lightly, and seeding grasses or legumes alone or in combinations. Seed into an existing closely grazed or clipped stand in late winter. The pasture should be cultipacked or rolled after seeding. If there is less than half a stand of desirable grasses and legumes, it is best to prepare a new seedbed and reseed.

Seedbed Preparation

For spring seedings on areas not subject to erosion, it is often desirable to plow heavy soils the previous fall to allow freezing and thawing to break apart the larger clods. For fall seedings, plow 3-4 weeks before the intended seeding date to allow the soil to absorb moisture and become firm before final seedbed preparation. Plowing in advance will often allow many weed seeds to germinate before the pasture mixture is seeded.

Just prior to seeding, disk lightly to kill the weed seedlings and loosen the soil for seed coverage. The actual seeding may be done with a cultipacker-seeder, with a cyclone-type seeder followed by a cultipacker, or with a grain drill. Do not cover the seed deeper than 1/4" in heavy soils and 1/2" in sandy soils. Always inoculate the clover seed just prior to seeding to ensure that it will have the ability to fix nitrogen.

Fertilizer Requirements for New Seedings

Take a soil sample so the soil can be tested to determine how much fertilizer is needed. Soil boxes, record sheets, and advice on how to take the samples are available from any Extension Agent. Ask the agent to send the soil sample to the VPI&SU Agronomy Department to be tested.

On soils low in fertility and pH according to soil test results, apply 1/2 the needed lime before plowing and plow it down. The remainder should be disked

in after the land is plowed. In the absence of a soil test, apply up to 50 lbs. of N, 50 to 200 lbs. of P_2O_5 , and 50 to 120 lbs. of K_2O per acre. Nitrogen should not be necessary, except on infertile soils.

Grazing Management

Do not allow new seedings to be grazed until the plants have become well established. The root systems should be well developed to reduce damage to the stand by sharp hooves. Animals galloping on soft, new pastures will cause considerable damage.

Regulate grazing to maintain clover in the stand. If the clover is thinning, keep the pasture grazed or clipped to reduce grass competition and to give the clover stand an opportunity to thicken.

Never allow pastures to become overgrazed. Before pasture plants are "eaten into the ground" remove the animals to another area. Keeping pastures grazed down continuously below 2" weakens and thins the stand, allowing weeds to invade. This reduces productivity and quality of the pasture.

A horse requires a larger pasture area than does a beef or dairy animal, since exercise is important for horses on pastures. Such light stocking rates often cause undergrazing and wasted pasture forage. Undergrazing is often as great a problem as overgrazing.

Undergrazed areas of the pasture which have overmature growth with seed heads present should be clipped in the spring. A second clipping may be necessary in late summer. Removal of this mature growth will allow the plants to produce new higher quality forage.

Piles of manure droppings contribute to uneven grazing, since horses avoid these spots. The plants in these areas make rapid growth due to the added fertility, producing lush forage which is often wasted. Scattering the manure periodically during the year will reduce this problem and the parasite population. This can be done by pulling a spike-tooth harrow, chain, or similar implement across the pasture. A good time to do this is shortly after clipping the pasture.

There are advantages in grazing different types of livestock on the pastures of horse farms. Horses tend to graze only particular areas in the pasture, while cattle and sheep graze more at random. A combination of livestock keeps pastures grazed more uniformly and helps to maintain them in the high-quality leafy stage of growth. Such a combination not only makes more efficient use of the pastures, but offers additional income. Beef animals and horses may be stocked together in the same field or beef animals may follow horses in the rotation of pastures on the farm.

Plan to remove the animals from pastures during very wet soil conditions, since horses can damage even a well-established pasture sod considerably by running, stopping, and turning sharply. This rips the sod up, leaving bare areas and often holes.

Fertilization to Maintain Productive Cool Season Perennial Pastures

Soil tests should be made every 2-3 years to determine the fertility status of the soil. Based on the results of this soil test the Extension Agent will make recommendations on the amount of fertilizer to apply.

As a general rule, the cool season mixtures of grass and clover should be fertilized each year with 50-140 lbs. of P_2O_5 and 120-200 lbs. of K_2O per acre. If the grass stand is thinning include 25-50 lbs. of nitrogen in this application.

The fertilization rate is also regulated by the need for grazing. Pastures to be heavily stocked should be fertilized at the higher application levels of the suggested range. If additional grazing is not needed, fertilize at the lower level, but apply enough to maintain the stand of desirable plants.

The time of year to apply fertilizer will also depend on the needs of the individual farm. In most instances, it is desirable to fertilize part of the pastures in the early spring (February or March) and part of them in the early fall (August or September). Since these cool season grasses make most of their growth during spring and fall, the greatest response from fertilizer is obtained at these times. By dividing the pastures as to time of fertilization, part of the pastures will show the growth response in the fall and part in the spring.

It is desirable to maintain either ladino and/or common white clover in these cool season pastures. Clover adds to the nutritive value of the pasture and furnishes nitrogen to the grasses growing with it. If the clover is thinning, be sure the K_2O level in the soil is adequate. When potash is limiting, grasses take most of the available supply, often causing the clover to be starved out.

Weeds lower the feed value of the pasture and compete with the desirable plants for water, light, and nutrients. In addition, some of them may be harmful to animals.

Proper fertilization and grazing management are the best weed control measures. If weeds still invade, clipping before the weeds form seeds is helpful. Selective chemicals are also available to kill many of the pasture weeds. Consult with your Extension Agent for the latest recommended chemical control for the particular problem weeds.

BERMUDAGRASS FOR SUMMER PERENNIAL PASTURES

Although the cool season pastures furnish abundant grazing in the spring and fall, they are usually low in productivity during the summer months. Bermudagrass is a warm-season perennial grass that does not break dormancy and begin to grow in the spring until the cool-season plants have already been growing for several weeks. Once the soil warms up in the late spring and early summer, bermudagrass grows rapidly and produces excellent pasture during the hot, often dry, summer months. The first frost in the fall kills the tops back, but by then the cool season pastures are growing vigorously again. Utilizing the growth habits of both the cool-season and warm-season grasses assures grazing from spring to early winter.

Bermudagrass prefers an open field with a southern exposure, and a light to medium texture soil. These pastures may be grazed continuously but for highest yields they should be grazed rotationally--down to 2" then allowed to recover to 6-12". Always graze the plants down before seedheads develop.

Several strains of common bermudagrass grow wild on farms throughout Piedmont and Eastern Virginia. Under proper liming, fertilization, and management, these strains will produce high yields.

Midland and Coastal are the 2 hybrid varieties recommended for planting new stands, since they are generally higher yielding than Common. Midland is the more cold-hardy, and is adapted in most regions of the state at low and medium

altitudes. Coastal is less cold-hardy but does well in Southeastern Virginia. Since neither of these hybrids produces live seed, new stands must be established by planting the underground stems or rhizomes of the grass. These plant portions used for establishment are commonly called "Sprigs".

The sprigs should be planted between May 15 and June 15 in a prepared seedbed free of Common bermudagrass plants. Plant freshly dug, 6-10" long sprigs every 19-30" in rows 3' to 5' apart. This spacing requires 12-20 bushels of sprigs per acre. Place one end of the spring 3-4" in the ground with the other end protruding slightly above the soil. Firm the soil around the sprig. The most effective way to plant sprigs is with a specially built planter. However, they may also broadcast on the soil surface and disked in.

Have the soil tested to determine lime and fertilizer needs. Apply lime as needed to bring the pH to 6.0-6.5 and disk into the soil.

In the absence of a soil test, disk in 50-80 lbs. each of P_2O_5 and K_2O per acre during seedbed preparation. Before planting, apply 30-40 lbs. of N and 30-40 lbs. each of P_2O_5 and K_2O per acre in the row. After the stand is assured, broadcast 40-60 lbs. per acre of actual N, 30-40 days following planting, but not later than August 15.

Topdress bermudagrass annually with a total of 50-200 lbs. of N, and 30-60 lbs. each of P_2O_5 and K_2O per acre. The higher N rates will promote high grass yields when more grazing is needed. Apply a complete fertilizer in March or April. Additional N applications of 30-50 lbs. each may be applied, but usually not more frequently than every 45-60 days during the growing season. The last N application should be made by August 15.

Warning: Sudangrass, sorghums, or sorghum-sudangrass hybrids are summer annual grasses which are not recommended for grazing. Research in Texas indicates that horses or ponies grazing these grasses or eating them as green chop may develop a sometimes fatal condition called cystitis syndrome. Hay from these grasses, properly cured and stored, can be safely fed to horses and ponies.

Winter Annual Pastures

The small grains such as rye and barley furnish grazing in the late fall, early winter, and early spring to complete the 12-month grazing program. Annual ryegrass is used in a similar manner. These are not the primary horse pastures but supply additional grazing during the months when the cool season permanent grasses are not actively growing.

<u>Small Grain Pasture*</u>	<u>Seeding Rate</u> (Bu./A)	<u>Area of Adaptation</u>
Rye or	2-3	All regions of the state
Barley or	2-3	
Mixture	2-4	

*Wheat and oats may also be grazed, but usually produce less total grazing.

The small grains are widely adapted and do well on soils with moderate drainage, fertility, and pH. They may be grazed continuously in fall, early winter, and early spring. The small grains do not form a tight sod. To avoid damage to the soil and plants, they should not be grazed while the soil is wet.

Annual ryegrass also provides late fall and spring grazing. It is adapted to all regions of the state and should be seeded at 20-30 lbs. of seed per acre.

Abruzzi is a variety of rye recommended which does well. Any of the barley grain varieties recommended for the region are satisfactory. Seeding of all the winter annuals should be done between August 15 and November 1.

Fertilize with 60 to 80 lbs. each of N, P_2O_5 , and K_2O per acre at the time of seeding.

HAYS FOR HORSES

by Dr. Harlan E. White
Extension Specialist, Forages, VPI&SU

KNOW WHAT TO LOOK FOR IN HAY QUALITY!

As everyone knows who has attempted to produce or buy hay, high quality is often elusive and difficult to obtain. There are so many variables involved in producing hay that it is not surprising that such a wide range in quality exists. Understanding the factors involved in producing hay and knowing how to evaluate it will help you to provide high quality hay for your animals.

GENERAL PRODUCTION FACTORS AFFECTING HAY QUALITY

1. Species of Plants Cured for Hay - Legume hay such as alfalfa is generally higher in protein and minerals than grass hay. Red clover is another legume commonly used for hay but is often dustier than alfalfa and lacks alfalfa's green color. Grasses such as orchard-grass and timothy also make high quality hay. A mixture of legumes and grass is often used. Most of the commonly grown leafy grasses and legumes make high quality hay.

Weeds, or undesirable plants, lower hay quality by adding woody material low in acceptability and digestibility, as well as contributing bad tastes or odors.
2. Growing Conditions - Hay grown during a drought may be stunted and less leafy than that grown with adequate moisture. Excessive moisture, on the other hand, often produces diseases which attack the leaves and may reduce leafiness. Plants grown under adequate fertility have a higher nutrient content and are more leafy and lower in fiber than those grown under low fertility.
3. Stage of Plant Growth at the Time of Harvest - As grasses and legumes advance from the vegetative to the reproductive stage, they become progressively lower in protein content, digestibility, and acceptability to livestock. This is the direct result of increased stemminess and fewer leaves, resulting in a higher fiber content. Legumes should generally be harvested when beginning to show a few flowers. Grasses should be harvested in spring when seed heads are beginning to appear.
4. Curing Conditions - If the hay is allowed to dry or "cure" in the field, rains and sunlight often reduce quality. Rains beat leaves from the legumes, leach nutrients from the leaves, and pack down mowed material to prevent proper drying. The crop thus soaked often begins to deteriorate before drying occurs. The sun further bleaches the leaves, resulting in losses of Vitamin A and in the "bleached" appearance of such material.

Artificially dried hay has the advantage of not having to remain in the field until dry. Thus, it has less bleaching and loss of leaves.

Hay stored before being properly dried will usually develop a musty, moldy odor. The molds present may be toxic to animals.

5. Harvesting Procedures - Hay allowed to completely dry in the field before raking into windrows for baling loses many brittle leaves in the raking process. Ideally, the stems should be crushed or "conditioned" at the time of mowing for more rapid drying and left in the windrow for drying. This avoids the necessity for raking which often shatters many leaves and mixes dust and dirt with the hay.

FACTORS TO LOOK FOR IN HIGH QUALITY HAY

1. Species of Plants. Determine what plants are in the bale and the relative proportions of each. Hay with a high percentage of legume is usually higher in feed value than pure grass hay.
2. Stage of Maturity of the Plants When Cut. No mature seed should be present. Plants should not be in full bloom.
3. Percentage of Leaves Present. Leaves are the part of the plant of highest quality, so high quality hay should contain a high proportion of leaves relative to stems.
4. Percentage of Green Color Present. A bright green color indicates a minimum of bleaching and leaching losses of vitamins and nutrients.
5. Aroma and Fragrance. Moldy, dusty smells are undesirable. Should have clean, "crop" odor.
6. Stemminess. Large and numerous stems are low in acceptability and quality.
7. Amount of Foreign Material Present. Such items are stubble, weeds, sticks, dirt, etc.

HAVE YOUR HAY ANALYZED!

A great deal can be learned about the quality of hay by physically evaluating it on the basis of the above factors. However, the only sure way to know its actual feed value and how much hay you need to feed your animals is to have it tested chemically to determine its nutrient content.

The VPI&SU Forage Testing Program is a free service which you are encouraged to take full advantage of. The VPI&SU Leaflet, MA-15, describes the procedure for sampling and mailing samples to the laboratory.

FORAGE TESTING AND PROPER NUTRITION

Scott Carr

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Proper feeding of horses need not be as difficult nor mysterious as some feeders would have you believe. The requirements for adequate nutrition are in general the same as for other large animals, namely: air, water, minerals, vitamins, protein, and energy. In addition to supplying an available source of the above, the relationships of one to another or what nutritionists often refer to as "balance" is just as important as the actual amount fed. Assuming that water is clean and plentiful and that the horse in question isn't required to breath something that he can see, then the ration should supply protein, energy, vitamins and minerals. The "how much" and "what" is how forage testing can help.

Feed analysis will never replace the judgement of the feeder. It may improve the degree of judgement, but it cannot replace it entirely. Among the decisions or "judgements" that the feeder must make are the activity or amount of energy expended and an allowance for the temperment of the animal. Other factors affecting nutrient requirements are size, pregnancy, and stage of development or age, but these are not difficult to quantify in terms of feed required.

The degree of activity is difficult to establish in terms of meeting nutrient requirements. For example, when a horse is worked at a trot or canter, the energy required is estimated to be approximately 10 times greater than that required for walking. Increasing the pace to a gallop increases this estimate to 48 times more energy than walking. Compound this with the weight of the mount, terrain, season, and frequency of the activity or work, and it is apparent that the judgement of the feeder will not be replaced by a feeding chart in the near future.

The area where feed analysis can benefit the feeding program is to provide reliable estimates of the energy and protein availability in feeds, especially forages. The concern for forages is due to the larger variation in energy (TDN) and protein found in forages that appear similar in texture, color, and composition. This information, properly applied, can remove much of the guesswork for meeting the nutrient requirements while preventing a big problem with pleasure horses, namely over-feeding.

From a practical approach to feeding, the major questions concerning horse rations will involve:

1. Amount of protein and its digestibility.
2. The availability of energy and the regulation of energy intake.
3. Supplying calcium, phosphorus, magnesium, iodine, and salt.
4. Whether vitamin supplements, primarily Vitamins A and D, are required.

The TDN and digestible protein values reported at the present time in the Virginia Tech Forage Testing Program are calculated primarily for cattle but can be used for horses as well. Many feeders prefer the digestible energy values to the older TDN procedure. To convert the TDN values reported by the Virginia testing program to DE values for horses, multiply the TDN by 1818 kcal DE.^{a/} For horses, digestible protein values can be estimated from the Virginia forage test results by the following equations:^{a/}

Grasses	$\%DP = 0.74 (\%CP) - 2.5$
Legumes	$\%DP = 0.95 (\%CP) - 5.2$
Forage-concentrate rations	$\%DP = 0.95 (\%CP) - 4.2$

Another area where forage testing will benefit the horse industry is in the area of purchased forages or forage substitutes. At present, hays are graded based on visible characteristics, including species, color, texture, leafiness, etc., which are only indirectly related to the feeding value. Efforts are underway to include some measures of feeding value, probably protein and fiber content, in the classification. This information can remove much of the guess work in ration formulation for horsemen depending entirely on purchased feeds.

^{a/} National Research Council - Nutrient Requirements of Horses, Number 6. 3rd revised ed., 1973.

BASIC HORSE NUTRITION

By: H. John Gerken, Jr.

I. Introduction

- A. Definition - Nutrition is the science that deals with food and the nutrients it contains in relation to the health of man and animals. A balanced ration for horses should provide nutrients required for body maintenance, growth, reproduction and work.
- B. Importance - The horse is an athlete that is expected to perform at peak efficiency for a long period of time. Good nutrition is essential to achieve this desired result. Failure to provide good nutrition can lead to disease, limited performance, injury, poor growth, reproductive failure, and economic loss.
- C. Nutrients - A nutrient is a food substance or group of substances of similar chemical composition which aid in the support of animal life. These may be grouped as energy sources (carbohydrates and fats), protein, vitamins, minerals, water and oxygen. These will be discussed further as follows:
 1. Carbohydrates are:
 - a. organic compounds containing carbon, hydrogen and oxygen.
 - b. the main compounds in plants, making up 50-75% of the dry matter in livestock feeds.
 - c. formed by photosynthesis in plants from H₂O from the soil, CO₂ from the air, and energy from the sun.
 - d. Function - Carbohydrates supply energy; are present in small amounts (about 1%) in animal body as glucose or glycogen.
 - e. Classification:
 - 1) Monosaccharides (simple sugars)
 - a) Examples
 - (1) Glucose - corn sugar
 - (2) Lactose - milk sugar
 - b) Glucose is a key energy compound containing six carbon atoms.
 - 2) Disaccharides - combination of two simple sugars.
 - a) Examples
 - (1) Table sugar (sucrose) - combination of glucose and fructose (very sweet).
 - (2) Milk sugar (lactose) - combination of glucose and galactose.
 - 3) Trisaccharides - combination of three simple sugars.
 - a) Example - raffinose, combination of galactose, glucose, fructose.
 - 4) Polysaccharides - combination of large numbers of simple sugars.
 - a) Examples
 - (1) Starch
 - (a) Main component in cereal grains such as corn, oats, barley.
 - (b) Highly digestible, rich in energy.
 - (c) Composed of combinations of glucose units, found in cereal grains.

(d) Glycogen, found in liver and muscle cells is made up of glucose, called "animal starch".

(2) Cellulose

(a) A major component of forages (such as hay or pasture).

(b) Also a combination of glucose units.

(c) Digested only by microorganisms, most prevalent organic compound on earth.

(d) Adds bulk, aids in maintaining muscle tone in digestive tract.

2. Lipids (Fats and Oils)

a. Commonly called fats. This group also includes oils, waxes, other compounds.

b. Fats are also made up of carbon, hydrogen and oxygen but have 2.25 times as much energy value as carbohydrates.

c. Classification:

1) Simple lipids

a) Fats are esters of 3 fatty acids and glycerol, an alcohol.

G - Fatty Acid

L

Y

C - Fatty Acid

E

R

O

L - Fatty Acid

(1) May be solid fat or oil depending on melting point and temperature.

(2) The functions of simple lipids are to supply energy and to furnish essential fatty acids.

b. Waxes - esters of fatty acids with alcohols other than glycerol. They are largely indigestible, and of little if any value to the animal.

2) Compound lipids - similar to simple lipids but contain additional groups on the molecule. Examples are:

a) Phospholipids such as lecithin are important in fat transport.

b) Glycolipids have a complex structure including a nitrogen - containing protein fraction.

3) Derived lipids - derived from simple or compound lipids. Examples are:

a) Fatty acids

b) Sterols - cholesterol, Vitamin D.

d. Sources - forages, grains, synthesis by the animal.

3. Protein

a. Structure - composed primarily of combinations of amino acids (building blocks).

b. Composition - contain carbon, hydrogen and oxygen plus nitrogen, may also contain sulfur; other elements.

- c. Kinds of protein - basic difference is the amino acid composition.
 - d. Protein quality - highest quality protein has amino acid composition similar to animal protein, i.e. egg protein, soybean meal, meat scraps.
 - e. Feed sources:
 - 1) Protein supplements of plant origin such as oil meals. Examples are soybean meal, linseed meal, peanut meal.
 - 2) Protein supplements of animal origin such as dried skim milk, fish meal, meat scraps. Not usually fed to horses because of expense but may be used in feeds for foals.
4. Vitamins - Specific complex organic compounds essential for normal growth and maintenance of animal life. Effective in small amounts, they function primarily as metabolic regulators in various chemical reactions within the animal.
- a. Fat soluble vitamins - soluble in fat solvents such as ether.
 - 1) Vitamins A, D, E, K.
 - b. Water soluble vitamins
 - 1) Vitamin C
 - 2) B-complex vitamins
 - Thiamine (B₁)
 - Riboflavin
 - Pyridoxine (B₆)
 - Niacin
 - Pantothenic acid
 - Biotin
 - Vitamin B₁₂ (cobalamine)
 - Folic acid
 - Choline
 - c. Requirements - usually present in sufficient quantity in high quality feeds or are synthesized by the animal. In some situations, supplementation, particularly of vitamins A and D, is required.
5. Minerals - Chemical elements that fulfill specific roles within the animal body.
- a. Primary functions
 - 1) Bone structure - calcium, phosphorus.
 - 2) Respiration - iron in hemoglobin.
 - 3) Enzyme function - magnesium, copper, zinc.
 - 4) Acid-base balance - sodium, chlorine.
 - 5) Osmotic relations - potassium.
 - 6) Hormone action - iodine.
 - b. Essential minerals
 - 1) Major minerals - required in relatively large amounts.

a) Calcium	e) Chlorine
b) Phosphorus	f) Potassium
c) Magnesium	g) Sulfur
d) Sodium	

- 2) Minor minerals - required in small or trace amounts.
 - a) Iron
 - b) Copper
 - c) Cobalt
 - d) Manganese
 - e) Zinc
 - f) Iodine
 - g) Fluorine, molybdenum, selenium may also be required in minute amounts.
 6. Water - Water is needed in large amounts for performance of essential body functions. An animal will die more quickly from lack of water than from lack of any other dietary essential.
 7. Oxygen - It is the most essential nutrient for sustaining life, however, our only major concern should be adequate stable ventilation.
- D. Proper nutrition of the horse is accomplished by providing a balanced ration of the nutrients required for body maintenance, growth, reproduction and work. Some factors to keep in mind are:
1. Animals differ considerably in the energy they use. Feed to maintain the desired body condition of each animal.
 2. Voluntary feed consumption of mature animals will be 1.5 to 2.5 percent of body weight, growing foals and lactating mares may eat up to 3 percent of their body weight.
 3. The amount of protein in a horse's ration depends on the age of the horse and the quality of forage consumed. Growing or lactating animals need more protein than those that are breeding or working.
 4. The need for vitamins depends on the forage fed. Vitamins A and D requirements will increase when poor quality, badly weathered or over mature hay is fed.
 5. Good pasture and free-choice minerals usually meet the nutrient requirements of mature horses.
 6. Salt is usually included in mineral mixtures to increase animal acceptability. Additional trace-mineralized salt should also be provided.

II. Anatomy and physiology of the digestive tract of the horse

A. Mouth, pharynx, esophagus

1. Mouth - the beginning of the alimentary canal starts with the lips which have a high degree of sensitivity and are well-adapted for the prehension of food and its retention in the mouth during mastication. The teeth are hard, bony organs of great importance for cutting, bruising and breaking down food. Salivary glands moisten dry feed with saliva preparing it for swallowing and initiating the process of digestion.

2. Pharynx - a muscular sac connecting the mouth with the esophagus. Its function is to transfer a bolus of food into the esophagus without permitting entry into the trachea or nose.
3. Esophagus - A muscular tube about 3 feet in length extending from the pharynx to the stomach.

B. Stomach

1. Anatomy - The stomach is a J-shaped muscular sac with a capacity of about 4 gallons. It has four distinct regions:
 - a. Esophageal region - next to the cardiac opening and making up 1/3 to 2/5 of the mucous surface of the stomach of the horse. This region contains no secretory glands.
 - b. Cardiac gland region - a narrow region that does not secrete digestive enzymes.
 - c. Fundus gland region - the largest area of the stomach, heavily supplied with glands which secrete hydrochloric acid and enzymes.
 - d. Pyloric gland region - the zone extending to the pylorus which is the valve-like structure leading to the small intestine.
2. Functions
 - a. Secretion of hydrochloric acid and enzymes (mainly pepsinogen).
 - b. The stomach serves as a reservoir, mixes the food and some digestion occurs there.
 - c. Because of its small capacity, food remains in the stomach of the horse relatively a short time although complete emptying may require 24 hours.

C. Small Intestine

1. Anatomy:
 - a. The small intestine is a tube about 70 feet in length extending from pyloric region of the stomach to the large intestine. Its width is about 1½ inches when undistended with feed. It is divided into three separate regions known as the duodenum, jejunum and ileum.
 - b. The interior surface is lined with mucous membrane which exhibits a velvety or pile-like appearance. This is due to immense number of projections called villi between which are glands which secrete digestive juices.
 - c. Ducts from the pancreas and liver deliver digestive secretions to the small intestine.
2. Function - digestion and absorption.
 - a. Most digestion occurs in the small intestine. Enzymes from the pancreas empty into the small intestine. These include trypsinogen, chymotrypsinogen, pancreatic lipase, pancreatic amylase and carboxypeptidase. Enzymes secreted by the small intestine include maltase, sucrase, enterokinase, dipeptidase and aminopeptidase. Bile supplied by the liver

aids in fat digestion.

- b. A rich capillary blood supply and a network of lymph vessels called lacteals which extend into the villi provide a means for the absorption of nutrients from the small intestine into the bloodstream.

D. Large Intestine

1. Anatomy:

- a. Consists of the caecum, great colon, small colon, rectum and anus with a total length of about 26 feet.
- b. Caecum - a greatly enlarged sac-like portion of the intestine about 4 feet long and with a capacity of about 8 gallons. It extends from high on the right flank forward and downward toward the diaphragm.
- c. Great colon - about 12 feet long, 10 inches in diameter and has a capacity of about 16 gallons.
- d. Small colon - The small colon is about 10-12 feet long and 3-4 inches in diameter with a capacity of about 6 gallons.
- e. Rectum and anus - These structures terminate the alimentary canal and function the storage and elimination of fecal material.

2. Function of the large intestine:

- a. Digestion of fiber (cellulose) by microorganisms occurs mainly in the caecum and great colon. Water absorption is the major function of the small colon.
- b. Vitamin and amino acid synthesis occurs as a result of microbial action. The B- vitamins and vitamin K are synthesized and are available to the animal. There is some question regarding the value of microbial protein synthesis to the horse since the means for digestion and absorption is lacking at this end of the alimentary canal.

E. Intestine Movements - These movements are brought about by the smooth muscles which line the digestive tract.

1. Functions:

- a. To mix ingesta with digestive juices.
- b. To bring digested products into contact with intestinal mucous membrane for absorption.
- c. To move the food mass down the digestive tract.
- d. To expel the residue from the tract.
- e. To assist the flow of blood and lymph through the vessels of the intestinal wall.

2. Disorders - If poor motility (movement) occurs, digestive disorders may result.

III Digestion, absorption and the role of nutrients within the animal body

- A. Digestion - Digestion consists of all the physical and chemical changes that take place in the preparation of feed for absorption. Chewing (or grinding) would increase the surface area so is in a

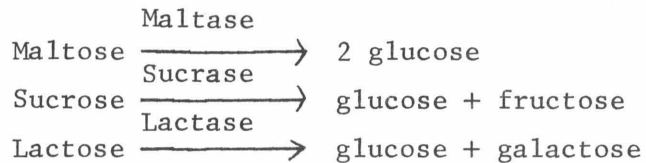
sense a part of digestion. Mixing with saliva (insalivation) and with the secretions of the glands of the digestive tract, the pancreas and the liver is accomplished by the muscular contractions (peristalsis) of the alimentary canal.

1. Carbohydrate digestion

- a. Starch is the most important energy source for simple stomached animals.
- b. Most starch is digested in the small intestine by the action of the pancreatic enzyme amylase.



- c. Disaccharides such as maltose, sucrose, and lactose are further broken down into simple sugars by enzymes produced by glands in the small intestine.



- d. In the first 3 compartments of the stomach of ruminants (cattle or sheep) and in the large intestine of all animals, microorganisms attack cellulose. In the horse, this action occurs in the caecum and colon. The products are volatile fatty acids, mainly acetic, propionic and butyric acids which are absorbed and used by the animal for energy and for synthesis of certain other compounds.

2. Digestion of Fats - Lipases break fats into component fatty acids and glycerol.

- a. Gastric lipase produced by glands in the stomach is important in the young, suckling animal.
- b. Pancreatic lipase acts in the small intestine.



- c. Bile salts secreted in the small intestine from the liver aid in the digestion of fat by their emulsifying action.

3. Digestion of Protein. Enzymes aided by the hydrochloric acid (H^+) ions produced in the stomach proceed with the breakdown of protein until free amino acids are produced.

- a. Pepsin produced in the stomach as pepsinogen is activated by H^+ ions or by pepsin and cleaves peptide linkages in the protein molecule.
 - 1) It acts on most native proteins to produce smaller peptide units.
 - 2) It has a clotting action on milk resulting in the formation of a curd which is then further digested.
- b. Hydrochloric acid has several functions in regard to protein digestion.
 - 1) It activates pepsinogen.

- 2) It causes swelling, denaturation and possibly hydrolysis of protein.
 - 3) It restricts fermentation by microorganisms.
 - c. In the small intestine, a number of enzymes produced by the pancreas continue the protein digestion that was begun in the stomach. Examples of such enzymes are:
 - 1) Trypsin which is secreted as trypsinogen and activated by enterokinase.
 - 2) Endopeptidase which attacks more proteins than pepsin.
 - 3) Chymotrypsin which is activated by trypsin, has a similar action, and a strong milk clotting ability.
 - 4) Carboxypystidase is an enzyme that attacks a terminal amino acid having a free carboxyl group.
 - d. Intestinal juice contains enzymes called amino peptidases which attack linkages of terminal amino acids with free amino groups. It also contains enterokinase which activates trypsinogen.
4. Digestion of other nutrients
- a. Minerals are dissolved from foods by the hydrochloric acid solutions of the stomach or released from organic compounds digested by enzymes.
 - b. Little is known about digestion of vitamins but they can probably be used without conversion to simpler compounds. Carotene is believed to be converted to vitamin A in the small intestine as well as in other tissues after absorption.
 - c. Water requires no digestion before being utilized by the animals.
- B. Absorption - The transfer of nutrients from the intestine to the bloodstream is called absorption. Most absorption takes place in the small intestine.
1. Carbohydrates - Carbohydrates are absorbed as simple sugars two mechanisms.
 - a. Simple diffusion - This method is probably not too important unless the sugar concentration in the intestine is very high.
 - b. The more important process involves phosphorylation and is called the active transport mechanism.
 2. Fat absorption:
 - a. Some fat is absorbed as such while on the other hand, fatty acids and glycerol may be absorbed and recombined into neutral fat in the intestinal wall.
 - b. Fat is transported by the lymph system to the thoracic duct where it enters the blood. It may then go to the liver or stores of body fat.
 - c. Fat absorption is not very efficient in horses.
 3. Protein absorption:
 - a. Protein is absorbed as amino acids by a diffusion process into the capillaries associated with the villi of the small intestine. From there they may go to the liver or to other body cells for resynthesis into protein.

- b. Intact proteins are not absorbed across the intestinal wall except in the newborn animal. In this instance it is of great importance however, as it permits the transfer of antibodies found in the colostrum of the mother.
4. Vitamins:
- a. Fats promote the absorption of vitamin A and its precursor, carotene and probably enhance absorption of other fat soluble vitamins as well.
 - b. Water soluble vitamins are absorbed from the small intestine and from the cecum and large intestine where they can be synthesized by microorganisms.
5. Minerals - Most minerals are absorbed quite readily from the small intestine.
- a. Certain factors may affect absorption such as the presence of Vitamin D in the case of calcium and phosphorus.
 - b. A high level of one mineral element may interfere with the absorption of certain other minerals.
- C. The role of nutrients within the animal body
1. Carbohydrates - The foremost function of carbohydrates is to supply energy and heat for all body processes. Surpluses are converted to fats which are stored as potential energy sources.
 2. Fats, other lipids - Dietary fat is a rich source of energy. Certain essential fatty acids (linoleic, linolenic, arachidonic) must be present in the diet because the animal cannot synthesize them. Body fat serves to insulate the body and to cushion and protect vital organs. Essential fatty acids play a role in proper cell structure and function but are present in adequate amounts in most practical farm animal rations.
 3. Protein - The function of proteins in the body include:
 - a. repair of tissue
 - b. growth of new tissue
 - c. metabolism for energy
 - d. manufacture of substances vital to body functions such as antibodies to fight infection.
 - e. enzymes essential for normal body functions.
 - f. hormones
 4. Vitamins - As previously mentioned, vitamins are primarily regulators of metabolism. They have been called organic catalysts. Vitamins function in digestion, absorption and utilization of food, growth and reproduction and in the maintenance of general health.
 5. Minerals - Minerals play a variety of structural and regulatory roles in the animal body, some of which, have already been mentioned.
 - a. Minerals constitute about 3 to 5 percent of the animal body.

- b. Symptoms of mineral deficiencies are often unrecognized until effects are extreme so proper supplementation is important.

IV. The nutritional requirements of the horse

A. Maintenance

- 1. The energy requirement for maintenance is the amount required for zero body-weight change in the mature horse undergoing normal non-working activity.
- 2. This is best judged by observing the animal's condition. For example is he gaining, losing or maintaining his weight.
- 3. High-quality hay and farm grains or good pasture supply adequate protein for maintenance.

B. Work

- 1. The energy requirement for work is greatly influenced by the type of work, the condition and training of the animal, the ability of the rider or driver, fatigue, environmental temperature, constituents of the diet.
- 2. For example, energy requirements are increased many times over when activity becomes strenuous.

<u>Activity</u>	<u>Requirement</u> <u>kcal/hour/kg of weight</u>
walking	0.5
slow trotting, some cantering	5.1
fast trot, canter, some jumping	12.5
cantering, galloping, jumping	24.0
strenuous effort	39.0

- 3. The protein requirement is not measurably increased by muscular activity. Feeding greater amounts of the maintenance diet to supply the extra energy for work will provide sufficient protein to cover the protein requirement for work.
- 4. When horses are under the stress of performance, racing or show, B- vitamins should be added to the ration to insure adequate intake.

C. Growth

- 1. The question of how fast a horse should grow is unresolved.
- 2. A shortage of energy will result in loss of weight and general poor condition.
- 3. Young horses require a higher protein percentage in their rations than do mature horses. Expressed as a percentage of ration dry matter:
 - a. a young foal requires about 19% protein in his ration, a

yearling needs about 12% and a mature horse needs about 10%.

D. Reproduction

1. In the early stages of gestation, nutritional requirements are not greatly different from maintenance levels.
2. In the last 90 days of pregnancy, energy and protein needs increase appreciably and need to be met with increased levels of feeding. The products of gestation will equal 10 to 12% of the mare's bodyweight.
3. Compared with a maintenance protein level of 10%, the pregnant mare in the last 90 days of pregnancy should receive 11.5% of her ration's dry matter as protein.

E. Lactation

1. Nutrient requirements during lactation are higher than during pregnancy. For example, the energy requirement at peak lactation is about 160% of the maintenance requirement.
2. The protein level for the pregnant mare should be increased to 13% of ration's dry matter to provide adequate amounts for maintenance and milk production. Otherwise the mare will produce milk at the expense of her body tissues.

F. Vitamins and Minerals

1. The young growing horse and the pregnant and lactating female have increased vitamin and mineral requirements which need to be considered.

V. Understanding feeding terminology

A. Analysis of feedstuffs - In order to evaluate commercial feeds, understand forage test results, and use feeding standards, it is necessary to have a working knowledge of terms used to describe the nutrient value of feeds. The ones usually seen on feed tags are:

1. Dry matter - Dry matter is determined by finding the percentage of water in a given feed by drying in an oven until a constant weight of the sample is obtained. The weight loss obtained is the amount of water naturally present in the feed. The remaining percentage is the dry matter. All feeds contain some moisture depending on length of time and manner of storage and the amount of moisture in the air. Dry forages and grains usually contain 88 to 92% dry matter.
2. Crude protein - The crude protein percentage in a feed includes all the nitrogen-containing compounds. The nitrogen content is determined chemically and this value is multiplied by a factor of 6.25 because protein contains about 16% nitrogen. The crude protein content of feeds can range from as low as 3% for molasses to more than 40% for soybean meal.

3. Fats (ether extract) - The percentage of fat in a feed is determined by distilling a finely ground sample in ether for several hours. The ether separates the ether-soluble components from the feed. The ether is then evaporated away and the residue, expressed as a percentage of the original sample, provides an estimate of the fat content of the feed. Cereal grains contain 4 to 5 percent fat.
4. Crude fiber - Crude fiber is an estimate of the non-digestible carbohydrates in a feed such as cellulose and lignin. It is determined by boiling a sample of feed first in weak acid, then in weak alkali. Concentrates contain only 2 to 3 percent crude fiber, while roughages may contain more than 20 percent.
5. Ash - The residue remaining after a sample is burned until all the carbon has been removed is the mineral portion of a feed. Cereal grains contain only 1 to 2 percent ash while alfalfa hay may contain 8 percent.
6. Nitrogen free extract - This value is an estimate of the digestible carbohydrate, primarily starch, that is present in a feed. It is determined by subtracting the percentages of water, ash, crude protein fiber and fat from 100 percent.
An example for calculating the percent NFE of a feed is as follows:

	PERCENT
Water	14.8
Ash	1.3
Crude protein	9.4
Crude fiber	2.2
Fat	3.9
Total	31.6

The percent NFE would be $100 - 31.6$ or 68.4 percent.

7. Value of chemical analysis - Chemical analysis of feeds, often called a proximate analysis tells us something about the energy value of feed and its protein and fiber content but it reveals nothing about vitamin content, protein quality, digestibility or whether spoilage may have occurred.
- B. Energy values of feeds - Publications giving suggestions about feeding horses contain terms that estimate the energy needs of the horse and the energy content of various feeds. Often these values are expressed as total digestible nutrients or TDN. In some instances, energy values will be given in caloric terms such as digestible energy (DE), metabolizable energy (ME) or net energy (NE).
1. Total digestible nutrients (TDN) - Total digestible nutrient content of a feed is expressed as a percentage and is determined by a digestion trial. Concentrates are high in TDN (68-78%) while forages are lower (49-50%). A limitation of TDN as a measurement of feed energy is that it does not account for the losses of energy that occur as the feed is eaten and digested

by the animal. These include the loss of combustible gases and heat. Such losses are higher for forages than for concentrates, thus a pound of TDN from forage has less value for productive purposes than does a pound of TDN in concentrate.

2. Caloric terms (DE, ME, and NE) - These terms are gradually coming into wider use because they more accurately express the true energy value of a feed for productive purposes by the animal.
 - a. Digestible energy (DE) - This value is the difference between the gross energy of a feed and the amount present in the feces determined by means of a bomb calorimeter. Values are expressed in calories and may be estimated from TDN values by using the factor of 2,000 kcal per lb. of TDN. Oats contain 3.09 Mcal (3090 kcal) per kilogram or about 1.4 Mcal per lb. Therefore 11.7 lbs of oats would be needed to meet the entire energy needs of a 1100 lb. horse on a maintenance program.
 - b. Metabolizable energy (ME) - Energy losses in feces, urine and gases is subtracted from total energy in feed to give a more accurate estimate of energy available for productive purposes.
 - c. Net energy (NE) - Net energy values account for heat losses as well as other losses mentioned above so it is that portion of the total energy in feed available for maintenance, growth, work, lactation and reproduction.

C. Protein terms

1. Crude protein - the total content of nitrogen-containing compounds in a feed determined by chemical analysis.
2. Digestible protein - Determined by a digestion trial, this value is an estimate of the protein actually available to the animal.

Because protein digestibility varies among feeds, the daily protein needs of the horse are best expressed in terms of digestible protein. The digestible protein content of most feeds is approximately 80 percent of the crude protein content.

Horse Farm Economics and Related Business Management

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The dollar and cents aspect of a horse enterprise can take on many dimensions just as in any other agricultural venture. Perhaps the only major difference between the economics associated with horse production and that of any other livestock production is the relative higher percentage of owners who are not in it to "make" money. Thus, we have those who are in the horse "business" and those who are in the horse "hobby".

All businesses have one thing in common, the goal of making a profit which requires a close control of "costs". Even though a hobbyist is not profit oriented he should be just as concerned in holding down costs as the business. A good rule of thumb in cost control is to concentrate on the "big three" largest costs. Usually, you can have the biggest effect on costs by doing a good job of cost control with the three largest than through all the other costs.

In order to identify the three largest costs you must be able to identify your inputs and outputs. A handy method of looking at these inputs and outputs is by using the budgeting process. Budgeting is just a systematic listing of all costs of production and value of products. Once a budget is developed it becomes relatively simple to determine if it is practical to start, expand, or decrease the size of an enterprise.

The sample budgets shown will not fit any particular operation but hopefully may be typical of many operations found in Virginia today. You will want to modify the values in the budget to better fit your own situation.

It is important that you differentiate between Fixed Costs and Variable Costs as you study the budgets. Just which costs are fixed and variable will depend upon each person's situation.

Normally we think of Fixed Costs as those costs associated with the **actual** ownership of a horse such as:

1. Depreciation - decrease in value over time
2. Interest on investment
3. Taxes
4. Insurance
5. Also labor and repairs at times

Variable costs are often called "out of pocket costs" and usually are the costs of production inputs such as:

1. Feed
2. Supplies

3. Vet - medicine
4. Bedding
5. Trucking and etc.

In reality a cost is variable if it can be omitted by not producing. Thus for a person thinking about going into some phase of the horse business all costs are variable. If he doesn't start, no costs are incurred.

However, if he buys a horse or already owns the horse then the ownership costs are fixed to him. He has locked himself in on certain costs such as depreciation, interest on investment, etc. His variable costs would then be the costs of feed, supplies and etc.

The important thing to remember is that Variable Costs are the only important ones on which to base a decision. If you continue the operation you pay them, if you don't you do not incur them. Conceivably then a person with a string of brood mares might logically continue to operate because his variable costs only include feed, supplies, vet - medicine, and etc. Whereas, someone else thinking about starting up in a similar operation might logically decide not to because his variable costs include both the feed, supplies, vet - medicine and the costs of ownership, i.e. depreciation, interest on investment, taxes, insurance, etc.

The values you use for investment, inputs and returns will probably vary considerably from those shown in the respective budgets. However, by using the example budget as a guide you make any necessary adjustments and "tailor" the budget to your situation.

Explanation of Example Budgets

The budgets contain several sections. Section #1 is the investment for the horse and represents the average dollar amount tied up while considering any depreciation. Section #2 reflects any revenue received from the horse enterprise. Sections #3, 5, 7, and 9 are the various costs associated with the horse enterprise. Sections #4, 6, 8 and 10 show what costs have not been paid to that point and how much is available to apply to these costs.

Estimated Fencing Costs per Mile (320 rods)

32" Woven Wire - 16 rolls @ \$45	\$720
Top Board - Rough cut 1 x 6" 5240 ft. @ 8¢	400
Paint or treatment - 12 gal. primer, 20 gal. paint @ \$6	192
Posts - 660 @ \$1.50	990
Labor - 240 hrs. @ \$2.50	600
Gates - 4 per mile @ \$30	120
Digging Post Holes - 440 @ \$30	132
Staples, Nails, Brace wire and etc.	40
	\$3194

[Two strands barbed wire used in place of top board saves \$376 per mile (8 rolls @ \$27 = \$216)]

ESTIMATED ANNUAL COST FOR KEEPING A
COMPETING HORSE
VIRGINIA

LIVESTOCK INVESTMENT		UNITS	SIZE	NUMBER	VALUE/UNIT	VALUE
1	HORSE	HD.	1.00	5.00	1999.999	2000.00
TOTAL LIVESTOCK INVESTMENT						2000.00
PRODUCTION		UNITS	QUANTITY	WEIGHT	PRICE VALUE/UNIT	VALUE
2	TOTAL RECEIPTS					0.0
OPERATING INPUTS		UNITS	RATE	NUMBER	PRICE	VALUE
	PASTURE	ACRE	2.00	2.000	30.00	60.00
	HAY	TONS	3.50	3.500	60.00	210.00
	GRAIN	TONS	3.25	3.250	150.00	487.50
	PROTEIN SUPPLEM.		3.60	3.600	10.00	36.00
3	SALT & MIN.	DOL.	10.00	10.000	1.00	10.00
	LIVESTOCK INS.	HD.	1.00	1.000	50.00	50.00
	VET & MED.	DOL.	1.00	1.000	186.00	186.00
	SHOW CLOTHES	AUMS	1.00	1.000	100.00	100.00
	BEDDING	DOL.	1.00	1.000	135.00	135.00
	ENTRY FEES	PER	10.00	10.000	45.00	450.00
	STABLE	HD.	12.00	12.000	35.00	420.00
	TRUCKING	PER	10.00	10.000	30.00	300.00
	FARRIER	HD.	9.00	9.000	20.00	180.00
	MISCL EXPENSE	HD.	1.00	1.000	100.00	100.00
	LODGING	PER	10.00	10.000	60.00	600.00
	EQUIPMENT REPAIR					11.93
TOTAL OPERATING COST						3336.43
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT						-3336.43
CAPITAL COST		PRICE	AMOUNT	VALUE		
	ANNUAL OPERATING CAPITAL	0.080	1650.716	132.06		
	EQUIPMENT INVESTMENT	0.080	775.899	62.07		
5	LIVESTOCK INVESTMENT	0.080	1999.999	160.00		
TOTAL INTEREST CHARGE				354.13		
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT						-3690.56
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)						
	EQUIPMENT	DOL.			312.55	
7	LIVESTOCK	DOL.			400.00	
TOTAL OWNERSHIP COST				712.55		
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT						-4403.11
LABOR COSTS						
	EQUIPMENT LABOR	PRICE	HOURS		0.82	
	LIVESTOCK LABOR	2.750	0.300		495.00	
9	TOTAL LABOR COST	2.750	180.000		495.82	
RETURNS TO LAND, OVERHEAD RISK AND MANAGEMENT						-4898.93

ESTIMATED -JST FOR KEEPING A
PLEASURE HORSE
VIRGINIA

LIVESTOCK INVESTMENT		UNITS	SIZE	NUMBER	VALUE/UNIT	VALUE	
HORSE		HD.	1.00	1.00	400.000	400.00	
1 TOTAL LIVESTOCK INVESTMENT							
PRODUCTION		UNITS	QUANTITY	WEIGHT	PRICE VALUE/UNIT	VALUE	
2 TOTAL RECEIPTS						0.0	
OPERATING INPUTS							
UNITS	PER UNIT	OF UNITS	RATE	NUMBER	TOTAL UNITS	PRICE	VALUE
ACRE	2.00	1.00		2.000	2.000	60.00	120.00
TONS	2.00	1.00		2.000	2.000	60.00	120.00
TONS	1.50	1.00		1.500	1.500	120.00	180.00
CWT.	3.00	1.00		3.000	3.000	7.00	21.00
DOL.	3.00	1.00		3.000	3.000	1.00	3.00
DOL.	1.00	1.00		1.000	1.000	25.00	25.00
DOL.	1.00	1.00		1.000	1.000	100.00	100.00
DOL.	1.00	1.00		1.000	1.000	30.00	30.00
HD.	12.00	1.00		12.000	12.000	35.00	420.00
DOL.	1.00	1.00		1.000	1.000	30.00	30.00
ACRE	6.00	1.00		6.000	6.000	15.00	90.00
EQUIPMENT REPAIR							0.36
TOTAL OPERATING COST							1139.36

61 RETURNS TO LAND, LABOR, CAPITAL, MACHINERY,
4 OVERHEAD, RISK, AND MANAGEMENT -1139.36

CAPITAL COST	PRICE	AMOUNT	VALUE
ANNUAL OPERATING CAPITAL	0.080	519.535	41.56
EQUIPMENT INVESTMENT	0.080	203.760	16.30
LIVESTOCK INVESTMENT	0.080	400.000	32.00
TOTAL INTEREST CHARGE			89.86

RETURNS TO LAND, LABOR, MACHINERY,
6 OVERHEAD, RISK AND MANAGEMENT -1229.22

OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)	DOL.	DOL.
EQUIPMENT	83.61	
LIVESTOCK	80.00	
TOTAL OWNERSHIP COST	163.61	

RETURNS TO LAND, LABOR, OVERHEAD,
8 RISK AND MANAGEMENT -1392.84

LABOR COSTS	PRICE	HOURS	VALUE
EQUIPMENT LABOR	2.750	0.500	1.37
LIVESTOCK LABOR	2.750	500.000	1375.00
TOTAL LABOR COST			1376.37

RETURNS TO LAND, OVERHEAD
10 RISK AND MANAGEMENT -2769.21

DEPRECIATED OVER 10 YEARS LIFE
2-76 W.L.BRANT

LIVESTOCK INVESTMENT		UNITS	SIZE	NUMBER	VALUE/UNIT	VALUE
1 MARE		HD.	1.00	1.00	1000.00	1000.00
TOTAL LIVESTOCK INVESTMENT						
PRODUCTION		UNITS	QUANTITY	WEIGHT	PRICE VALUE/UNIT	VALUE
2 HORSES		HD.	0.50	1.00	800.00	400.00
TOTAL RECEIPTS						
OPERATING INPUTS						
OPERATING INPUTS	UNITS	RATE	PER UNIT	NUMBER	TOTAL	VALUE
PASTURE	ACRE	2.75	1.00	2,750	60.00	165.00
HAY	TONS	3.15	1.00	3,150	60.00	189.00
GRAIN	TONS	1.95	1.00	1,950	120.00	234.00
PROTEIN SUPPLEM.	CWT.	3.00	1.00	3,000	7.00	21.00
SALT & MIN.	DOL.	5.00	1.00	5,000	1.00	5.00
LIVESTOCK INS.	DOL.	1.50	1.00	1,500	20.00	30.00
VET & MED.	DOL.	1.50	1.00	1,500	120.00	180.00
TAXES	DOL.	1.00	1.00	1,000	35.00	35.00
BEDDING	DOL.	1.00	1.00	1,000	60.00	60.00
UTILITIES	DOL.	1.00	1.00	1,000	100.00	100.00
TRUCKING	DOL.	1.00	1.00	1,000	50.00	50.00
ORGANIZATIONS	DOL.	1.00	1.00	1,000	50.00	50.00
STUD FEE	HD.	1.00	1.00	1,000	500.00	500.00
EQUIPMENT REPAIR						20.36
TOTAL OPERATING COST						1639.36
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY,						
4 OVERHEAD, RISK, AND MANAGEMENT						
CAPITAL COST						
ANNUAL OPERATING CAPITAL		PRICE	AMOUNT		VALUE	
EQUIPMENT INVESTMENT		0.080	937,988		75.04	
LIVESTOCK INVESTMENT		0.080	1253,759		100.30	
TOTAL INTEREST CHARGE		0.080	1000,000		80.00	
TOTAL INTEREST CHARGE						255.34
RETURNS TO LAND, LABOR, MACHINERY,						
6 OVERHEAD, RISK AND MANAGEMENT						
OWNERSHIP COST: (DEPRECIATION,						
TAXES, INSURANCE)						
7 LIVESTOCK	DOL.					349.21
EQUIPMENT	DOL.					200.00
TOTAL OWNERSHIP COST						549.21
RETURNS TO LAND, LABOR, OVERHEAD,						
8 RISK AND MANAGEMENT						
LABOR COSTS						
EQUIPMENT LABOR		PRICE	HOURS		VALUE	
LIVESTOCK LABOR		2.750	8,500		23.37	
TOTAL LABOR COST		2.750	100,000		275.00	
TOTAL LABOR COST						298.37
RETURNS TO LAND, OVERHEAD						
10 RISK AND MANAGEMENT						
DEPRECIATED OVER 10 YEARS LIFE						-2342.29

STUD HORSE
VIRGINIA

LIVESTOCK INVESTMENT		UNITS	SIZE	NUMBER	VALUE/UNIT	VALUE
1	STUD	HD.	1.00	1.00	5999.992	5999.99
TOTAL LIVESTOCK INVESTMENT						
PRODUCTION		UNITS	QUANTITY	WEIGHT	PRICE VALUE/UNIT	VALUE
2	STUD FEE	HD.	15.00	1.00	500.000	7500.00
TOTAL RECEIPTS						
OPERATING INPUTS						
	UNITS	PER UNIT	RATE	NUMBER	TOTAL	PRICE
					UNITS	VALUE
PASTURE	ACRE	2.00		1.00	2.000	60.00
HAY	TONS	4.00		1.00	4.000	60.00
GRAIN	TONS	1.00		1.00	1.000	120.00
PROTEIN SUPPLEM.	CWT.	3.00		1.00	3.000	7.00
SALT & MIN.	DOL.	3.00		1.00	3.000	1.00
LIVESTOCK INS.	DOL.	1.00		1.00	1.000	120.00
3 VET & MED.	DOL.	1.00		1.00	1.000	150.00
TAXES	DOL.	1.00		1.00	1.000	50.00
BEDDING	DOL.	1.00		1.00	1.000	50.00
ADVERTISING	DOL.	1.00		1.00	1.000	300.00
UTILITIES	DOL.	1.00		1.00	1.000	50.00
TRUCKING	DOL.	1.00		1.00	1.000	75.00
ORGANIZATIONS	DOL.	1.00		1.00	1.000	50.00
EQUIPMENT REPAIR						31.93
TOTAL OPERATING COST						1380.93
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY,						
4	OVERHEAD, RISK, AND MANAGEMENT					6119.07
CAPITAL COST						
	ANNUAL OPERATING CAPITAL	PRICE	AMOUNT			VALUE
	EQUIPMENT INVESTMENT	0.080	655.831			52.47
5	LIVESTOCK INVESTMENT	0.080	1550.899			124.07
	TOTAL INTEREST CHARGE	0.080	5999.992			480.00
RETURNS TO LAND, LABOR, MACHINERY,						
6	OVERHEAD, RISK AND MANAGEMENT					5462.53
OWNERSHIP COST: (DEPRECIATION,						
	TAXES, INSURANCE)					
7	LIVESTOCK	DOL.				420.85
	TOTAL OWNERSHIP COST	DOL.				2000.00
RETURNS TO LAND, LABOR, OVERHEAD,						2420.85
8	RISK AND MANAGEMENT					3041.68
LABOR COSTS						
	EQUIPMENT LABOR	PRICE	HOURS			
	LIVESTOCK LABOR	2.750	8.300			22.82
9	TOTAL LABOR COST	2.750	500.000			1375.00
RETURNS TO LAND, OVERHEAD						1397.82
10	RISK AND MANAGEMENT					1643.85

DEPRECIATED OVER 4 YEAR PERIOD
BREEDING 15 MARES ANNUALLY

USING FARM RECORDS

Complete, accurate records, effectively used, can help increase profits for farm business managers. Both financial and production records are needed for a complete system. Obviously the records need to be accurate if they are to be used as a business, financial and production management tool.

To properly keep a set of records the manager needs: (1) some basic knowledge of accounting and (2) a fundamental grasp of income tax rules so the records meet Internal Revenue Service (I.R.S.) and State income tax requirements.

GENERAL USES OF RECORDS

Records have four main uses: (1) Service tool, (2) Diagnostic tool, (3) Indicator of progress, and (4) Forward planning.

As a service tool, the record system can provide income tax information for filing Federal and State income tax returns and Social Security reports, as well as providing a basis for tax management decisions. Unfortunately, many accounting systems only provide information organized to fulfill the tax information obligation. The record system can provide a basis for developing equitable business arrangements for operating agreements, sharing agreements, partnerships, and corporations. Records can also help in obtaining and effectively using credit by showing factors relating to the profitability, liquidity, and solvency of the farm business. The total financial structure of the firm can also be analyzed.

The record system used as a diagnostic tool can help determine the absolute and relative profitability of the business by identifying the strengths and weaknesses of the business. Thus, the manager can see strong points and capitalize on them while recognizing weak points and taking steps to correct them.

The record system can be used as an indicator of progress, both from a business management as well as a financial management standpoint. As a business indicator, the manager can measure change in size, productivity, efficiency, and organization factors unique to his business and businesses similar to his. He can measure actual performance in comparison with planned performance and/or standards of performance for his type of business. As a financial indicator, the farm manager can measure the changes in the financial condition of the business as well as measuring actual performance with planned performance. Thus, the record system can be used as a monitoring device for the manager to observe actual change with planned change and take steps to make necessary adjustments. This needs to be done on a regular basis so problems can be worked on as soon as possible.

Finally, records should be used as a forward planning device for short- and long-term planning. Past records can be used as a basis for projecting cash flows. The manager can then compare actual performance with the plan. The record system can provide cost information and coefficients of production unique to his situation for budgeting ahead in both the short and long run. He can project short- and long-term credit needs and repayment capacities. Further, the manager can schedule purchases of inputs, compare various inputs as to costs and returns, select the kinds and sizes of enterprises, and determine capital generation capacities of different alternatives. There are several alternative procedures available to do partial budgeting, total budgeting, and linear programming both with the desk calculator and the computer. In these volatile economic times, forward planning is becoming increasingly crucial.

LABOR

There are several requirements specified by law that relate to the use of labor in agriculture. The Fair Labor Standards Act include the following provisions:

Child Labor

1. Farmers may employ minors 16 years old and over at any time in any farm job.
2. No minors under 16 may work during school hours except on the home farm for his parents.
3. Minors under 16 are prohibited from working in certain hazardous occupations which includes:
 - a. operating certain equipment unless specifically trained,
 - b. working in a farm yard, pen or stall occupied by a stud horse maintained for breeding purposes,
 - c. working from a ladder or scaffold at a height over 20 feet,
 - d. handling, applying or cleaning equipment for certain agricultural chemicals.

Minimum Wage

1. The minimum wage requirements applies if the farm worker is employed by an employer who used more than 500 man days of farm labor in any calendar quarter of the preceding calendar year.
2. The minimum wage for agriculture is \$2.20 per hour starting in January 1977. This will increase 10¢ per hour in January 1978 at which time it will be the same as industry.
3. Agricultural employers are not required to pay overtime.

* It may be just as important to have records to prove you are not included in some regulations as it is meet the requirements of regulations.

Occupational Safety and Health Act (OSHA)

The OSHA regulations apply to all employers engaged in a business that affects interstate commerce. The interpretation of what affects interstate commerce can be rather broad but basically means goods or products that eventually cross state lines.

OSHA Standards have been set for four areas of agriculture:

1. Sanitation in Temporary Labor Camps
2. Storage and Handling of Anhydrous Ammonia
3. Pulpwood Logging

4. Slow-moving Vehicles (includes animal drawn equipment traveling on the highway)

In addition, employers are required to maintain accurate records and to make periodic reports of work-related illnesses, injuries and deaths.

Further information may be obtained by contacting:

U. S. Department of Labor
(Wage and Hour Division) or
(Occupational Safety and Health Administration)
609 Peoples Federal Building
101 South Jefferson
Roanoke, VA 24011
Phone: 703/982-6342

TAXES

The horse industry like any other industry is regulated by some specific income tax requirements. Basically the horse industry is treated as other agricultural ventures.

Perhaps the first thing to be considered is whether or not your horse enterprise is being operated for business or for pleasure. This is important in deciding if expenses may be deducted and if losses can be used to offset other income.

You are presumed to be operating for a profit for the current year if in two or more out of the past seven consecutive tax years your gross income from the activity exceeds the deductions attributable to it. There are exceptions to this general guideline, it is possible to have the activity considered as operating as a business without meeting the two years of profit and it is also possible to be considered as a hobby with two years of relatively low profit. In either case, you must be able to substantiate the facts and circumstances to indicate you entered the activity or continued the activity with the objectives of making a profit.

Deducting Expenses

If your horse enterprise is considered to be a business, you are entitled to deduct all ordinary and necessary expenses of carrying on the business as farming. Typical expenses are labor, repairs, interest, rent on farm pasture, purchased feed, purchased seed, fertilizer, breeding fees, vet and medicine, depreciation, and etc.

Even if you are not engaged in operating your farm for profit, you must include the income from that activity in your return. From this income you may deduct items of normal operating expense even though your horse activity is not considered a business. The deductions are limited to the amount of income received. The order that expense items may be deducted from the non-business horse activity is as follows:

1. Interest and taxes

2. Other operating expenses that are deductible when attributable to the business of farming
3. Depreciation and other expenses involving adjustment to basis of property.

Interest and taxes are deductible items without any non-business horse income if you itemize your deductions.

Depreciation

Horse farms operated for a profit may deduct depreciation on purchased race horses and breeding stock. The amount of depreciation is the cost or basis of the animal (less salvage) allocated and deducted over its useful life. Useful life is determined by the period of usefulness to you in your normal operation. You may chose to use the Asset Depreciation Range as established by the Internal Revenue Service.

Any reasonable and consistent method of computing depreciation may be used. The three methods most generally used are (1) straight line method, (2) the declining balance method, and (3) the sum of the years - digits.

Additional depreciation equal to 20 percent of the cost (not basis) is allowable in the first year a depreciation deduction is allowable on new or used tangible personal depreciable property. The property (including horses) must have a useful life, in your business, of six years or more. This additional first-year depreciation is in addition to your regular depreciation.

Capital Gains

Everything you own is, for income tax purposes, either a capital asset or a non-capital (or ordinary) asset. Gains and losses from sales or other disposition of ordinary assets used in the farming business and held more than six months (24 months for horses) are often treated as gains and losses from sales of capital assets. These provisions usually result in tax savings.

The 24-month holding period for horses does not automatically qualify the animal for capital gain or loss treatment. Your normal procedure can lengthen the required period. For example, a horse bred, raised and trained for racing by someone other than you or your employees is in all probability not held for sporting purposes by you.

Investment Credit

If you acquired new or used depreciable property (not horses) for use in your business and placed the property in service during the tax year, you may qualify for investment credit. Investment credit is a credit against your tax liability as opposed to depreciation which is a deductible expense. The amount of your investment eligible for the investment credit depends upon the useful life of the property and whether new or used. The useful life of the eligible investment must be at least three years with full credit given for seven years or more expected life. If the eligible investment is new then the "basis" of the property is used to determine the amount. For used property only the cost of the qualifying investment is considered.

The actual credit allowable depends upon when the property was acquired. Property acquired prior to January 21, 1975 is credit as a 7 percent rate, while eligible property acquired after January 20, 1975 is credited at the 10 percent rate. The 10 percent Investment credit will expire December 31, 1980 unless extended by new legislation.

1976 Tax Reform Act

Several changes were made in the tax legislations with the passage of the 1976 Tax Reform Act. Many of those changes will affect people in the horse business. However, there are very few regulations or rulings established for these changes at the time this is written. In fact, it may well be several years before the changes are fully interpreted. Also, many of the changes take place over a period of time.

Some of the provisions of the 1976 Tax Reform Act that a horseman should endeavor to find out if it concerns his operation are:

1. The "At Risk" limitation on losses
2. Minimum Tax provisions on preferential treatment property
3. Home office expense
4. Vacation home rental
5. Net capital losses
6. Partnership rules on 1st year additional depreciation
7. Prepayment of interest on loans
8. Prepayment of feed expenses
9. Maximum tax on earned income
10. 10% Investment credit

It is suggested that you ask your tax practitioner about these provisions and how they might affect your operation.

BUILDINGS AND FACILITIES FOR HORSES

by

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"Carefully planned, well designed facilities make horse care easier and add to personal satisfaction and riding enjoyment"^{1/}

Few horse owners would disagree with the preceding statement. But, what are the characteristics of the "carefully planned, well designed" facility? How is one recognized? Horse owners frequently lack the background and knowledge to plan and design good facilities.

This paper summarizes and presents some requirements for good horse housing. The advantages and disadvantages of a number of alternatives that may be used under certain conditions are included.

SYSTEM PLANNING

The first area of concern should always be planning. System planning is the "big picture" view of the entire operation. System planning is needed before design and construction of facilities or any time modification of an existing setup is contemplated. The size and type of operation which you ultimately intend to develop will substantially effect the effort and importance of the planning activity. The following section contains several factors that should be considered when planning your system.

Herd Size

Determine the number of animals of each type to be handled. The list may be as limited as one or two pleasure horses or it may include the stallion, brood

^{1/}From "HORSE HANDBOOK HOUSING AND EQUIPMENT" MWPS-15, Midwest Plan Service, Iowa State University, Ames, Iowa.

mares, youngstock, and other animals kept on a breeding farm. Consider expansion. You may want to increase herd size or change the herd makeup at a later date.

If you have a plan for your herd, you will probably do a better job of planning for the facilities that you will need.

Type of Housing

You can keep your stock on range, in confinement, or use a combination of the two systems. Provide open front buildings or shades for range animals. The horses should have "free choice" access to shelter so they can go to the area which is most comfortable.

Animals kept in confinement are easier to care for and to observe. However, you must make some provision for exercise. Provide an exercise yard if you have confined horses. The exercise area should be handy to the housing facility to minimize the effort involved in moving the horses.

Covered Areas

Roofed area is needed for stalls, walkways, feed alleys, feed storage and tack storage in nearly all systems. Other places that you may want to cover include areas for washing, breeding, showing, sales, training, riding, exercise, and equipment storage. You may want to include an office. If not, allocate space in the feed room or tack room where office work can be done. If you anticipate visitors, a lounge area may be appropriate. This can often be combined with your office space. Also, if people are expected to live and work on the farm, include suitable living quarters for them.

Open Areas

Open area is required for lanes and roads, outside lots, corrals, exercise areas, parking for trailers and other vehicles and equipment, and special events.

Buffer zones between buildings are needed for pleasing appearance, fire protection, and future expansion.

Waste Handling

Plan how you are going to handle the manure. The physical and social aspects of collecting, handling, storing, transporting, and disposing of manure can be a major problem. Poor waste handling methods can allow contamination of water supplies and are often the cause of odors, flies, and other nuisances.

Check on local or state regulations for storage and disposal of manure. If such regulations exist, follow them! If regulations do not exist, plan to dispose of manure daily when possible. Use land disposal or composting. Do not spread manure on pasture land unless it has been composted. Provide temporary storage for manure that cannot be disposed of daily. Plan to empty the storage at least once a week during the summer fly breeding season. Provide for drainage away from the storage area, but do not allow any material which is polluted with animal waste to reach surface or subsurface water.

Feed and Water

Determine the amount of feed and water that will be needed. Locate sources of feed and grain in the area. Find out who can do the grinding and mixing if you grow some of your own feed. Do not construct anything until you are assured of a good supply of water.

Zoning Regulations

Early on in the planning stage, check to find out the effect of various regulations and restrictions on your proposed project. Zoning regulations are usually limitations on the use to which property can be put. It is not uncommon

to find, particularly within cities or towns, that animal housing is restricted. This restriction may take the form of an outright ban. More commonly, there will be statements about the density of population of animals, and the way in which the animals must be housed and handled.

Even if you do not have zoning regulations, it is often to your advantage to operate as if a typical set of regulations was in effect. This is particularly true if you have close neighbors. Don't allow horses to graze right up to the line fence. Keep the pasture fence 5 to 8 feet back from the property line. Locate barns and other structures at least 75 feet away from the property line. Have secure fences. Your neighbor may enjoy your horses on your place. He is not likely to enjoy your horses on his property!

Building Codes

Building codes set construction standards for all types of structures. Depending upon where your structure is to be located, it may or may not be classified as an agricultural structure. Agricultural structures can sometimes be built to somewhat lighter structural requirements than other types of structures. Check out the building code requirements with your local building inspector.

Building Style

Choose a style for barns and other buildings that fits in with the site and is in harmony with the surroundings. This is especially important if you are in an urban area, or an area which is likely to become urban in the near future. Close neighbors are much less likely to be offended by your horse operation if it has a clean, neat, and attractive appearance. A good operation can be an asset to the neighborhood. A poor operation is always a detraction from the neighborhood and can be expected to produce complaints from neighbors.

Site

Try to locate your operation on high ground if at all possible. Good drainage is necessary if the buildings, arenas, and other areas are to be dry and useful. Be aware that there will be some odors from your horse operation. Try to locate down wind (consider the prevailing winds) from concentrations of houses, apartments, or other places where there are going to be a lot of people.

Consider all aspects of the location which might be pertinent. A lot of traffic to and from your farm, particularly trucks, can be very irritating to neighbors. Suburban housewives, with no objection to your horses, may not desire to have large feed trucks or livestock trucks traveling up and down the street leading to your operation.

Capital

Review your budget. Place priorities on necessities, conveniences, and overall desires. It may be necessary to build your operation on a step by step basis. If you do this, you may also want to grow into the operation which you plan to develop. It may be desirable to start with a restricted type of operation, or a smaller size operation, then the one which you ultimately hope to have on the site.

Frills

The definition of a frill varies from person to person. What one individual considers a necessity, another may consider to be an absolute unneeded frill. Also what may be a frill in one location will not be a frill in another location. For example, a building style which is very attractive and would fit into a suburban setting, might be considered a frill if it was placed in a very rural setting or on a farm where the rest of the buildings did not conform to the same style.

Do not be afraid to plan for a few frills in your operation, provided they are not excessively expensive. A frill can be a source of pride to the owner or the operator. As such it can increase the pleasure and the time which the individual spends at his operation and will often result in superior management of the system.

BARNS

Horse barns, whether large or small, should be well planned, attractive and durable. Barns provide an environment that protects the horses from temperature extremes, keeps them dry and out of the wind, eliminates drafts, provides fresh air in winter and summer, protects them from injury, and is easy for the operator to work in and around. Provide ample space in the barn, based on established space requirements that you can find in many publications, for the well being of the animals and the convenience and safety of the people caring for them.

Barn Styles

Barn styles are usually classified by the distinctive shape of the roof. Most new barns use a shed roof, gable roof, or an offset gable. Gambrel, gothic and monitor roofs which were once very popular are only occasionally used now. The trend in barns is toward the use of a single story structure with clear span or post and beam supported roofs. The use of single floor construction permits lighter, less costly buildings. Clear span roofs add flexibility to buildings by making them more adaptable to other purposes.

The shed roof structure has a single slope roof. It may be an open front or fully enclosed free standing structure, may be attached to other structures or a small movable building. It is relatively low in cost, provides good headroom, and is simple to build and insulate.

The gable roof is the most widely used for new structures today. It is applicable to both open front or closed buildings and for other facilities such as riding arenas.

The gable roof has a triangular shape with two equal pitches which meet at a line in the center of the building. It has a pleasing appearance, is fairly simple to construct and insulate and is about medium in cost. Clear span construction can be obtained in widths as large as 100 feet, by the use of readily available wood or steel trusses. The offset gable roof is similar to the gable except that the two parts of the roof are of unequal length.

Open Front Buildings

Open front buildings are frequently used as shelters for horses kept on range. Allow 60 to 80 square feet of floor space per 1,000 pounds of animal weight. The building should be at least 32 feet wide in moderate climates, such as we have here in Virginia. Provide additional room if you intend to use the shelter for hay and bedding storage, parking tractors, or other purposes.

The open side of the building should be faced away from the prevailing winds. In Virginia this usually means that the building should face to the south or southeast. The open front of the building should be at least 10 feet high. The building should include ridge vents and adjustable panels in the backwall for summer and winter ventilation.

Headroom

Provide plenty of headroom for the horse and the rider, if any riding is to be done in the area. Eight feet of headroom is the minimum acceptable door height for an average horse. For a horse and rider, at least 12 feet are needed.

Ceiling height in stalls should be no less than 9 feet. Riding arena ceilings should be at least 14 feet high. If jumping events or training are to take place in the arena, the ceiling (or lower chord of the truss) should be at least 18 feet high.

Layout

Horse barn layouts are extremely varied. One, two or more rows of stalls can be used. Frequently, stalls are arranged around two or three sides of a building leaving an open area in the center which can be used for riding or exercising the horses.

Choose your own layout. Read books on horse housing and study the plans which are available. Visit other farms and talk to people who are in charge. Plan the building layout so that it is easy to work in and suitable for the kind of stock which you are going to house.

If you need more help, contact your local extension agent. He can supply you with plans and publications about horse facilities. If necessary he can put you in contact with an extension specialist who deals with horse housing and management.

Box Stalls

All stalls should be sturdy and free from sharp projecting corner objects. Stall lining should be solid 4 to 7 feet above the floor. Bars or heavy wire can be used above that. Pressure treated lumber is most durable. Boards should be placed on posts so that the posts take the pressure, not the nails. Locate feeders, waterers and other stall equipment where the animal can't injure itself on them. Minimum stall size is 10 ft. by 10 ft. Most operators prefer larger stalls. Stalls for a brood mare and her colt should always be 12 ft. by 12 ft. or larger.

Creep Feeders

Creep feeders allow access to feed for colts and keep full sized horses away. Creeps can be built in a box stall or in pasture. A plan of a pasture type creep feeder is attached.

Doors

Sliding doors and hinged doors, both solid or dutch can be used. If you use hinged doors, make sure that they can be latched open. This is also true of dutch doors. Both the top and bottom portions should be latchable in the open and closed positions.

Stall doors should be at least 4 feet wide. If you plan to ride through doors leading into the building, they should be about 12 feet wide. Doors which will accommodate trucks or other large equipment should be 16 feet wide.

Feed Room

The feed room is usually about the size of a box stall. It should be organized for convenience and easy house keeping. Plan the storage of feed materials, equipment, and tools to maximize the use of space and to be convenient for you, the operator. Keep the storage area as clean and dust free as possible.

Hay can be stored in an overhead loft or on the ground floor. Small rooms and narrow doors should be avoided, because they make it inconvenient to move hay into and out of storage. Grain feed should be stored in vermin proof bins or containers. Metal containers such as large garbage cans are excellent for limited feed storage. Hopper-bottom bins with mechanical unloading systems can be used for feed storage, particularly where a large number of horses are involved. A good rodent control program is essential.

Provide for feed storage on a rule of thumb basis. Allow for 1 3/4 pounds of hay and one pound of grain per day for each 100 lb. horse weight. Baled hay weighs approximately 10 pounds per cubic foot and a ton occupies about 200 cubic feet. Oats weight approximately 26 pounds per cubic foot, ear corn about 28 pounds per cubic foot, and bulk feed about 40 pounds per cubic foot.

The amount of storage space which you should provide will depend upon the number of animals, their total weight, and how often the feed supply is to be replenished.

Windows

A small window in each box stall provides light and ventilation. However, if other methods are provided for lighting and ventilating the building, windows are not essential. If used, locate the windows near the top of the wall. They should be at least 6 feet above the stall floor and protected by heavy screening if they can be reached by the horses. Windows add to building cost. Summer ventilation can be better provided by solid adjustable ventilation doors near the top of outside walls instead of windows.

Translucent roof panels and wall panels are used to admit daylight into some animal shelters. In the summer, however, they allow extra heat loading on the building. They are also subject to severe moisture condensation and frosting in cold weather.

Floor

Packed or puddled clay on a well drained base makes one of the best floors for horses. It is usually easy to obtain, however, it may have to be hauled to a location. It is also difficult to keep clean and has to be renewed from time to time. Wood planked stall floors or wood floors on concrete or asphalt have been

used by some horse owners. These floors are usually difficult to keep dry and free from odors. If concrete floors are used, a considerable amount of bedding such as sawdust is needed or the horses may get stiff. Artificial turf has been used by some operators for stall floors and alleys.

To insure adequate drainage, the top of the floor should be elevated 8 to 12 inches above the outside ground level. Concrete makes a good floor material for a wash area, feed room, feed alleys, and tack room. Avoid slick floor finishes. Use brush or broomed concrete surfaces.

Lighting

Good illumination is important for the convenience and safety of both the horse and the attendant. In particular, light should be provided for general illumination of alleys and pathways, specific illumination of stalls, storage areas and speciality areas, and illumination of outside approach and service areas.

Electric wiring and fixtures must comply with applicable state and national electric codes.

Water

A healthy horse needs an adequate supply of clean fresh water. A mature horse uses 8 to 12 gallons per day. It is difficult to supply this much water by carrying it in pails if a number of horses are to be watered. You may want to use an electrically heated watering bowl. One unit can serve two stalls or 8 to 10 horses in a lot. If the horses are confined in tie stalls and several are released at once for watering, a small frost free watering tank is preferable. If the horses are watered in their stalls, the watering device should be located where spillage can drain or out of the stall.

Ventilation

Moisture is one of the biggest problems in all types of livestock housing. All animals produce both heat and moisture. The moisture must be removed from the building to prevent condensation and odor buildup. Ventilation is the most commonly used technique for removal of moisture and odors in temperature control. A number of publications are available on the topic of ventilation from the Extension Service. If you need more help or more information, contact your Extension Agent.

Fences

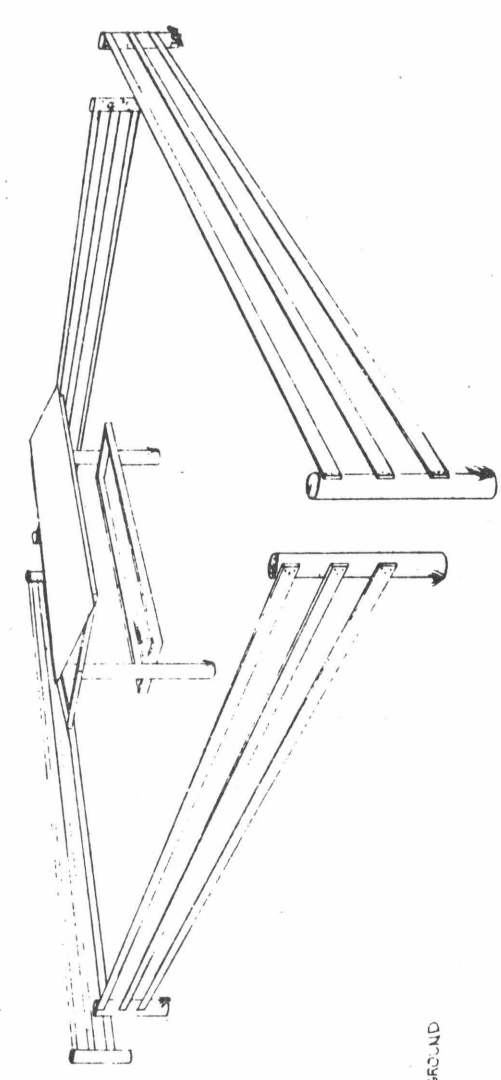
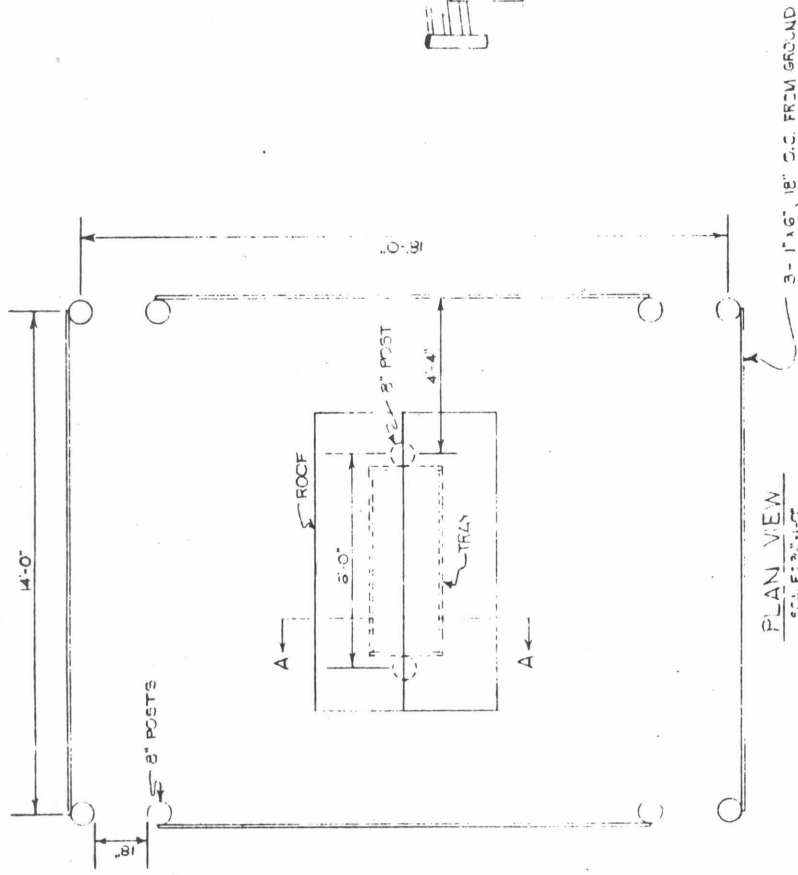
Traditionally fences for horses have been made of wood. Wood is the most widely used material for fencing roadways, paddocks, exercise lots, etc. However, pipe or 4-inch diamond woven wire fence are also satisfactory. If wire fencing is used, select a mesh that a colt cannot get his feet through. Use a protective board on top of the fence. Use pressure treated 5-inch diameter wood post or their equivalent.

Wood fences are normally made of 1 x 6 or 1 x 8 rough-sawn native lumber. The bottom board is located 9 to 12 inches above the ground, and other boards are spaced about 8 inches apart to obtain the desired fence height. If a higher and more rugged fence is desired use 2-inch thick fence boards and 6-inch diameter posts.

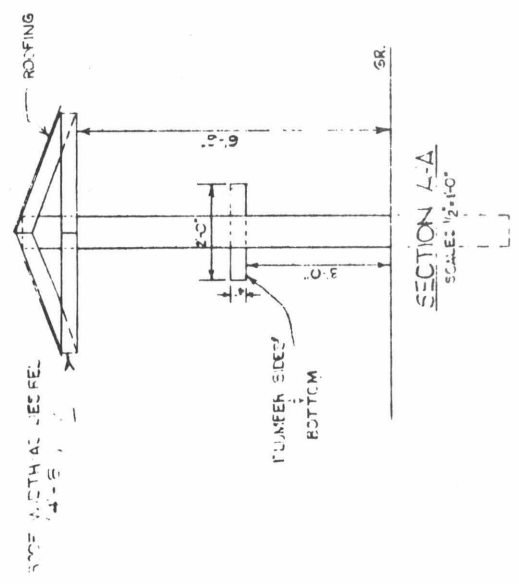
The fence should be free of sharp projections such as nails, bolts, and latches. Do not use barbed wire fences. Planks may be pressure treated, sprayed or brushed with pentachlorophenol for durability and long life. For appearance use a penetrating stain or lead-free paint.

Gates

Use positive locking devices on all gates, such as chain and snap locks or slide locks which require more than one motion to unlock and open. Horses often learn to open gates or doors equipped with conventional locks.



PERSPECTIVE



SUMMARY

Planning is essential to the development of a good horse production system. Consider the needs and resources which you presently have. Include an allowance, or at least a consideration, of expansion at sometime in the future. Be aware of the zoning and other regulations which may affect your system. Select all facilities and components so that they work together as a unit, not a group of pieces located in the same general area.

If you follow the principles that have been outlined above, you should be able to develop a satisfactory horse production system.

PLEASURE HORSE MANAGEMENT

T. N. Meacham
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The pleasure horse, by definition, is a horse kept primarily for pleasure rather than for the showring, race track, or breeding farm. How you can use the pleasure horse is almost unlimited. By its name, the horse is a source or means of deriving pleasure. This may be just riding down a back road once in a while or competing in a 100-mile endurance ride. He may be the means to getting back into that good fishing or hunting area. He may go to that weekend gymkhana or playday or calf roping. You may take him on a Sunday afternoon trail ride with a friend or two or a weekend ride with a large group. He may haul a pack saddle for a trip into the mountains, or he may just carry you across a pasture to check the cows. Some folks just keep him around to look at and talk about. That's okay, if they get pleasure out of it. Whatever your idea of fun is, and if it can be done on horseback, that is what the pleasure horse is for. The horse may be a grade or registered animal of essentially any breed or type. The pleasure horse today is often found in or near suburban areas as well as on farms in rural areas. It is usually one of a small operation, one to six horses. It is risky to put a price tag on this pleasure horse, but it may run from \$300 to \$3,000. The pleasure horse, as we will talk about him, is a non-profit proposition from a financial standpoint.

MANAGEMENT

Health Program

One of the important factors is a good health program. The program should be worked out with your veterinarian. It will include the necessary vaccinations and immunizations for your locality. A control program for internal parasites is a very important part. Worming frequency will depend on the age of the horse, number of horses in the group, and exposure. A periodic examination by the veterinarian can spot potential problems the owner may overlook. A daily inspection by the owner, however, can pick up many small problems before they become big ones.

While grooming horses is not my favorite equine activity, it is an important part of the health program. It should be done thoroughly before and after riding. Particular care should be taken to groom well the areas where your bridle and saddle rest. It is good for the horse's hair coat, skin and mental attitude. It is an excellent opportunity to make that health check while you are at it.

Feeding Management

Feed balanced rations of quality feedstuffs based on roughages for the greatest economy. Utilize home grown hay and grain if possible. Feed according to the individual needs of the horse. The young growing horse needs a higher

quality (protein) ration than the mature horse. The idle mature horse can make it on quality roughage alone if he is healthy. Working horses will need concentrates in addition to roughage to get adequate energy. Reduce the concentrates when the working horse will be idle for a day or so. Do not fatten horses. This is not only wasting money, it is actually harmful to the horse. A fat, sloppy horse is no athlete and cannot perform. Some horses are easy keepers and some are not. Some are nervous and high strung; others are quiet. Each will need different amounts of feed to perform properly. Therefore, they should be fed as individuals. Clean, fresh water, trace mineral salt and a calcium-phosphorus supplement should be available at all times.

Housing

The housing requirement of the horse is actually minimal. If they have some protection from the wind and shade as furnished by a grove of trees, they will make it all right. The investment in stabling is more or less up to the individual owner. It can run all the way from a simple run-in shed to a structure complete with individual boxstalls for each horse. A stall or two is convenient for confining a sick or injured horse, or one that you want to have available. Whatever the type of housing used, it should be strong, free of hazards and easily managed.

Facilities

Storage facilities for hay, feed, tack and equipment is necessary. This space may be part of the horse barn or a separate structure. Again, how elaborate this is depends on the individual. A few basic requirements must be met. Grain and tack storage should be dry, rat-proof, and horse-proof. Unfortunately, we had better make it thief-proof also. Hay and equipment can be stored in open sheds.

Fencing for pens, paddocks and pastures is very important and expensive. Small lots and pens next to the barn area are convenient for separating and holding horses. These should be fenced with boards or rails if possible. Larger paddocks may use woven wire with a board on top. Pasture fences are subject to less animal pressure and can be made of wire alone. It would be nice to fence the entire place with board fences, but most pleasure horse operations cannot afford this. The wire fences are either woven wire with a barb on top, a combination of smooth wire and barb wire, or barb wire alone. We all know the hazards of barb wire, but I would say that the majority of pleasure horses are kept home with a few strands of barb wire. Mature horses that are used to barb wire will stay off of it. Electric fences are good temporary fences and sometimes used as permanent fences. Gates in all types of fences must be well constructed with horse-proof latches. Passthroughs, wide enough for a person but not a horse, are very handy around the barn area. They save a lot of gate openings and eliminate a lot of gates left open accidentally. Select the type of fence you want, build it properly, and maintain it well.

Exercise and Education

The pleasure horse needs to be in good condition. It is hard on a horse to ride him six to eight hours one day and then let him loaf for a month. He

does not need to be as fit as a race horse, but he does need some exercise. Ideally, we should ride them an hour a day, but this is not always possible. Plenty of exercise, either free or under saddle, will eliminate many problems such as chronic colic, cribbing, wood chewing, and other vices as well as keeping the horse in better condition.

We also need to spend some time refreshing the horse's education. He may be a "well broke" horse, but without a little "continuing education" he tends to forget his manners and training. It is the well-mannered, attentive horse that is a real pleasure to ride.

Hoof Care

Ideally, we should inspect and clean out the horse's feet daily. This is not always feasible particularly on pasture. Stabled horses should have their feet picked out daily. All horses should have their feet checked before and after being ridden.

Shoeing horses is a necessary evil at best. It is necessary, however, when normal use of the horse wears down the hoof faster than it can grow out. If the horse is on grass or soft ground, it may not be necessary to shoe it at all. While most of us do not do our own shoeing, we should know what a good job looks like. Shoes should be reset or replaced every six to ten weeks, depending on the horse and amount of use.

Unshod horses should have their hooves trimmed every six to eight weeks if needed. This will insure even wear and prevent excess hoofwall from chipping and breaking off.

When hooves are particularly dry and brittle, a good hoof dressing should be used to keep the hoof moist.

Stable Management

Maintaining a sanitary and safe environment for your horse is a major part of the health program. Clean feeding and watering equipment regularly. Proper manure handling and disposal is becoming more and more critical. Stock pile manure for two weeks before spreading on pasture. Manure can be spread on crop land immediately. Keep trash and junk picked up and hauled off. Eliminate wet areas and standing water where mosquitoes and other insects may grow. Remember, your neighbors will like horses a lot better if the flies and odor are controlled and the facilities are well-kept and attractive.

Transportation

Today, some means of transporting our horses seem almost essential to get the most out of your pleasure horse. There are many types of transportation used. Horses are hauled in large vans, trailers of various types and sizes, and large and small trucks. It doesn't make a lot of difference to the horse as long as the truck or trailer is in good condition and operates safely. The skill and attitude of the driver makes a lot of difference.

Management in the Saddle

We have talked about a number of management factors that we should consider

but these were basically "at home" things. In my opinion, there are a few things we need to keep in mind while we are using our pleasure horses. One of the major uses of the pleasure horse is trail riding, so let's get together with some friends and take a ride.

Make sure you grain the horse at least an hour before the ride starts. Groom the horse thoroughly, picking out the feet and checking the shoes. Saddle and bridle the horse carefully. Make sure the saddle pads and blankets are clean, properly positioned and adequate to protect the back. If the weather is cold, warm up that bit before you stick it in his mouth. Check your tack for weak or broken parts. Tighten the cinch or girth, pull his front legs out to smooth the skin under the cinch and lead him a step or two. Mount up and walk the horse for the first five to ten minutes to get his blood circulating and muscles warmed up. After thirty to sixty minutes, stop and adjust the girth, it will usually be a little loose. When you stop for a break, slip the bit out and let him graze if practical. Allow your horse to drink at every opportunity as you ride. Do not let the horse graze or prune the shrubbery as you ride. He won't be watching where he is going.

When you stop for lunch, cool him out before you water him. Loosen the girth a little, but leave the saddle on. Let him graze while you eat. If grazing is not available, tie him securely and safely with a halter and lead rope. When you are ready to go, don't forget to retighten the girth and pull out the legs. Water him and ride out at a walk again.

Let the horse pick his own way across streams and areas of uncertain footing. If the trail is particularly bad, get off and lead the horse. Trot and canter only where the footing is good and level.

As you approach the end of the ride, walk the horse the last mile. Get off, loosen the girth and lead the horse for the last quarter of the mile. Your horse will be fairly cool and you will feel better when you get in. Tie the horse if he is cool and leave that saddle on for thirty minutes or so.

Take the saddle off and rub him down well. After this, water him and then feed him in an hour or so.

These are a few "in the saddle" management ideas we have found useful in getting the most pleasure out of our horses.

In summary, if we:

1. Do a good job of managing the feeding, health, exercise, conditioning, and hoof care;
2. Provide and maintain safe and clean facilities and equipment;
3. Use the horses with some degree of horse sense;

We won't make much money, but we will derive a great deal of pleasure from our pleasure horses -- that's what it's all about, isn't it!?!?

APPLIED HORSE NUTRITION

J. P. Fontenot

Horses have to be fed properly in order to obtain optimum performance. Deficiencies of any required nutrients will result in sub-optimal health and/or performance. If an excess of nutrients is provided, this is always wasteful and in some cases toxicity may result.

In order to properly feed a horse one must be familiar with the science and art of feeding. The science means providing a balanced ration that will contain the proper amounts and proportions of nutrients needed by the horse. In order to formulate a balanced ration the following must be considered: 1) Nutrient requirements of the particular horse, 2) Available feeds, 3) Nutrient content of the available feeds. The art refers to knowing how to feed a horse so it will consume the required nutrients. The feeds must be presented to the horse in such a form that the horse will consume these in the amounts needed. Palatability of the feeds is of utmost importance - the feed left in the manger or trough will not do the horse any good.

Nutrient Requirements of Horses

The requirement per day for energy, protein, calcium, phosphorus and vitamin A are given in table 1 for mature horses, pregnant mares and lactating mares and in table 2 for growing horses.

Energy

The energy requirement varies according to size and function performed. For example, growth, work, reproduction and lactation increase the energy requirement, above maintenance. Since horses cannot utilize fat very well, changes in energy requirement will usually mean changing

the proportion of starch and fibrous components such as cellulose, or changing the amount of feed allowed to the horse. In practice, this means changing the roughage to concentrate ratio or the amount fed.

The two methods of expressing energy requirement for horses are TDN (total digestible nutrients) and digestible energy. There is a trend toward wider use of the digestible energy and less use of TDN.

Protein

Protein is essential for maintenance, growth, reproduction and lactation. The body requires amino acids, which make up protein. There is synthesis of protein by microorganisms in the cecum of the horse. However, it is not known how efficiently the microbial protein is digested and absorbed from the cecum and large intestine. One should give attention to the quality of protein in the ration, at least for young, growing horses. The use of a protein supplement of high quality such as soybean meal would ensure proper protein quality in the ration. Also, usually, commercial feeds from reputable concerns will contain good quality protein. Usually, amino acid supplementation is not needed.

Minerals

Calcium and phosphorus nutrition is of utmost importance for proper bone development and maintenance in horses. Not only the levels but the ratio of these is important. The minimum calcium to phosphorus ratio should be 1.1 to 1. If adequate phosphorus is fed weanling foals can tolerate a 3 to 1 ratio and mature horses, a 5 to 1 ratio. Also, for proper utilization of calcium and phosphorus, an adequate level of vitamin D is important. Deficiencies or imbalances of calcium, phosphorus and vitamin D will result in abnormal bone development, spavins, splints,

enlarged fetlocks, knees and hocks, stiff gaits and fractures.

Adequate phosphorus nutrition is important for proper reproduction.

Cereal grains and their by-products, straw and dried mature grasses are low in calcium. Legume forages and protein supplements of animal origin are high in calcium. Dried non-legume forages are likely to be low in phosphorus. Protein supplements are usually rich in phosphorus.

Horses should be provided with adequate levels of salt. If horses are allowed free choice access to salt they will consume enough to meet their requirement. In hot weather the salt requirement is increased due to loss during perspiration.

Iodine deficiency results in stillborn or weak offspring and goiter in other horses. In order to ensure against a deficiency, it is a good idea to provide horses with iodized salt.

Other trace minerals such as copper, iron, cobalt, zinc and manganese are required by the horse. If good quality feeds are used, usually, these will be supplied in adequate amounts. Legume forages, protein supplements and molasses are good sources of trace minerals. If trace mineral levels are suspected to be low, a trace mineral supplement should be provided.

Vitamins

Vitamin A requirements of horses can be met by carotene, the precursor of vitamin A in feeds or by vitamin A supplementation. Green forages are rich in carotene. Good sources are fresh green pasturage, dehydrated hay and good, green sun-dried hay. Carotene content is lost during storage. Thus, hay which has been stored for a year or longer will have lost

much of its vitamin A value. If vitamin A (or carotene) level is suboptimal a supplement containing stabilized vitamin A should be fed.

Vitamin D is essential for proper calcium and phosphorus utilization. It appears that 300 I.U. of vitamin D per 100 lb. liveweight will satisfy the requirements of horses. Usually, horses can obtain sufficient vitamin D from sun-cured forages or exposure to sunlight. Vitamin D should not be supplemented unless it is needed. Vitamin D toxicity is characterized by calcification of blood vessels, heart and other soft tissues, bone abnormalities, general weakness and loss of body weight. The toxic level has not been established in horses, but in other species a level 10 times the requirement has been found to be toxic.

It is likely that horses have a dietary requirement for vitamin E. Green forages and other leafy materials such as good quality hay are very good sources. The wide distribution of vitamin E in feedstuffs indicates that a deficiency is not likely in horses fed normal rations. However, many horsemen feel that vitamin E supplementation improves fertility of mares and stallions. It is assumed that sufficient amounts of vitamin K are synthesized by the intestinal microflora.

It appears young horses require a dietary source of the B-complex vitamins before synthesis by intestinal microflora begins. Usually, mature horses obtain adequate amounts of B-vitamins for maintenance from natural feedstuffs and from synthesis by the microflora. Under some conditions, hard working horses may need to be supplemented with B-vitamins. Some horsemen have reported that supplementing with riboflavin prevents "moon blindness". Thus, at times supplementation with this and certain other B-vitamins may be advisable.

Feedstuffs for Horses

Horses are usually fed roughages, alone or supplemented with certain concentrates. The need for supplementation will be determined by the kind and function of the horse and composition of the roughage. Supplementation may consist of grain, protein supplement, mineral supplement or vitamin supplement. Composition of feeds commonly fed horses is given in table 3.

Roughages

Roughages for horses usually consist of pasture forage, hay and silage. The hay and silage should be tested for protein and energy value. This can be done by the V.P.I. & S.U. Forage Testing Laboratory or Commercial Laboratories.

Pasture. There is no better roughage for horses than high-quality pasture. If it is in an actively growing stage and contains a sizeable amount of legume, the pasture will be fair in energy, a good source of protein and will contain considerable levels of certain minerals and vitamins. For best results pastures should not be allowed to get too tall and unpalatable. Also, they should not be overgrazed.

Hay. This is one of the most important feedstuffs for horses. The hay should be of high quality. It should be cut at an early stage of maturity, be free of weeds, dust and molds, and be green and leafy. Legume (alfalfa, clover, lespedeza) hays are generally more nutritious than grass hays. If grass hay, such as timothy or orchardgrass, is used it should be cut at an early stage of maturity in order to optimize its nutritional value and palatability. Contrary to popular belief by many horsemen

feeding alfalfa hay is not harmful to horses; in fact, it is an excellent hay for horses.

Silage. During the winter good quality, well preserved silage, free from mold and not frozen, provides a nutritious forage for horses. The most common silages fed to horses are corn and grass-legume silages. In the event the silage is high in grain content, the concentrate fed would be reduced, compared to lower energy forages.

Grains and Other High Energy Feeds

These contain higher levels of energy than roughages. The amount of grain fed will depend on the function of the horse and the quality of the roughage. Of the three grains commonly fed to horses corn is highest, oats is lowest and barley is intermediate in energy value. Barley and oats are higher in protein content than corn. Wheat bran is lower in energy value than these three grains, but is palatable and has a laxative effect. Sugarcane molasses may add palatability, reduces dustiness and prevents separation of ingredients in a mixed feed. It contains a high level of energy but is low in protein.

Protein Supplements

Soybean meal is higher in protein quality than linseed meal or cottonseed meal. Milk protein is of high quality but sources such as dried skim milk are usually quite expensive.

Mineral and Vitamin Supplements

These should be supplemented only when needed to prevent nutrient deficiencies.

Balancing Rations

A balanced ration is one which supplies the proper levels and proportions of all the required nutrients for a given purpose. Balanced rations will be different, depending on the function of the horse (maintenance, pregnant, lactation, light work, growth, etc.). Thus, a ration that is balanced for one horse will not necessarily be balanced for another. Rations for horses are usually balanced for protein (total or digestible), energy (TDN or digestible energy), calcium, phosphorus and carotene. A ration must be balanced with feeds which are available to the horseman. Balancing a ration is simply determining the amounts of feedstuffs which will supply the nutrients in the amounts required.

A balanced ration has to be palatable. Also, the rations should be economical. This usually means using a maximum amount of roughage. Home grown feeds should be used to maximize economy of feeding. Horses should be kept healthy and free of parasites. Good nutrition will not correct for poor health and poor performance due to disease and parasites.

Balancing a Ration

There are many different methods of balancing rations. One method will be presented, stepwise, as an example for balancing a ration for an 1100 lb. mare at peak of lactation.

Step 1 - Set down the nutrient requirements of the horse. These are as follows for this horse (taken from table 1).

Daily feed	Total protein	Digestible protein	TDN	Calcium	Phosphorus	Carotene
lb.	lb.	lb.	lb.	lb.	lb.	mg.
24.6	2.9	1.82	13.8	0.103	0.085	63

Step 2 - Determine the feeds which are available and their composition. It is assumed that orchardgrass hay, corn grain, oats grain, soybean meal, dicalcium phosphate and limestone are available. The composition of these, taken from table 3, is as follows:

Feed	Total protein %	Digestible protein %	TDN %	Calcium %	Phosphorus %	Carotene mg/lb
Orchardgrass hay	8.1	3.8	41	0.40	0.20	6.8
Corn grain	8.9	4.7	81	0.02	0.27	0.8
Oats grain	11.7	7.4	62	0.06	0.29	
Soybean meal	45.8	39.8	71	0.32	0.67	
Dicalcium phosphate				22.20	17.90	
Limestone				35.84		

We will assume that the grain mixture will be composed of equal parts of corn and oats, plus soybean meal, dicalcium phosphate and limestone, if needed.

Step 3 - Balance for energy.

a) First try to balance with only hay.

	Lb. feed	TDN lb.
Orchardgrass hay	24.6	10.1

The ration is low in energy. Determine how much grain mixture (concentrate) will need to be substituted for hay. Assume that the grain mixture will contain 70% TDN.

Amount to substitute = $\frac{\text{Amount deficient}}{\text{Difference in TDN between orchardgrass hay and grain mixture}}$

TDN requirement	13.8	TDN content of grain mix 70% or 0.70
TDN in 24.6 lb. hay	10.1	TDN content of hay 41% or 0.41
TDN deficient	3.7	Difference in TDN content

$$\text{Amount to substitute} = \frac{13.8 - 10.1}{0.70 - 0.41} = \frac{3.7}{0.29} = 12.8$$

So 12.8 lb. grain mix will be substituted for 12.8 lb. hay.

Step 4. Determine the nutrient composition needed in the grain mix.

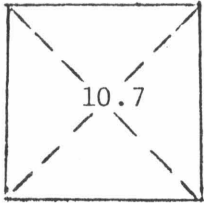
	Lb. feed	Total protein lb.	Dig. protein lb.	TDN lb.	Calcium lb.	Phosphorus lb.	Carotene mg.
Requirement	24.6	2.9	1.82	13.8	0.104	0.085	63
Supplied by orch- ardgrass hay	11.8	0.96	0.45	4.84	0.047	0.024	80.2
Needed in grain mix	12.8	1.94	1.37	8.96	0.057	0.061	0
Percent needed in grain mix		15.2	10.7	70.0	0.45	0.48	

Step 5. Formulating grain mix -

a) Composition of 1:1 mix of oats and corn

Total protein %	Dig. protein %	TDN %	Calcium %	Phosphorus %
10.3	6.05	71.5	0.04	0.28

b) Determining proportions of grain and soybean meal by square method to meet needed digestible protein.

		Grain	
Grain 6.05 dig. protein		29.1 parts	86.2% = 86%
Soybean meal 39.8% dig. protein		4.65 parts	13.8% = 14%
		33.75	

You will notice that the proportions were rounded off to nearest whole number. Thus, in order to meet the protein requirement, 100 lb. of grain mix would consist of 43 parts of corn grain, 43 parts of oats grain (86 parts grain) and 14 parts of soybean meal.

Feed	Lb. feed	Total protein lb.	Dig. protein lb.	TDN lb.	Calcium lb.	Phosphorus lb.
Corn	43.0	3.83	2.02	34.8	0.009	0.116
Oats	43.0	5.03	3.18	26.7	0.026	0.125
Soybean meal	14.0	6.41	5.57	9.9	0.045	0.094
		15.27	10.77	71.4	0.080	0.335

c) The grain mix is too low in calcium and phosphorus. At this point, the horse could be fed 12.8 lb. of this grain mix and 11.8 lb. hay and provided, free choice, a mineral mixture containing high levels of calcium and phosphorus. Also, the mixture can be formulated to contain the proper levels of calcium and phosphorus. To do this, correct for phosphorus, then calcium as follows:

- 1) Need 0.48% phosphorus. $0.48 - 0.335 = 0.145$ lb. deficient.
- 2) Dicalcium phosphate containing 17.90% phosphorus and 22.20% calcium will be used.

$$\frac{0.145}{0.1790} = 0.8 \text{ lb.}$$

- 3) Amount dicalcium phosphate = 0.1790
- 4) Calcium supplied by 0.8 lb. dicalcium phosphate = $0.8 \times 0.2224 = 0.178$
- 5) Calcium to be supplied by limestone
 - (a) Total of 0.45 lb. calcium is needed per 100 lb. grain mix.
 - (b) Calcium supplied by corn, oats and soybean meal 0.080
Calcium supplied by dicalcium phosphate 0.178
Total 0.258
 - (c) $0.45 - 0.258 = 0.192$ lb. calcium to be supplied by limestone.
 - (d) Limestone contains 35.84% calcium
 $\frac{0.192}{0.3584} = 0.5$
- 6) Amount limestone = 0.5
- 7) Substitute 1.3 lb. mineral (0.8 lb. dicalcium phosphate and 0.5 lb. limestone) for 1.3 lb. corn and oats.

d) Final composition of grain mixture

	Lb. feed	Total protein lb.	Dig. protein lb.	TDN lb.	Calcium lb.	Phosphorus lb.
Corn	42.3	3.76	1.99	34.3	0.008	0.114
Oats	42.4	4.96	3.14	26.3	0.025	0.123
Soybean meal	14.0	6.41	5.57	9.9	0.045	0.094
Dicalcium phosphate	0.8**				0.178	0.143
Limestone	0.5**				0.179	
Nutrient content, %		15.13	10.70	70.5	0.435	0.474

** 1.3 lb. mineral supplements were substituted for 0.7 lb. corn and 0.6 lb. oats

Step 6. Check ration

	Lb. feed	Total protein lb.	Dig. protein lb.	TDN lb.	Calcium lb.	Phosphorus lb.	Carotene mg.
Orchard- grass hay	11.8	0.96	0.45	4.84	0.048	0.024	80.2
Grain mix- ture	12.8	1.94	1.37	9.02	0.056	0.061	
Total	24.6	2.90	1.82	13.86	0.104	0.085	80.2

The ration meets all the requirements for this particular horse.

The ration was essentially balanced for total protein as well as digestible protein. When purchasing commercial feeds (grain mixtures) only the total protein or crude protein will be given on the feed tag. Therefore, in deciding on the protein needed in these feeds, it would be best to use only the total protein and not the digestible protein.

In figure 1 is given a quick reference for calculating the protein content needed in the grain mixture. In order to do this, the protein requirement on a percent basis from either table 4 or table 5 and the protein content of the roughage are needed. If your hay has been analyzed by the Forage Testing Laboratory, the protein content of it will be given. In this quick reference it is assumed that the horses will be fed approximately 1 part of grain mixture to 1 part of hay. The proportion will depend largely on the kind of roughage fed. The total amounts of feed to be fed are given in tables 4 and 5. It is assumed that the TDN content of commercial feeds is about 70%.

An example of the method to determine the protein content of the grain is given in figure 1. If the protein content of the roughage is 8% and the protein requirement of the horse is 12%, you then lay a straight edge on 8 and 12, which would give you a protein content of the grain mixture of 16%. Therefore, you would purchase a grain mixture that contains about 16% total protein.

Concerning proper feeding of horses, it is important that a balanced ration be fed. The minimum levels of the nutrients given should be met. Usually, you will not want to exceed the energy levels given since this would be expensive and would excessively fatten your horse. When feeding legume hay, the protein level in the ration may exceed the levels given in the requirement tables. This will not be harmful to the horse. In the case of calcium and phosphorus, the phosphorus level must never exceed the calcium level.

The nutrient composition of the feeds given in table 3 should be used only as guides. The best is for you to send a hay or silage sample to the Forage Testing Laboratory or other laboratory for analysis.

Horses should be fed as individuals. Some horses are easy keepers while others have a higher requirement. They should be fed according to their condition, use, etc. It is important that you look at the condition of your horse frequently to determine if it is getting enough energy.

TABLE 1. NUTRIENT REQUIREMENTS OF MATURE HORSES, PREGNANT MARES AND LACTATING MARES^a (DAILY NUTRIENTS PER ANIMAL)

Body weight lb.	Daily ^c feed lb.	Digestible energy Mcal	TDN lb.	Protein lb.	Digestible protein lb.	Vitamin A ^b 1000 I.U.	Calcium lb.	Phosphor lb.
Mature Horses at Rest (Maintenance)								
440	7.3	8.2	4.1	0.66	0.35	5.0	0.018	0.013
880	12.3	13.9	6.9	1.11	0.59	10.0	0.035	0.026
1100	14.6	16.4	8.2	1.31	0.70	12.5	0.044	0.033
1320	16.7	18.8	9.4	1.50	0.80	15.0	0.053	0.040
Mature Horses at Light Work (2 hr./day)								
440	9.3	10.4	5.2	0.84	0.44	5.0	0.018	0.013
880	16.3	18.4	9.2	1.48	0.78	10.0	0.035	0.026
1100	19.5	21.9	10.9	1.77	0.93	12.5	0.044	0.033
1320	22.6	25.4	12.7	2.05	1.08	15.0	0.053	0.040
Mature Horses at Medium Work (2 hr./day)								
440	11.7	13.2	6.6	1.06	0.56	5.0	0.020	0.015
880	21.1	23.8	11.9	1.92	1.01	10.0	0.038	0.029
1100	25.5	28.7	14.3	2.30	1.22	12.5	0.047	0.035
1320	29.9	33.6	16.8	2.70	1.43	15.0	0.055	0.042
Mares, Last 90 Days of Pregnancy								
440	7.7	8.7	4.4	0.80	0.48	10.0	0.023	0.018
880	13.2	14.9	7.4	1.35	0.82	20.0	0.043	0.033
1100	15.4	17.4	8.7	1.60	0.95	25.0	0.053	0.040
1320	17.7	20.0	10.0	1.84	1.10	30.0	0.062	0.046
Mares, Peak of Lactation								
440	13.5	15.2	7.6	1.65	1.06	10.0	0.075	0.051
880	21.8	24.4	12.2	2.60	1.65	20.0	0.092	0.078
1100	24.6	27.6	13.8	2.90	1.82	25.0	0.103	0.085
1320	26.7	30.0	15.0	3.09	1.93	30.0	0.141	0.095

^aAdapted from N.R.C. 1973. Nutrient Requirements of Domestic Animals, No. 6. Nutrient Requirements of Horses, National Research Council, Washington, D.C.

^bOne mg. beta carotene equals 400 I.U. vitamin A.

^cAir dry feed.

TABLE 2. NUTRIENT REQUIREMENTS OF GROWING HORSES^a (DAILY NUTRIENTS PER ANIMAL)

Age mo.	Body wt. lb.	Percentage of mature wt. %	Daily gain lb.	Daily feed ^c lb.	Digestible energy Mcal.	TDN lb.	Protein lb.	Digestible protein lb.	Vitamin A ^b 1000 I.U.	Calcium lb.	Phosphorus lb.	
												lb.
440 lb. Mature Weight												
3	110	25.0	1.54	7.2	7.4	3.7	1.16	0.84	2.0	0.038	0.024	
6	198	45.0	1.10	7.6	8.5	4.3	1.02	0.69	3.6	0.037	0.023	
12	297	67.5	0.44	7.1	8.0	4.0	0.74	0.45	5.4	0.026	0.016	
18	363	82.5	0.22	7.2	8.1	4.0	0.69	0.40	6.6	0.023	0.014	
42	440	100.0	0.00	7.3	8.2	4.1	0.66	0.35	5.0	0.018	0.013	
880 lb. Mature Weight												
3	187	21.3	2.20	9.3	10.4	5.2	1.63	1.22	3.4	0.057	0.036	
6	374	42.5	1.43	11.0	12.4	6.2	1.41	0.95	6.8	0.077	0.048	
12	572	65.0	0.88	12.1	13.6	6.8	1.32	0.81	10.4	0.048	0.033	
18	726	82.5	0.55	12.5	14.1	7.0	1.26	0.75	14.2	0.042	0.030	
42	880	100.0	0.00	12.3	13.9	6.9	1.11	0.59	10.0	0.035	0.026	
1100 lb. Mature Weight												
3	242	22.0	2.42	10.7	12.1	6.0	1.83	1.36	4.4	0.067	0.042	
6	495	45.0	1.76	13.7	15.4	7.7	1.76	1.18	9.0	0.101	0.063	
12	715	65.0	1.21	14.9	16.8	8.4	1.65	1.04	11.0	0.057	0.038	
18	880	80.0	0.77	15.3	17.2	8.6	1.54	0.92	16.0	0.051	0.035	
42	1100	100.0	0.00	14.6	16.4	8.2	1.31	0.70	12.5	0.044	0.033	
1320 lb. Mature Weight												
3	308	23.3	2.75	12.6	14.2	7.1	2.11	1.55	5.6	0.114	0.071	
6	583	44.2	1.87	15.3	17.2	8.6	1.91	1.28	10.6	0.113	0.070	
12	847	64.1	1.32	16.8	18.9	9.4	1.84	1.15	15.4	0.072	0.045	
18	1056	80.0	0.77	17.1	19.2	9.6	1.71	1.01	19.2	0.069	0.043	
42	1320	100.0	0.00	16.7	18.8	9.4	1.50	0.80	15.0	0.053	0.040	

^aAdapted from N.R.C. 1973. Nutrient Requirements of Domestic Animals, No. 6. Nutrient Requirements of Horses, National Research Council, Washington, D.C.

^bOne mg. beta carotene equals 400 I.U. vitamin A.

^cAir dry feed.

TABLE 3. COMPOSITION OF FEEDS FOR HORSES^a

Kind of feed	Dry matter %	Digestible energy Mcal/lb.	TDN %	Protein %	Digestible protein %	Calcium %	Phosphorus %	Carbtene mg./lb.
Roughages								
Alfalfa hay	89.2	0.91	51	15.3	9.8	1.20	0.20	13.5
Red Clover hay	90.1	0.89	50	12.8	7.5	1.31	0.21	14.3
Orchardgrass hay	88.3	0.75	41	8.1	3.8	0.40	0.20	6.8
Timothy hay	88.4	0.78	43	7.3	3.2	0.36	0.17	4.3
Oat hay	88.2	0.79	43	8.1	4.0	0.23	0.21	40.5
Crimson clover hay	87.4	0.87	48	14.8	9.5	1.24	0.16	13.9
Fescue hay	88.5	0.79	43	9.3	4.7	0.44	0.32	8.4
Lespedeza hay	93.2	0.88	48	12.5	7.0	0.97	0.21	-
Corn cobs	90.4	0.50	26	2.5	.0	0.11	0.04	-
Grains and other high energy feeds								
Barley grain	89.0	1.48	74	11.6	7.3	0.08	0.42	0.6
Corn grain	89.0	1.62	81	8.9	4.7	0.02	0.27	-
Oats grain	89.0	1.25	62	11.7	7.4	0.06	0.29	-
Sugarcane molasses	75.0	1.09	54	3.2	.0	0.89	0.08	-
Wheat grain	89.0	1.57	78	12.7	8.4	0.12	0.30	-
Corn and cob meal	87.0	1.39	68	8.1	4.0	0.04	0.27	0.6
Wheat middlings	89.0	1.52	76	18.0	13.4	0.08	0.52	-
Wheat bran	89.0	1.04	58	16.0	11.5	0.14	1.17	-
Protein supplements								
Soybean meal	89.0	1.43	71	45.8	39.8	0.32	0.67	-
Dried skim milk	94.0	1.54	77	32.0	-	1.21	0.99	-
Linseed meal	91.0	1.38	69	35.1	29.6	0.40	0.83	-
Mineral supplements								
Dicalcium phosphate	96.0	-	-	-	-	22.20	17.90	-
Limestone	100.0	-	-	-	-	35.84	-	-

^aAs fed basis.

TABLE 4. PROTEIN REQUIREMENT OF MATURE HORSES,
PREGNANT MARES AND LACTATING MARES^a

Body wt.	Daily feed per animal ^b	Requirement	
		Total protein %	Digestible protein %
lb.	lb.		
Mature Horses at Rest (Maintenance)			
440	7.3	9.0	4.8
880	12.3	9.0	4.8
1100	14.6	9.0	4.8
1320	16.7	9.0	4.8
Mature Horses at Light Work (2 hr./day)			
440	9.3	9.0	4.8
880	16.3	9.0	4.8
1100	19.5	9.0	4.8
1320	22.6	9.0	4.8
Mature Horses at Medium Work (2 hr./day)			
440	11.7	9.0	4.8
880	21.1	9.0	4.8
1100	25.5	9.0	4.8
1320	29.9	9.0	4.8
Mares, Last 90 Days of Pregnancy			
440	7.7	10.4	6.2
880	13.2	10.4	6.2
1100	15.4	10.4	6.2
1320	17.7	10.4	6.2
Mares, Peak of Lactation			
440	13.5	12.2	7.8
880	21.8	12.0	7.6
1100	24.6	11.8	7.5
1320	26.7	11.6	7.2

^a Adapted from N.R.C. 1973. Nutrient Requirements of Domestic Animals, No. 6. Nutrient Requirements of Horses, National Research Council, Washington, D.C.

^b Air dry feed.

TABLE 5. PROTEIN REQUIREMENTS OF GROWING HORSES^a

Age mo.	Body wt. lb.	Percentage of mature weight	Daily feed per animal ^b lb.	Requirement	
				Total protein %	Digestible protein %
440 lb. Mature Wt.					
3	132	25.0	7.2	16.1	11.7
6	198	45.0	7.6	13.4	9.2
12	297	67.5	7.1	10.5	6.4
18	363	82.5	7.2	9.6	5.6
42	440	100.0	7.3	9.0	4.8
880 lb. Mature Wt.					
3	187	21.3	9.3	17.6	13.1
6	374	42.5	11.0	12.8	8.6
12	572	65.0	12.1	10.9	6.8
18	726	82.5	12.5	10.1	5.9
42	880	100.0	12.3	9.0	4.8
1100 lb. Mature Wt.					
3	242	22.0	10.7	17.1	12.7
6	495	45.0	13.7	12.1	8.6
12	713	65.0	14.9	11.1	6.9
18	880	80.0	15.3	10.2	6.0
42	1100	100.0	14.6	9.0	4.8
1320 lb. Mature Wt.					
3	308	23.3	12.6	16.7	12.3
6	583	44.2	15.3	12.5	8.3
12	847	64.1	16.8	11.0	6.8
18	1056	80.0	17.1	10.0	5.9
42	1320	100.0	16.7	9.0	4.8

^aAdapted from N.R.C. 1973. Nutrient Requirements of Domestic Animals, No. 6. Nutrient Requirements of Horses, National Research Council, Washington, D.C.

^bAir dry feed.

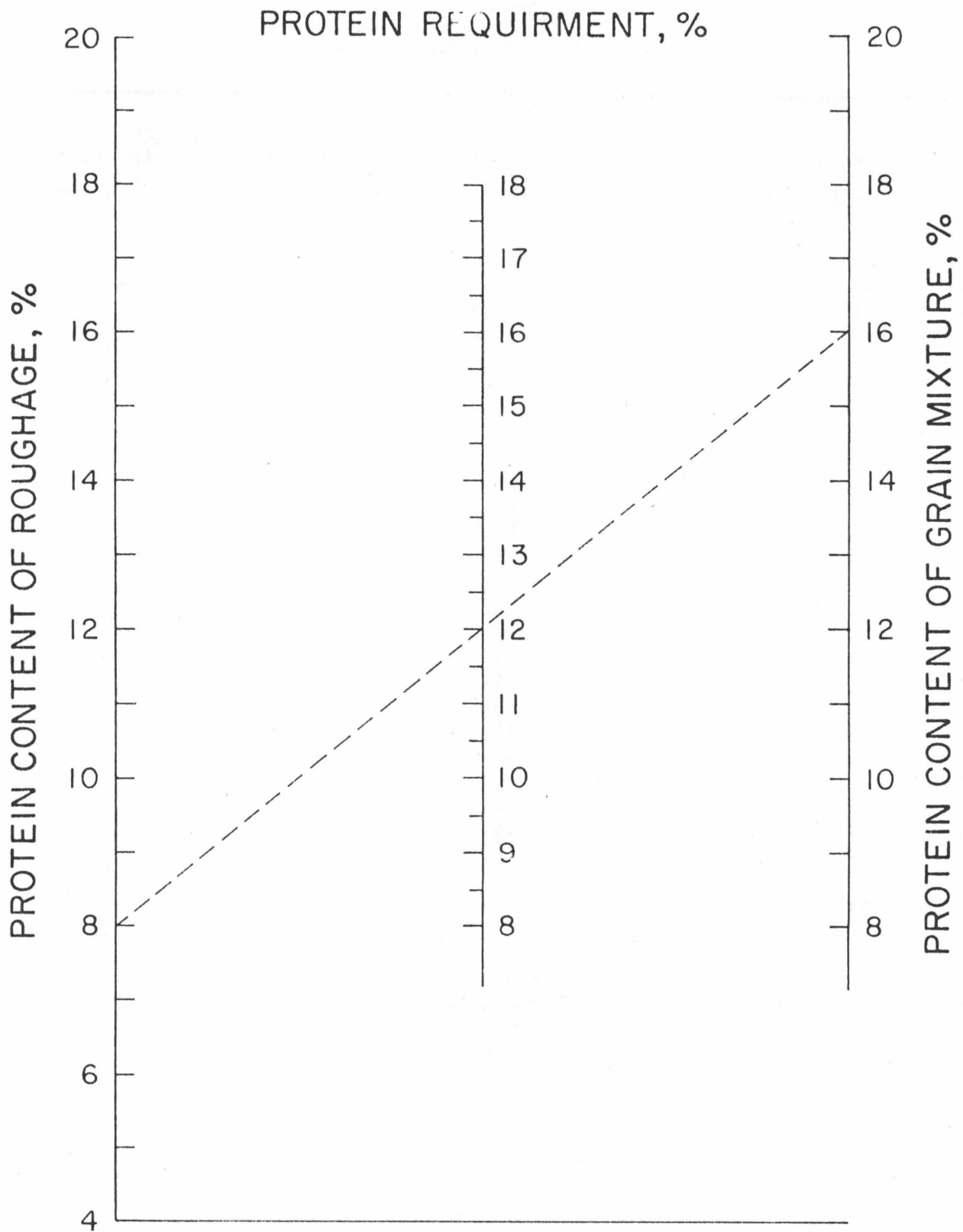


FIGURE I. QUICK REFERENCE FOR DETERMINING PROTEIN CONTENT OF GRAIN MIXTURE FOR HORSES.

THE COMMON EXTERNAL PARASITES OF HORSES

James E. Roberts, Sr.

Introduction

External parasitism is an overall farm, herd, or group problem rather than a problem of one or more individual horses. The horse owner is responsible for applying sanitary methods to prevent or control external parasites on horses.

External Parasite Damage to Horses

An external parasite is any form of living organism that spends all or part of its life on another living organism (the host). This close relationship between parasite and host often proves detrimental to the host.

The most serious damage from parasites occurs in young horses during their first 2 years of life. The greatest injury to foals and colts is insidious, and parasitism results in varying degrees of impaired growth, development, and resistance to diseases. However, some parasites in or on mature horses can cause unthriftiness, weakness, and increased susceptibility to diseases, or even death. Injury to all horses is related primarily to the type and number of parasites present and the length of time over which infections or infestations are acquired.

Signs sometimes associated with internal parasitic infections are rough hair coat, weakness, emaciation, colic, chronic cough, stunted growth, diarrhea (sometimes bloody), and tail-rubbing.

An infestation of external parasites may cause some of the same symptoms associated with internal parasites. For example, dense populations of lice or ticks on a horse may result in weakness and emaciation; the tail louse can cause tail-rubbing. Loss of hair may be due to lice or, in some instances, to insect bites.

Ticks

The lone star tick is a common tick in some areas of Virginia. It has four stages in its life cycle: egg, larval or seed tick, nymphal tick, and adult. The adult female is brown with a prominent white spot on the back. Males are solid brown in color and smaller than the females. The larvae or seed ticks are solid in color, as are the nymphs or yearling ticks.

Adult ticks are abundant from very early spring until the last of June. Seed ticks are most abundant during July and August, and nymphal ticks are plentiful in the fall.

There are two species of winter ticks. These are most numerous during early winter. Winter ticks and the lone star tick will feed on horses.

Mites

Mites are closely related to ticks and cause a variety of skin conditions called mange. Outbreaks of mange occur only sporadically in horses. Of the several mite species, some produce scabby areas on the skin surface, and others form tunnels by burrowing just under the skin. Mites may infest any part of the horse's body.

The life cycles of these mites are very similar. Mating occurs in the burrows or on the skin surface, and female mites lay one to two eggs each day during a life span of 12 to 15 days. Eggs hatch in about 4 days, and the immature mites reach maturity in 10 to 14 days.

Sarcoptes scabiei is the mite that usually causes mange of the neck, shoulders, head, chest, flank, and abdomen of the horse. These mites burrow under the skin, producing great irritation and itching. The skin becomes inflamed and swollen, and small nodules form over and around the burrows. The horse rubs and bites these infected areas so that hair is lost and large scabs develop. If left untreated, the skin becomes thickened and wrinkled.

Chorioptes bovis (var. equi) lives on the horse's skin surface and produces lesions similar to those caused by sarcoptic mites. These mites are more commonly found below the hocks and knees, and skin lesions in these areas are called foot mange. Infested horses are restless and attempt to relieve the irritation by pawing, licking, or biting their lower leg areas.

Psoroptes equi lives on the skin surface, appearing primarily on the poll, under the mane, or on the tail -- on any part of the body thickly covered with hair. The mites cause intense itching, and the horse constantly rubs and bites affected areas. These areas begin to lose hair, and scabs form over the thickened and wrinkled skin.

Mange caused by any of these mites is difficult to treat and eradicate. Mites are transmitted to healthy horses through contact with infested horses and objects like blankets and curry combs. It is important to isolate infested horses and keep all equipment separate until the disease is controlled.

Skin scabs and scrapings should be taken by a veterinarian and examined to determine whether the horse has sarcoptic (burrowing mites), chorioptic, or psoroptic mange. Treatment requires thorough, weekly applications of a highly specific insecticide. Dusts are not effective, and high-powered sprays are necessary to get the insecticide into the skin if sarcoptic mange is diagnosed. A thorough wetting with a brush-wash technique is necessary to kill chorioptic and psoroptic mites.

Lice

Three species of lice live as permanent parasites on horses. The blood-sucking louse, Haematopinus asini, and two biting lice, Trichodectes pilosus, and T. equi, are the most common on horses in North America. These lice do not survive transfer from horses to cattle nor can the species peculiar to cattle live on horses.

The life cycles of sucking and biting lice are similar in the time required to develop from egg to nymph to adult. The white-colored eggs (nits) stick to the animal's hairs and incubate for 5 to 14 days, whereupon the young lice (nymphs) emerge. The growing nymphs feed for about 2 weeks before they become males and females. As adults, they continue to feed. They mate in about 1 week, and then the females begin to lay a few eggs each day. Different species lay from 50 to 100 eggs in a life span of 4 to 5 weeks.

Since lice are wingless, they depend mainly on animal contact to transfer from an infested host to a clean one. This occurs more often when animals are penned and closely crowded together. Some animals are particularly susceptible to louse infestations and so are known carriers. These animals should be routinely inspected and treated. Horses should be carefully inspected and treated. Horses should be carefully inspected when bought at sales or from private sources; if infested with lice, the horses should be treated before they are introduced onto the ranch. Equipment, such as grooming brushes, blankets, and harnesses, may contain louse-infested hairs and thus can transmit louse infestations among horses. Modern rapid transportation of horses over long distances intensified the problem of keeping animals free of lice.

Dense louse infestations are more common during winter and through the early spring months when the horse's long hair coat protects the lice against the cold and against the animals licking themselves.

Sucking and biting lice can occur on all body regions, but, because of the animal's self-grooming, lice are usually first seen on the head, neck, mane, and tail.

It is difficult for the untrained observer to see louse infestations on horses. Lice usually go unnoticed until there are larger numbers in certain body regions or until the entire body is invaded. During this time, horses may become nervous and scratch, rub, and even bite to relieve the irritation caused by lice. Lice on light-haired animals are usually detected when "greycoats" gradually appear as a result of blood-sucking louse infestations. The scabbed-over lesions may be mistaken for those caused by mange or scab mites or by nutritional deficiencies.

The condition of horses on short-feed rations may decline during the winter. These horses are more prone to severe louse infestations than are

animals on full feed and maintained in good condition. When louse populations are left unchecked, the blood-sucking lice may cause more severe damage to horses than the biting lice. Blood-sucking may result in weakness and contribute to stunted growth in young stock and to the loss of condition and weight in older animals. Horses with lice are more susceptible to systemic disease.

Horses should be routinely inspected for lice during the winter, particularly if they are kept in close confinement with other animals. Several insecticides, sold as emulsifiable-concentrate or wettable-powder formulations, are available for use on horses. Since most horses are difficult to control under application of high pressure sprays, we suggest that horses be individually treated by brisk, thorough brushing of the insecticide onto the louse-infested body areas. It is necessary to re-treat the horse in about 2 weeks to kill young lice hatching from eggs not affected by the first treatment.

Soak saddle blankets of louse-infested horses in boiling water. Also treat general equipment like brushes, rope halters, and leather articles in hot water or rub it down with an insecticide solution and re-treat it in 2 weeks.

Insects (Internal Parasite Forms)

Bots of horses are the larvae of botflies (gad-flies). Of the three species in North America, the most widespread is the common bot, Gasterophilus intestinalis. The adults are nearly the same size as bees (1/2 to 3/4 inch long), but botflies are covered with either black and yellow hairs or all black hairs. Adult flies have undeveloped mouthparts and so they do not feed or bite as is commonly believed.

Adult botflies are usually active from July until the first frost in October. Female botflies can lay from 150 to 500 eggs in a life span of 7 to 10 days. The female flies deposit eggs on the hairs of horses. The droning noise while in flight, the sudden attack to lay eggs, and the possible sensation felt during egg-laying cause irritation.

The yellow-colored eggs are glued to hairs on the horse's front legs, chest, neck, belly, and sometimes on the hind legs. Eggs incubate for 1 to 2 weeks before the larvae are ready to hatch. The eggs hatch only if the horse licks or bites the area where they have been deposited. The moisture, warmth, and friction from licking stimulate larval hatch. The young, spiny bots are taken into the horse's mouth and begin their internal journey. They will remain inside the horse for 8 to 10 months.

Inside the horse's mouth, the young bots penetrate the mucous membranes of the tongue and, after 3 to 4 weeks, migrate to the stomach, where they attach themselves to the lining of the stomach wall.

When the bots are fully grown, they detach themselves, move through the intestines, and are passed out in the droppings. While they travel through the intestines, the bots change to the pupal stage (nonfeeding). Once outside, the pupae burrow beneath the ground surface. They spend from 1 to 2 months belowground until adult flies develop inside the pupal cases and are ready to emerge during the warm summer months. The life cycle from egg to adult fly takes 1 year.

The throat botfly or chin fly, G. nasalis, lays eggs under the horse's jaw and throat. Incubation takes 4 to 6 days, after which the larvae hatch without external stimulation. The larvae crawl into the mouth and penetrate gum tissue between the molar teeth. Large numbers of larvae in the gums may cause pus pockets and mouth irritation. After 1 month in the mouth, the larvae migrate and attach themselves to the stomach wall. They may even be found in the forward end of the small intestine.

The nose botfly, G. hemorrhoidalis, darts at the horse's nose to lay black-colored eggs on the hairs in front of the upper and lower lips. This activity annoys horses and may result in head-tossing, lip-rubbing on corral posts, and "bunching-up," with muzzles over the backs of other horses. The larvae hatch by themselves in 2 to 4 days, penetrate the inner lip membranes in front of the incisors, and, after 5 to 6 weeks, migrate to the stomach. Once in the stomach, the throat and nose bots develop and then leave the horse in the same manner as the common bot.

A few bots cause little damage, but, when numerous, they can cause gastrointestinal disturbances and, in a few instances, mechanical blockage of the stomach outlet. This blockage results in colic and may possibly cause the stomach wall to rupture.

Effective control depends on treatment and interruption of the bot life cycle. For external treatment of bot eggs, apply a warm water wash (110° to 120° F) that contains an insecticide. Briskly rub or sponge the area infested with eggs to stimulate hatching so that the insecticide will kill the larvae. It is usually sufficient to treat once a week for common botfly eggs, but it is necessary to treat two to three times each week for throat and nose botfly eggs.

For internal treatment of the horse to control bots, consult a veterinarian. A few drugs are available as powders or granules that can be added to a grain supplement. Palatability may be a factor with some horses; the horse must eat the entire portion to obtain maximum bot control. Other formulations, available in paste form, are prescribed and inoculated by veterinarians.

Cattle Grubs

Cattle grubs are the larvae of heel flies, Hypoderma species. Two of these species are found in North America - H. lineatum and H. bovis. These flies lay eggs on the lower extremities of cattle. After hatching, the larvae pass through the skin and migrate for many months inside the body tissues. Then they cut holes in the skin along the backline, drop to the ground, and pupate. This cycle takes 8 to 9 months.

When populations of these flies are dense, they may attack horses that are near cattle on range or pasture. Because the larvae are in the wrong host, they cannot complete development and many make aberrant migrations to the head, neck, withers, and rib cage areas. Here they remain just under the skin and form hard nodules that, in some cases, form sores when the horse itself or the saddle rubs the affected part. These grubs can be surgically removed.

House Fly

The house fly, Musca domestica, is closely associated with man and his domestic animals. This species is widely distributed around the world and is one of the principal pests around horse stables. Adult house flies are attracted to waste materials, where they feed and deposit their eggs. The house fly, which feeds twice daily, regurgitates liquid through its proboscis while depositing fecal matter as it crawls over its food. Thus, this species can transmit human and animal diseases. House flies transmit stomach worms, Habronema species, to horses; the section "Internal Parasites" gives more information on this disease.

The dark spots often seen on walls, ceilings, overhead beams, pipes, electric wires, and on corral fencing are the characteristic "fly specks" of vomit and fecal material. Adult flies rest on overhead surfaces inside stables. Flies also can be seen outside on undersurfaces of roof overhangs, on fences, and in weeds, shrubs, and trees. These resting places are always close to the flies' food sources and egg-laying areas, such as stacked horse manure, manure plus straw bedding, wet feed, and decomposed plant material (grass clippings, vegetable and fruit wastes). House flies do not normally develop in single manure droppings but rather in those gathered and piled for later use as fertilizer.

Under favorable conditions -- warm weather and an abundance of food -- each female may produce many batches of eggs, and the usual life cycle from egg to adult fly is 1 week. Because the house fly is a warm-weather species, populations are denser during the summer, particularly in the southern temperate and semitropical regions.

Stable Fly

The stable fly, Stomoxys calcitrans, sucks blood and is a vicious biter, particularly in the early evening hours when the weather is warm and humid. Horses, cows, dogs, man, and other mammals are the usual victims.

Dense populations of stable flies are commonly observed flying about or resting on the sides of horse barns and on nearby vegetation. Severe fly attacks irritate horses and may cause restlessness and the stamping of feet.

Because stable flies crawl over horse manure and then suck blood from horses, these flies readily transmit stomach worms, Habronema species. More information on this disease is given under "Internal Parasites."

Female stable flies lay eggs in horse manure mixed with stall bedding or feed wastes. Other breeding places are piles of decomposed fruit and vegetable waste, and compost piles of lawn clippings. Adult flies are more numerous in the spring and late summer. The life cycle of the stable fly takes approximately 3 weeks under optimum conditions.

Horn Fly

The horn fly, Haematobia irritans, sucks blood and is a nuisance to cattle and occasionally to horses. Horses are attacked when they are pastured with cattle, ridden into rangeland areas, or kept in paddocks near cattle on rangeland or irrigated pasture.

Horn flies commonly hang downward on the sides and legs of cattle and horses. The flies remain on their host day and night, resting behind the head, on the sides of the neck, and on the shoulders, withers, backline, abdomen (particularly in the navel area), and legs. Horn flies are gray to black and resemble the common house fly but are about half as large.

Horn flies breed in single, fresh droppings of cow manure. Eggs hatch in less than 24 hours and require moisture for survival. The life cycle from egg to adult may be as short as 10 days in hot, humid weather and up to 1 month during the spring and fall. This species is not known to transmit any disease of horses.

Face Fly

Musca autumnalis is a fly pest of horses, cattle, and open-faced sheep. This fly species invaded the United States during 1950-1951 and now occurs in all states except Alaska, Arizona, Florida, Hawaii, Louisiana, New Mexico, and Texas.

The face fly breeds only in single, fresh animal droppings and only in those from cattle on rangeland or pasture. The life cycle from egg to adult takes 8 days during warm summer months and up to 2 to 3 weeks in cooler weather. Adult flies are present from April through October and in greatest numbers between July and September.

Face flies attack horses that are pastured with cattle, ridden into rangeland areas, or kept in paddocks near cattle on rangeland or irrigated pasture. The flies cause irritation when they obtain nourishment by sucking mucous secretions from the horse's mouth, eyes, and nostrils, or from fresh wounds caused by blood-feeding insects (horse flies, gnats, and mosquitoes) and ticks. M. autumnalis is not known to transmit any disease of horses.

Good face fly control is difficult to achieve because adult flies visit horses only to feed. At other times, these flies are found in nearby vegetation, on fences or buildings, and on cattle droppings, where the females lay eggs. Chemicals applied to the horse's face and head, either as repellents or contact insecticides, do not last long enough for effective control. An old-fashioned face mask or net can be attached to a rope or leather halter so that its movement keeps flies from attacking the horse's eyes.

Blow Flies

Black blow flies, Phormia regina, are most numerous during the spring and fall. The life cycle takes 3 to 4 weeks during the spring but may take only 1 to 2 weeks in summer. Females usually lay eggs in the necrotic tissue of horse wounds (from castration, in navels of newborns, etc.) but may also lay eggs in animal carcasses, afterbirths, or in garbage that contains meat scraps. Adult blow flies rest in sunny areas outside horse barns or on adjacent vegetation. The adults have been known to fly as far as 28 miles from their point of origin.

Larvae of green or bronze blow flies are most often found in household garbage, but they also can occur in animal carcasses, dog droppings, dead snails, dead fish, and decaying fruit and vegetable waste. The larvae occasionally occur in animal manure, particularly in horse manure mixed with spilled feed, decomposed plant material, or straw bedding.

The adults appear in dense populations from July through September. Green blow flies are particularly troublesome around food. Since they are attracted by cooking odors, these flies are the primary pests at outdoor patio barbecues but may also be a problem in kitchens. The adults commonly rest on the sunny outside surfaces of buildings, and large numbers are also seen on the leaves of shrubbery, trees, and in other types of vegetation. These blow flies have been found as far as 10 miles from their point of origin.

Horse Flies and Deer Flies

The bloodsucking flies of this group, Tabanus and Chrysops species, are of various sizes and colors. The most common horse fly, Tabanus, is about 1 inch long and is dark gray and black, with a white triangular spot behind the head. Deer flies are smaller, about 3/8 to 1/2 inch long, and usually have yellowish-orange and black body markings.

These flies are summer pests of horses and are distributed from sea level to mountain elevations. Horse and deer flies do not occur in as large numbers on horses as do mosquitoes, gnats, and manure-breeding flies. Horse and deer flies attack horses pastured in or ranged near areas with a marsh, swamp, creek, or irrigation ditches. The life cycle may help explain this distribution.

Horse and deer flies lay eggs on plants, stones, or twigs next to or in water areas. After hatching, the fly larvae (maggots) burrow into the muddy edges bordering the stream or pond. The maggots feed and grow for about 9 to 10 months and then seek drier soil near the water's edge, where they transform into a pupal or resting stage (nonfeeding). The adult fly emerges from the pupal case in about 2 to 4 weeks.

The adults are strong fliers and can be found many miles from their original water source. They possess sharp, scissorlike mouthparts, which slice into the skin and permit a good flow of the blood they need for food and subsequent egg development.

Control of these flies during the larval stage is difficult because of the extensive areas that require treatment. Swamp or marsh drainage, filling seepage areas along streams, weed control along irrigation ditches, and prevention of waste irrigation water in pastures all help reduce places where these flies lay eggs and where their larvae develop.

Fly strike on horses is also difficult to control. No satisfactory fly repellent that lasts longer than a few hours after application has been developed against these species.

Gnats

Only the bloodsucking gnats are important to horse owners. The most common are the black flies, which belong to the family Simuliidae and are represented by many different species. They are distributed throughout mountainous areas, forested river valleys, coastal plains, and hilly areas.

The adults of the various black fly species attack different parts of the horse. Some species are particularly attracted to and suck blood inside the ears; when in large numbers, these gnats cause considerable irritation and tissue damage. Other adults blood-feed on body areas around the head, neck, or belly. When dense black fly populations suddenly descend on horse ranches, the animals react by frequently tossing their heads, switching their tails, and twitching their skin. Some horses attempt to avoid black fly attacks by restless movement around the paddock or by moving indoors, into water, or into the dense shade of tree and shrub growth.

The lesions caused by black flies may form papules, which rupture, ooze serum, and become crusted. Repeated attacks or biting may cause a high level of sensitivity in horses; intense skin wheals develop that later emit a pruritic discharge, causing the wounds to heal very slowly.

Black flies usually produce one generation a year; the adults appear in late spring and early summer. Some species may have more than one generation, and the adults are found all through the summer. Water temperatures and the availability of water flow in streams, rivers, creeks, and water-supply and drainage ditches influence the number of generations. The eggs of black flies are deposited along the edges of these water sources or are attached to vegetation, rocks, or objects subject to flooding by natural or manmade water systems. The larvae and pupae develop only in relatively fresh, clear, moving water, and are not found in stagnant water masses, such as lakes, ponds, and reservoirs. For this reason, many black fly attacks occur shortly after spring rains and flooding conditions caused by excessive runoff. Large agricultural areas may sustain longer periods of adult black fly activity due to irrigation practices.

Other types of gnats that bother horses are known as Culicoides ("no-see-ums"). They produce extremely small adults that are not readily seen. Unlike the black flies just described, these two groups of gnats lay eggs in mud or sand in margins of ponds, lakes, ground pools, tree holes, and even liquid manure. Single or multiple generations are produced each year, depending on the species and on whether the breeding places are subject to drying or to repeated wetting by rains or irrigation. The no-see-um adults are encountered during the entire summer.

Culicoides gnats transmit the virus of blue tongue disease in sheep, but these are not known to transmit any disease to horses. Although the bites are painless, they cause skin reactions a short time afterwards. On some animals, papules develop in large areas, with subsequent irritation, and the animals lose hair when they constantly scratch or rub the affected areas.

All these gnats are difficult to control because of their extensive breeding places in natural woodland and agricultural areas. In recent years, urbanization around horse ranches has minimized or eliminated many of the gnat breeding sources, but this is of little solace to horse owners whose operations are in rural areas.

Repellents in the form of sprays, wipe-ons, or smears offer some protection, but applications are needed almost daily to prevent continuous gnat attacks. A light spray or smear can be applied to ears of horses, but most animals resist repeated ear handling and treatment. Ear nets are effective during periods of gnat attack if the animals will wear such devices. Other temporary methods are keeping horses inside stables or barns during most of the day or, if possible, the transfer of horses to other locations during the gnat-breeding period.

Consult a veterinarian for curative and protective treatments for skin rash and lesions or for internal ear damage.

Mosquitoes

Mosquitoes are important temporary parasites because of their widespread distribution, tremendous breeding potential, vicious biting habits, and their ability to transmit diseases to man and animals.

Particularly important to horsemen are the mosquitoes that transmit viruses causing "sleeping sickness," or, as properly called, Western Equine Encephalomyelitis (WEE) and Eastern Equine Encephalomyelitis (EEE). In 1971, Venezuelan Equine Encephalomyelitis (VEE) entered the U.S., causing many horse deaths and resulting in a benign illness in humans. Vaccines for horses are available for these three virus diseases, and all horses should be routinely vaccinated, depending on ranch location and extent of interstate travel. To date, there is no licensed vaccine developed to protect humans against WEE and EEE (known as encephalitis in humans).

The life cycles of all mosquitoes consist of four stages: egg, larva ("wiggler"), pupa ("tumbler"), and adult. Mosquitoes lay eggs either directly on water or on dry surfaces -- on the ground, inside tree holes, or in manmade containers (tin cans, wheel-barrows, buckets, rubber tires). Eggs hatch when water later covers the eggs laid in these drier areas. During warm summer weather, the cycle from egg to adult mosquito may take as little as 1 week.

Around horse farms or stables, the most common water sources where mosquitoes breed are water-holding low spots in corrals and paddocks, large, infrequently used drinking troughs, irrigated pastures, drainage ditches, natural flooded meadows, swamps, creeks, tree holes, manmade containers, leaf-choked rain gutters, and poorly covered septic tanks and drains.

Large populations of adult mosquitoes are usually found around their water breeding sources, but many species are able to fly several miles or are carried by wind several miles into surrounding areas.

Skin reaction in horses may develop when large numbers of mosquitoes blood-feed during a short period. Papular skin eruptions may also appear on the legs, flanks, and neck areas as a result of the horse's sensitivity to the bites of particular mosquito species.

Mosquito control largely depends on elimination of standing water. Good housekeeping methods around the horse ranch are the first line of defense. All water-holding containers should be disposed of or turned over when they are not in use. Stock large water troughs with surface-feeding minnows (mosquito fish) or drain the troughs weekly if they are not in constant use. Clean rain gutters each spring to permit free flow and drainage of water.

Fill low spots in corrals or paddocks; the ground surface should be sloped for proper drainage. Rework larger water-holding areas, such as low spots in pastures and drainage ditches, to afford good drainage. Weed control along ditch banks may be necessary to ensure the free flow of water.

Owners of horses within the boundaries of mosquito abatement districts should obtain assistance in permanent and temporary (insecticide application) control methods. Those not so fortunate can obtain similar information from their county health and agricultural departments, even though personnel in these latter agencies do not usually have insecticide-application equipment.

Fly and Mosquito Control

Management. Three basic ranch practices are necessary to reduce natural fly attractants and to prevent fly breeding. These are manure management (collection and disposal), water management (supply and drainage), and general ranch sanitation (disposal of animal and other organic debris).

Manure: Remove manure from stalls daily and re-bed at least twice a week during the summer and once a week in the winter. Also remove urine-soaked bedding on the same schedule and replace it with fresh bedding as needed.

Stable wastes should be immediately spread in a thin layer on a fallow field. Do not use these wastes as fertilizer on grazing pastures, particularly if the horses have recently had internal worm infections. Various parasite eggs are resistant for weeks or even many months against heat or cold and wet or dry conditions. As alternatives, wastes can be thinly spread in arenas or paddocks as a cushion, hauled directly to farmers for fertilizer use, or taken to a county-approved landfill for destruction.

Water: Paddocks and corrals should be properly graded to permit drainage of rainwater or water-trough overflow. Automatic, nonleak valves are essential for all troughs, bowls, cups, and other water sources. Feed bins should be separate from water sources.

Re-level flat pastures when potholes or drainage problems develop; fence off the potholes and swampy areas until re-leveling is accomplished. These corrective measures reduce the chances of internal parasitism, and pasture improvement also helps control mosquitoes and horse flies.

Sanitation: Good sanitary methods around the barn, outdoor stalls, paddock, arena, tack sheds, and the residence are as important as manure and water management.

Give particular attention to the following: 1) Immediately remove stillborns and afterbirths to compacted earth-covered pits, tight-lid containers, or off-ranch disposal areas. 2) Give horses' open wounds immediate care and medication; have a veterinarian treat wounds that need suturing. Apply fly repellents daily over wounds (and over dressings). 3) In summer, keep bedding material in stalls to a minimum consistent with good management. 4) Remove damp or spilled feed from manger bottoms. Such feed provides a good breeding place for flies and interferes with the effectiveness of chemical fly control. 5) Keep all garbage, organic wastes, and pet droppings in fly-tight bins. 6) Weed control around stables, corrals, and surrounding areas allows more air movement, aids in drying manure, and reduces the number of resting places for some flies. Controlling weeds in open wastewater drains reduces potential habitats of flies, gnats, and mosquitoes, and allows easier access for chemical control.

Chemical control. Numerous insecticides are available for domestic fly control and are sold under many brand names as residual sprays, space sprays, baits, or repellent sprays and wipe-ons.

Surface sprays applied to the walls of barns, stalls, tack sheds, and outdoor shades provide a toxic residue that usually kills flies for 2 to 4 weeks. Some of these sprays also contain a quick knockdown compound to immediately reduce the number of adult flies.

Space sprays are most valuable when quick kill of large numbers of flies is desired. These sprays are best used in enclosed areas, such as tack rooms or offices. They have little value in open-stall or outdoor areas because air currents quickly disperse the spray droplets.

Baits are most useful in conjunction with good manure management to help kill adult flies attracted to the ranch from outside areas.

Repellent sprays or wipe-ons for use on horses have little residual effect and bring only temporary relief against flies. Such materials usually have to be applied once a day, and more frequently if horses are ridden after treatment. Repellent sprays are best used to control stable flies, which prefer to bite horses on the legs. Wipe-ons are more easily applied to the horse's head to control house and face flies because most horses do not like the hissing sound of spraying.

Necrotic or fresh wounds invaded by blow fly maggots should be treated with a suitable insecticide, available as sprays, dusts, or smears. Be sure to apply these materials in the deep recesses as well as around the edges of the wounds; reapplication may be necessary in a few days if the wound is not properly medicated. Consult a veterinarian if the wound does not heal.


Insect Control Recommendations

EXTENSION DIVISION

Virginia Polytechnic Institute and State University,

EXTERNAL PARASITES OF HORSES

J. E. Roberts, Sr., Extension Specialist, Entomology

Pests	Insecticide and Percent Dilution	How to Mix and Apply	Precautions and Days Between Last Application and Slaughter
	Trichlorfon (Anthon) Treat 30 days after first killing frost. Repeat 30 days later.	Mix with a palatable (tasty) ground feed. Use one 5-gram pkg. per 250 lb. of body weight. Do not exceed this dose. Withdraw all feed 12-18 hr. prior to treatment to help insure complete intake of treated feed. Do not offer additional feed for 12 hr. or until all medicated feed is consumed.	Do not treat sick animals, colts under 4 mo. of age, mares in last mo. of pregnancy, or animals to be used for food. Do not repeat more often than every 30 days. Remove and destroy any food not consumed after 12 hr. Do not administer along with other organic phosphates or cholinesterase inhibitors. Do not treat slaughter animals. READ LABEL CAREFULLY BEFORE USING.
	Dichlorvos (Horse Wormer)	Mix with $\frac{1}{2}$ the grain portion of the ration normally used in a single feeding. Use 19.5 grams per 250 lb. of body weight. Do not exceed this dose. To insure maximum bot removal, withhold all water for 4-6 hrs. before and for 3 hrs. after consumption of the medicine. READ LABEL CAREFULLY BEFORE USING. Do not allow fowls to have access to feed containing this chemical or to manure from treated animals.	Do not administer Dichlorvos Horse Wormer to horses affected with heaves or suffering from colic, diarrhea, constipation or infectious disease until such conditions have been corrected. Dichlorvos should not be given in conjunction with, or within 1 wk. of the administration of tranquilizing drugs or other worm medicines. Horses should not be subjected to any insecticide treatment for 5 days prior to or after Dichlorvos treatment. Do not treat slaughter animals.
	Bathe or sponge with warm water. (Apply 30 days after first killing frost.)	No mixing is necessary, but water should be kept warm to the point where the hand can be immersed without discomfort. Apply warm water with sponge where eggs are present. (Clipping of hairs infested with fly eggs should aid in control.)	Firm rubbing is a must. Water must be kept warm (115-120° F.) Worms will hatch and die when wet thoroughly with warm water.

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Pests	Insecticide and Percent Dilution	How to Mix and Apply	Precautions and Days Between Last Application and Slaughter
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SPRAYS OR WIPE-ONS

Horn flies and lice and ticks	Coumaphos (Co-Ral) 0.06%	Per 100 gal.	Per 3 gal.	Read label and observe precautions pertaining to use of coumaphos (Co-Ral). See footnote 2/. Do not treat slaughter animals.
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2 lb. of 25% WP or 2 qt. of 11.6% EC	1 oz. of 25% WP or 2 oz. of 11.6% EC
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Apply as a spray 1/ when pests are present. Use 2X concentration for tick control.

 Malathion 0.5%

Mix 1 gal. of 57% EC	Mix 4 oz. of 57% EC
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Apply up to 2 qts. per animal depending on size by means of spraying or with a sponge that has been dipped in solution.

Do not contaminate feed, water, water utensils or feed troughs. Do not treat slaughter animals.

Face flies House flies	Rabon 1% + 0.09% Pyrethrum + Piperonyl Butoxide 0.18% + Repellent 1.4%
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No mixing necessary. Available in ready-to-use oil base. Apply only as a wipe-on, preferably, to the head area. Pay particular attention to around the nostrils and eyes.

Avoid direct contact with the eye itself. Do not treat slaughter animals.

 Stable flies

Apply as a wipe-on or spray to the legs and flanks, leaving no unprotected area.

More frequent applications may be necessary if the legs are exposed to high grass or water.

 Biting gnats

Apply only as a wipe-on preferably, to the head, neck, belly and forelegs. Be sure to apply the insecticide/repellent to the inside surfaces of the ears.

Mosquitoes, Horse flies, House flies, Deer flies, Horn flies	Rabon 1% + 0.09% Pyrethrum + Piperonyl Butoxide 0.18% + Repellent 1.4%
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No mixing necessary. Available in ready-to-use oil base. Apply as a wipe-on or spray to evenly cover the flanks, belly, and back of the horse or pony.

More frequent applications may be necessary if the legs are exposed to high grass or water. Do not treat slaughter animals.

Face flies, House flies	Rabon 2.0% + Pyrethrum 0.09% + Piperonyl Butoxide 0.18% + Repellent 10.0%
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No mixing necessary. Available in ready-to-use gel base.

 Stable flies



Apply a thin film of the gel as a wipe-on to the head area paying particular attention to around the nostrils and eyes, however, avoid direct contact with the eye itself.

Pests	Insecticide and Percent Dilution	How to Mix and Apply	Precautions and Days Between Last Application and Slaughter
Biting gnats	Rabon 2.0% + Pyrethrum 0.09% + Piperonyl Butoxide 0.18% + Repellent 10.0%	Apply a thin film as a wipe-on to the legs and flanks leaving no unprotected area. Apply a thin film as a wipe-on to the head, neck, belly and forelegs. Be sure to apply gel both inside and outside surface of the ears.	More frequent applications may be necessary if the legs are exposed to high grass or water. Do not treat slaughter animals.
Horn flies, face flies, stable flies, deer flies, black flies ³ / ₄ , mosquitoes, gnats and punkies	Synergized pyrethrins ⁴ / ₁₀₀ 0.05% to 0.1% + synergist 0.5% to 1%	Follow directions on container. Many ready-to-use mixtures have these ingredients. Apply 1 to 2 oz. as a fine mist with hand or automatic sprayer or as a wipe-on when pests are present. Repeat as necessary.	This chemical is very safe with normal precautions. May be available with a repellent added. Do not treat slaughter animals.

HAND DUSTING

Horn flies and lice	Malathion 4% or 5% dust	No mixing is necessary. Apply liberal amount to neck, back and shoulders with shaker can. Rub or brush into hair.	Do not contaminate feed, water, water utensils or feed troughs. Do not treat slaughter animals.
Horn flies, stable flies	Carbaryl (Sevin) 5% dust	No mixing is necessary. Rub 2 oz. of dust into hair on back and neck when pests are present. Do not use on slaughter animals.	Do not apply more than once every four days. Claims limited to suppression of populations of stable flies.

- 1/ One of the most effective ways of treating horses for control of external parasites is by spraying. However, if only a few animals are being treated or if the animals are too nervous to tolerate spraying, sponging the animals with a spray mixture may be desirable. Rubber gloves that will give complete protection should be worn by anyone who chooses the sponge or wipe-on method of treatment.
- 2/ Do not apply to sick, convalescent, or stressed animals or animals less than three months old. Do not dip or spray animals for 10 days before or after shipping, weaning, or after exposure to contagious or infectious disease. Do not apply in conjunction with oral drenches or other internal medications such as phenothiazine, or with natural or synthetic pyrethroids or their synergists, or with other organic phosphates.
- 3/ Results of recent research conducted in Virginia indicate that vaseline applied in the ears of horses will give up to four days protection from blackflies.
- 4/ MGK R-11 or R-326, Tabutrex or Crag fly repellents may be added to synergized pyrethrins for increased effectiveness, especially against horse flies.

AG - Indicates the proper EC formulation for agricultural uses; AI - Active Ingredient; AI/Gal. - Active Ingredient per Gallon; D - Dust; E - Emulsifiable; EC - Emulsifiable Concentrate; EL - Emulsifiable Liquid; F - Flowable; fl. oz. - fluid ounce; G - Granular; gal. - gallon; gal/100 - gallon per 100; in. - inch; IU - International Unit; lb. - pound; lb./gal. - pounds per gallon; LC - Liquid Concentrate; liq. sol. - liquid solution; LS - Liquid Solution or Suspension; MG - Milligram; oz. - ounce; pt. - pint; qts. - quarts; S - Soluble or Sprayable; SC - Soluble Concentrate; SP - Sprayable or Soluble Powder; sq. ft. - square ft.; tbsp. - tablespoon; tsp. - teaspoon; W - Wettable; WP - Wettable Powder

Trade and brand names are used only for the purpose of information and the Virginia Cooperative Extension Service does not guarantee nor warrant the standard of the product, nor does it imply approval of the product to the exclusion of others which may also be suitable.

KEYS TO PROPER USE OF PESTICIDES

1. Read the label on each pesticide container before each use. Follow instructions to the letter; heed all cautions and warnings, and note precautions about residues.
2. Keep pesticides in the containers in which you bought them. Put them where children or animals cannot get to them, preferably under lock and away from food, feed, seed, or other material that may become harmful if contaminated.
3. Dispose of empty containers in the manner specified on the label.

SEE YOUR DOCTOR IF SYMPTOMS OF ILLNESS OCCUR DURING OR AFTER USE OF PESTICIDES.

INTERNAL PARASITES AND THEIR CONTROL IN THE HORSE

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There are 57 species of parasites that have been found in horses. This is more than is found in any other livestock species. Fortunately, all of them are not common in Virginia. Strongyles, Ascarids, Bots, and Pinworms are responsible for the vast majority of parasitisms observed in horses in this state.

The damage to the horse varies with the parasite involved, the organ or tissue affected, and the number as well as the feeding and migratory habits of the particular parasite or parasites involved. Almost every tissue and organ may suffer damage and it can be minor or severe enough to cause the death of the animal.

All members of the equine family are subject to parasite infection including ponies, burros, mules, etc. While horses of any age may be parasitized, infections in the young animals are usually the most dangerous.

Strongyles

The strongyles, or blood sucking worms, feed on blood from the host animal. They are found in the intestines where they cause extensive damage to the blood vessels and the mucous membrane. The loss of blood results in anemia and makes the animal more susceptible to bacterial infections. Young animals are more severely affected than older animals.

Life Cycle

The infective larvae are ingested by the horse grazing on contaminated pastures or eating contaminated feed. The larvae migrate extensively causing damage to many organs and tissues. The larvae of one species of strongyle may penetrate the walls of arteries particularly, those that supply blood to the intestines causing recurrent colic. The larvae require 6½ to 8 months to reach maturity. The adult parasites then migrate to the large intestine and remain there during their adult life.

The adult worms penetrate the intestinal wall, attach themselves to small blood vessels, and thus secure the blood necessary for them to survive. The injury to the intestinal wall results in interference with the digestion and absorption of food as well as loss of blood. The adult females lay thousands of eggs daily and these pass out of the body in the manure.

When the temperature is 75 to 80° F. the eggs hatch in approximately 20 hours. The resulting free living larvae develop into the infective stage in 5-6 days. They are then capable of infecting the horse when ingested and it must be ingested to complete the life cycle. Freezing stops the hatching of the eggs and the development of the larvae but does not kill either. Heat generated by composted manure kills both. Larvae live about 3 months on the average but may live for a year or even longer in moist cool climates.

Ascarids

Ascarids or roundworm infections are primarily a problem of young horses. They seldom cause significant damage in animals that are 4 years old or over. They are primarily found in the small intestine.

Life Cycle

Infective (embryonated) eggs are taken in with contaminated feed and water. The eggs hatch in the small intestine and the microscopic larvae penetrate the intestinal wall, enter the blood stream and are carried to the liver and lungs. Heavy numbers of larvae can cause severe inflammation and destruction in the liver and lungs. After approximately one week in the lungs the larvae move up the trachea, are coughed up, and swallowed again. When they reach the small intestine the second time they quickly mature, become adult worms, and produce eggs. While ascarids do not attach themselves to the intestinal wall as do the strongyles, they do utilize a great deal of food, excrete toxic wastes, depress growth and development, cause digestive disturbances and produce potbellies.

The eggs pass out in the manure but do not hatch outside the host. They do embryonate and become infective in 10-14 days. The eggs are quite resistant especially to drying and freezing and can remain alive and

infective for 5 years or longer. Heat is harmful to them and the hot dry weather of summer or the heat generated in composting can destroy many. Lye is also effective in destroying ascarid eggs.

Bots

Stomach bots are the larvae of the horse bot flies. There are more than one species and they differ primarily in the location on the horse, where the eggs are laid, and in the way in which the eggs hatch.

Life Cycle

During the summer and early fall eggs are deposited by the bot fly on the hair of the forelegs, shoulders, lips, and muzzle of the horse. The eggs hatch as they are licked by the horse and enter the mouth via the tongue. The minute larvae burrow into the tongue, remain there for approximately one month and then migrate to the stomach. They attach themselves to the mucous membrane lining the stomach causing damage to the stomach wall and sometimes producing a fatal colic when they block the valve located at the juncture of the stomach and small intestine. The larvae remain in the stomach for 8-10 months until they have completed their development. They detach themselves from the wall and are passed out in the manure.

The larvae pupate outside the host and the mature fly emerges in about one month. The flies mate and reproduce thus completing the life cycle.

The female fly darts at the horse very quickly and repeatedly, attaching an egg to a hair each time. While the flies do not bite, they do annoy the horses often causing them to run wildly or even panic.

Pin Worms

Pin worms are less harmful than the parasites discussed previously. They cause rectal irritation primarily.

The details of the life cycle of these worms are not completely known. It is known that the worm lives in the lower intestine where they produce a moderate inflammation. The females leave the rectum and deposit

their eggs on the skin around the anus causing an intense itching which the horse attempts to relieve by rubbing the tail.

Immature worms can produce severe damage to the mucous membrane in the upper large intestine. Horses become infected by consuming feed and water contaminated with infective worm eggs.

Internal Parasites of the Horse

Kind	Location	Ages Affected	Damage and Symptoms
Bots	<u>Eggs</u> -on hair <u>Larvae</u> -mouth, tissues and stomach	All Ages	<u>Flies</u> -cause excitement among horses <u>Larvae</u> -digestive upsets, retarded growth, poor condition and death (due to stomach rupture or perforation)
Ascarid or Large Roundworm	<u>Larvae</u> -in liver and lungs <u>Adults</u> -small bowel	Young animals 2 years old and under	Retarded growth, rough hair coats, potbellies, digestive upsets, such as colic, pneumonia and death due to rupture of the bowel.
Strongyles or Bloodworms	<u>Larvae</u> -arteries, liver and gut wall <u>Adults</u> -large bowel	All ages but young are especially susceptible	<u>Acute Infection</u> -Fever, loss of appetite, rapid loss of weight, depression, progressive weakness, diarrhea or constipation and death. <u>Chronic Infection</u> -Retarded growth, loss of weight, poor appetite, rough hair coat, weakness, recurrent colic and death.
Pinworms	<u>Larvae</u> -large bowel <u>Adults</u> -large bowel and rectum	<u>Larvae</u> -all ages <u>Adults</u> -young	<u>Larvae</u> -digestive disturbances, retarded growth <u>Adults</u> -irritation of anus and tail rubbing

Internal Parasite Control Recommendations for Horses

An effective control program for internal parasites of horses must include recommended management procedures along with proper diagnosis and treatment based on the diagnosis. Drugs alone cannot effectively solve the parasite problem.

It is not possible to develop a simple program that will be effective on all horse farms. The existing conditions vary from farm to farm and stable to stable and influence the type of program that will be effective in a particular operation. It is, therefore, best to design a parasite control program that will best fit each situation. The local veterinarian with his knowledge of the prevailing local conditions is in the best position to assist in developing such a program.

There are certain basic management practices that are essential to the control of all parasites. These should be applied at all times.

- I. Cleanliness and Sanitation is most Important
 - A. Keep stalls dry and clean
 - B. Keep stalls and paddocks free of trash and dirt
 - C. Eliminate wet or muddy areas
 - D. Keep all utensils clean

- II. Proper Manure Disposal
 - A. Stable Manure
 1. Compost before spreading on pasture OR
 2. Spread on cropland or other ungrazed areas
 - B. Small Corrals and Pasture Lots
 1. Pick up all manure frequently and compost or dispose as above

- III. Pastures
 - A. Mow and use chain harrow frequently
 - B. Do not overstock. Some species can produce 7-10 eggs per minute per adult female -- buildup of parasites can be extremely large
 - C. Rotate pastures as much as practical
 - D. Alternately graze horses and other species of animals
 - E. Graze young animals (weanlings and yearlings) separately from older horses

IV. Feed

- A. Provide bunks, mangers, or racks for hay and grain and do not feed off of the ground
- B. Prevent contamination of feed with manure

V. Water

- A. Provide clean fresh water at all times
- B. Prevent contamination of water with manure

Drugs in Internal Parasite Control of Horses

There are many drugs used to treat internal parasites in horses in conjunction with the other measures recommended. They vary in their effectiveness against different parasites. The choice of drugs, frequency of administration, and level of dosage will depend upon the number and kinds of parasites present, the condition of the animal, the environment and time of year among other things.

The following are examples of a few programs among many that may be used. None of them may fit your needs. Consult your veterinarian for the program that is best for your particular situation.

Examples of Treatment Programs

A. Foals

1. Start treatment at 8 weeks of age
2. Repeat at 8 week intervals for ascarid control. This will also control pin worms and small strongyles but not large strongyles.
3. Maintain mares on a strongyle control program to control large strongyles.

B. Yearlings, two year olds and mature horses

1. Low level program--Feed phenothiazine, 2 grams per day for 21 days per month for strongyles. It should be given only 21 days and then omitted for the rest of the month, beginning again on the first of the next month.

--Bot control drugs are given in late fall or winter.
 --Yearlings may require 1-3 treatments for ascarids during the first part of the year.

2. Periodic treatment program--Varies from 2-6 treatments per year depending upon level of parasitism. Drugs are used alternately as indicated below. Mares should not be treated within one month of foaling. Alternating drugs will provide broad control of strongyles, bots, ascarids, and pin worms.

Periodic Treatments

<u>Date</u>	<u>6 times per year (Drugs)</u>	<u>4 times per year (Drugs)</u>	<u>2 times per year (Drugs)</u>
February 1	Parvex- phenothiazine	-----	-----
April 1	Thiabendazole	Parvex- phenothiazine	Parvex- phenothiazine
June 1	Thiabendazole	Thiabendazole	-----
August 1	Parvex- phenothiazine	Thiabendazole	-----
October 1	Thiabendazole	-----	-----
December 1	Dyrex T.F.	Dyrex T.F.	Dyrex T.F.

Low Level

<u>Date</u>	<u>Drug</u>
January 1-21	Low level phenothiazine
↓ Repeat each month	
November 1-21	
December 1	Parvex-phenothiazine <u>or</u> Dyrex T.F.

EQUINE ANTHELMINTICS*

The following efficacy study on equine anthelmintics lists the commercially available drugs. This listing does not mean that they are necessarily safe when mixed indiscriminately or combined with other compounds not mentioned. The compatibilities and use warnings should be known for each drug before administered. Example: Succinylcholine should not be used on horses within 30 days after treatment with organo-phosphate wormers or topical application.

ANTI-PARASITIC DRUGS IN THE HORSE

Name	EFFICACY PERCENTAGE					
	Bots	Ascarids	Strongyles Large S. vulgaris	Small	Toxicity	Edibility
Carbon Disulfide (CS ₂)	90-100	50-100	0	0	high	N.R. ¹
Phenothiazine (PTZ)	0	0	0-75	0-90	medium	low
Phenothiazine	0	0	0-40	0-60	low	low
Phenothiazine	0	0	95-100	90-100	low	high
Piperazines (PPZ)	0	90-100	40-60	90-100	low	high
Parvex (PPZ + CS ₂ Complex)	75-85	90-100	40-60	90-100	low	N.R.
PTZ + PPZ	0	90-100	90-100	90-100	low	low
PTZ + Parvex	70-85	90-100	90-100	90-100	low	N.R.
Dizan + PPZ	0	90-100	60-80	90-100	low	N.R.
Dyrex Captabs (Trichlorfon)	90-100	90-100	70-90	90-100	medium	N.R.
Dyrex + PPZ + PTZ	90-100	90-100	90-100	90-100	low	N.R.
Equizole (Thiabendazole)	0	10-30	90-100	90-100	low	high
Anthon (Trichlorfon)	90-100	90-100	5-10	40-50	low	high

¹N.R. -- Not Recommended.

*Dr. J. H. Drudge, University of Kentucky, Lexington, Kentucky

FIRST AID FOR HORSES

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Before attempting to discuss first aid measures for the horse, I would like to impress upon you that you should have a "family" veterinarian if you are in the horse business. Many times if your horse has a problem and you wonder if it needs a veterinarian's attention, you can talk with him and get his advice as to what should be done. Don't wait and call him when the poor horse has "three legs in the grave."

Realizing that some of this may be rather basic to certain people, maybe we should try and put a definition on what is a healthy horse and a sick horse.

A Healthy Horse

A healthy horse stands squarely on his four feet, seldom resting a foreleg unless there is something the matter with it.

Coat - shiny and soft and lies down flat and smooth.

Eyes - wide open and the conjunctiva (lining) is a salmon pink color.

Appetite - normal.

Skin - slightly moist, just enough to keep the coat soft and the skin supple.

Temperature - 99.5° to 101° F.

Respirations - even and quiet, 8-16 respirations per minute.

Pulse - 36-48 per minute.

Bowel movements - 4-8 times during a 24-hour period and should be free of mucous or abnormal odor.

Urine - light yellow color and slightly cloudy.

Limbs and joints - free from excessive heat and swelling.

A Sick Horse

A sick horse assumes abnormal attitudes such as lying down frequently and in unusual positions - "pointing" with one leg. "camped out" position, rolling, lying on back, sitting.

Coat - dull and staring.

Mucous membranes - off-color - pale, yellow, dark red, blue red.

Appetite - abnormal, depraved, off feed.

Skin - tight feeling and dry or may sweat profusely.

Temperature - subnormal - under 99°F or high 102° - 106°F.

Respirations - fast, slow, noisy, labored.

Bowel movements - abnormal color (red, dark black), consistency (loose, hard), amount.

Urine - abnormal in amount, color, consistency and produced with pain.

Limbs and joints - heat, swelling.

First Aid Kits

The question of what constitutes a basic first aid kit is frequently asked and is difficult to answer. Many factors such as type and kind of horse, the horseman's experience and his veterinarian, among others, influences the answer. What may be adequate for one would not be for another.

Following is a suggested list of items that would constitute a basic first aid kit:

1. thermometer
2. bandage scissors
3. mild disinfectant
4. white lotion
5. antiphlogistine powder
6. leg brace
7. liniment
8. healing powder and/or solution and/or ointment
9. eye medications
10. vasoline
11. bandages, cotton, gauze, tape, leg wraps
12. alcohol
13. iodine
14. a colic remedy and a cough medicine - only on your veterinarian's advice

Discuss these ideas with your veterinarian. There may be other things that he or she would suggest based on his or her knowledge of your situation.

After having looked at some of the characteristics of healthy and sick horses and talked about a first aid kit, let's get down to some problems. To detect and "see" most of the characteristics discussed does not take a lot of expensive diagnostic equipment. These things can be detected by the use of the following equipment: your eyes, ears, nose, hands and mind.

I would be remiss if I did not emphasize that a good many problems requiring first aid would not occur if a good preventive medicine program was practiced along with a maintenance program on trailers, barns, fences, lots, etc.

Some of the common problems or ailments that affect horses will be discussed now. Hopefully, you will add to the printed material as we discuss these conditions. With all of these conditions, consult your veterinarian as soon as possible.

1. Colic
 - not a disease but is a sign of pain in the abdomen
 - determine where the pain is and what is the cause
 - remove access to feed and water
 - keep animal from rolling and thrashing
 - keep animal on his feet if possible, but if it wants to lie quietly, that is all right
 - don't get horse exhausted by forced exercise, as this makes prognosis worse
 - note frequency, amount and condition of feces and urine and presence of gas expulsion

2. Laminitis or Founder
 - cause will dictate course of treatment
 - keep feet cool
 - keep "heart mechanism" of foot activated by limited exercise
 - remove feed and water immediately
 - remove shoes

3. Azoturia - Typing Up
 - keep animal warm
 - do not exercise
 - reduce feed

4. Colds, Shipping Fever, Strangles, Distemper
 - keep animal warm, dry, out of damp and drafty quarters
 - reduce feed, use a palatable laxative feed
 - keep fluids available
 - keep checking temperature and condition of lymph nodes
 - reduce exercise

5. Grease Heel, Thrush
 - both are a result of dirty environment, so clean up area
 - trim hair around fetlock
 - keep frog trimmed so foot can be cleaned properly
 - routine use of agents such as Iodine-glycerine, Kopertox, Clorox

6. Punctures, Wounds (nail in foot)
 - clean up area around puncture
 - if foreign body is still present, pour disinfectant such as Iodine around it before removing and then in wound as it is removed
 - bandage or cover area and keep dry
 - tetanus immunization

7. Eye Lesions, Wounds, Injuries, Problems
 - need professional help early for a diagnosis
 - do not treat without consultation
 - may use a mild eye wash such as boric acid

8. Choke

- animal will be coughing, profuse salivation, painful, anxious expression
- keep your hand out of mouth
- remove feed and water
- try to determine cause
- gently massage neck region anteriorly or toward head

9. Lameness

- examine foot for punctures and/or foreign bodies - close examination is important
- palpate leg and joints carefully
- if fracture or severe tendon injury has occurred, use temporary splint and support and transport animal to barn
- application of cold therapy is indicated early, followed, possibly, by heat or alternate heat and cold
- be sure and get extra support on leg opposite the injured one

10. Wounds

- area and extent of wound will determine course of treatment
- keep wound clean and control bleeding by pressure bandage
- if wound is contaminated, wash with saline solution or tap water - do not use disinfectants
- consult veterinarian about possibility of suturing before applying medications
- keep check for excess granulation tissue
- tetanus immunization

11. Foaling Problems

- colic
- laminitis
- delivery problems
- retained placenta
- retained meconium or constipation
- naval cord

EQUINE IMMUNIZATIONS

R. Reynolds Cowles, Jr., D.V.M.

The role of vaccinations in the overall program of equine management cannot be overemphasized. Preventive medicine is the name of the game in today's spiral of rising costs of raising and maintaining equine athletes.

Most of you are quite familiar with the routine vaccination programs in use today and much of what we will cover is old hat, but possibly there are some aspects which will refresh your basic knowledge and add a few new ideas.

It goes without saying that most of our vaccinations today are used in the prevention of infectious disease. Let's look at the diseases and vaccines available.

The first routine vaccination that come to mind is for the prevention of tetanus.

Tetanus or "lockjaw" is the dread disease caused by bacterial organisms (Clostridium tetani) that follows introduction of the infection through a wound or possibly through the gastrointestinal tract in the young foal. It is an uncommon condition today due to the use of tetanus antitoxin and tetanus toxoid.

Tetanus antitoxin is prepared from the blood of horses repeatedly injected with large doses of the toxin.

We routinely administer this after an animal is noticeably wounded. This is usually adequate, but depends on one large factor - the owner noting and treating the wound.

The other avenue for prevention of tetanus is the use of tetanus toxoid. This vaccine produces a good immunity that lasts for some time - probably several years.

It requires administration of two initial doses, four to eight weeks apart, followed by yearly boosters. In the case of injury, a booster is recommended unless the annual booster was given within the preceding three months. If a horse has had only one toxoid injection and receives an injury, then it should have a tetanus antitoxin injection.

We start this vaccination in foals as early as two weeks of age. The best program for the immunization of the foal is to booster the broodmare within two months previous to foaling. This allows passage of tetanus antibody through the colostrum to the foal and gives good immunity for the first three months of age. If the foal is born from an unvaccinated mare, then it should receive tetanus antitoxin at birth and be vaccinated with tetanus toxoid at an early age. If the young animal has not been vaccinated by weaning time, it is advisable to do so at this time.

The second common vaccination is that for Eastern and Western Encephalomyelitis, or Sleeping Sickness. In areas where this disease is present, this vaccine is a necessity. Most of Virginia contains the potential for this disease that is spread by mosquitoes. Certainly any horse that moves through endemic areas should be vaccinated. Your local veterinarian can advise you on the incidence in your particular region. The vaccination program consists of two injections annually.

EQUINE IMMUNIZATIONS

These may be given as an intradermal injection, seven to fourteen days apart or as an intramuscular injection to be given thirty days apart.

This should be given in late winter or early spring before the mosquito season starts. This will produce sufficient immunity for ten to twelve months. It must be repeated every year.

Several combinations are now available that allow vaccination for tetanus toxoid and Eastern and Western Equine Encephalomyelitis in one injection. These are quite handy if the timing fits your program.

Now we come to Equine Influenza - Flu, Racetrack Cough, etc.

This is a viral disease caused by A₁ and A₂ Equine Influenza Virus. It accounts for a good percentage of cough in our race and show horses. Most stables that use this vaccine are quite convinced of its efficacy. As you know, this disease can produce a very high fever and a cough which may render a horse useless for work for three to six weeks. Because of this, I believe it is foolish for a racehorse or a show horse not to be vaccinated for flu.

The vaccine must be given as two deep intramuscular injections four to twelve weeks apart followed by a yearly booster.

This vaccine often causes a local tissue reaction and should be given in the deep muscles of the hind quarter.

Everyone asks - "What about V.E.E.?"

Venezuelan Equine Encephalomyelitis is the tropical disease that invaded southern Texas in 1971. As you know, there were massive state and federal programs to vaccinate horses against this disease. The disease is no longer found in the United States, but can crop up at any time in those areas where it was found in 1971. It was predicted then that V.E.E. would eventually spread along the southern coastal areas. However, it has not materialized, due in part to the crash vaccination program implemented. It was thought that the original vaccine caused abortion in mares and many other ill effects in the equine. Certainly this vaccine had a number of side effects, the most common being a high fever for three to seven days after administration. The killed vaccine - Cephalovac^R Jen Sal - in use today, in my experience, is freer of side effects with only an occasional fever noted.

V.E.E. vaccine is still not recommended for use in pregnant mares. Any horse that has not been vaccinated and is not pregnant should be vaccinated. Young stock should be at least six months old before vaccination. The drug company manufacturing the vaccine recommends an annual booster. However, studies indicate that the immunity lasts for at least four to five years in most horses. Recently the U.S.D.A. has recommended that horses be boosted every two years. Combination EEE, WEE, VEE one month apart excellent.

I advise the routine vaccination of all young stock as weanlings or yearlings. Boosters should be given for shows and track requirements.

EQUINE IMMUNICATIONS

I would now like to discuss the viral condition, Equine Rhinopneumonitis, caused by Equine Herpes Virus I. This is, in its purest form, a viral respiratory disease. It accounts for a lot of the fall nasal discharge seen in our sucklings and weanlings and accounts for about twenty percent of the cough complex seen in race and show horses. Probably the most dread form of the disease is that of viral abortion. In most cases, the mare goes through a subclinical case of respiratory disease and then aborts her fetus some time later. Usually late pregnancy 7 - 10 months.

This abortion syndrome may occur as an isolated mare on a farm or as an abortion storm with most mares on the farm slipping. Obviously this can be a costly disease.

The vaccination program that has been used in the prevention of the "virus abortion" due to E.H.V.₁ has been the use of a live virus spray. Two years ago a new vaccine was marketed that is a modified live virus grown in tissue culture that promises to be a better program of immunization. Let's discuss both programs taking the live virus first.

This is the method that most large Thoroughbred farms have used in the past. It involves the vaccinating of all horses on the farm with a nasal spray. It is administered in two doses - July and October of each year. No mare should receive the first injection after her fifth month of pregnancy. This July date conforms to our Thoroughbred breeding season. The Standardbred program runs slightly different due to the earlier breeding season. All horses on the farm are sprayed and quarantined for twenty-one days. This includes all foals and other young horses. This program can produce abortion as this vaccine is only slightly modified. Abortion has been seen in about 0.5-1.0% of the mares vaccinated. It also will produce a mild upper respiratory disease in sucklings that must be observed to prevent it from become more severe. The obvious disadvantages to this program can be noted. However, it is quite effective in reducing abortion in areas where E.H.V.₁ is a problem.

Use of this vaccine must be approved by the State Veterinarian's office and requires a thorough understanding of the possible consequences.

The new vaccine out is a tissue culture modified live virus that appears to be much safer than the previous program. I must state, that although the work done by the drug company on this vaccine looks quite good, it has been used for two to three years and this is the first year of actual clinical usage. Your veterinarian may have his own opinion concerning its usage so you may want to discuss it with him. At this time, our experience indicates that this is a very good vaccine for prevention of the abortion syndromes.

The mare should be over sixty days pregnant before the initial dose is given. The second dose is given at the fifth to the seventh month of pregnancy. There is an annual booster of two injections given after the sixtieth day of pregnancy. We will be in a better situation to fully evaluate this vaccine after this foaling season because many mares are presently in this program.

EQUINE IMMUNIZATIONS

Its use in horses other than pregnant mares is to be highly recommended. As I stated earlier, the E.H.V.₁ makes up about twenty percent of our cough complex and if we can reduce cough in our race and show horses, then we are financially ahead. I recommend vaccination of all such animals. We give two injections, four to eight weeks apart and an annual booster.

Foals can be vaccinated any time after three months of age.

Another vaccine that is used by many farms is that used for strangles. Strangles is a bacterial respiratory disease that is common throughout the state. It varies from a mild, upper respiratory disease to full blown pneumonia and death. Unfortunately the vaccine causes a lot of local tissue reaction and this may be worse than the disease itself. It consists of three injections, each administered one week apart and must be repeated annually. It is useful on farms where strangles is a constant problem. It may be used in foals.

Other vaccines that may occasionally be used are the bacterins for Salmonella and Leptospirosis.

Salmonellosis is an acute enteric disease seen on some farms in certain localities and your veterinarian may administer these vaccines if you have a farm problem.

Leptospirosis is an uncommon cause of disease in the horse, although it is one of the causes of periodic ophthalmia. Many veterinary pathologists state that Leptospirosis is not a cause of systemic disease in the equine. Although the occasional situation may warrant its use, routine vaccination with Lepto bacterins is not recommended.

I have put this information in chart form for you and I've broken it down as to the age group and use of the horses. I hope this has given you a refresher in your program for preventive medicine.

HOOF CARE

By
James Reece, Farrier
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Only when the horse's feet are properly cared for can he give his best. Any neglect will result in second rate performance or lameness.

Under ideal conditions not much care is needed. Upon domestication, the horse is exposed to man-made elements and the feet have to be cared for.

I. Control of the Horse

The horse should be held or tied on a level area, preferably in familiar surroundings. He should be made as comfortable as possible. Do not hold his foot too high or pull it sideways. Be sure the horse is standing square on all four feet.

II. Cleaning out the Feet and Checking for Thrush, Puncture, Wounds and Rocks

With the foot in a comfortable position, use a hoof pick and clean out all dirt in the foot and check for any rocks imbedded in the sole or lodged under the shoe. Also, check for thrush and any pus that could mean a puncture wound. This is also a good time to check for loose shoes and shoes that need resetting.

III. Hoof Dressing

If the horse is in a pasture he should not need any hoof dressing. But if his feet should become dry a dressing should be applied. The dressing should only be put on the sole, frog, and coronary band. The best and cheapest dressing is lard. Another way to put moisture back into the hoof is to have a mud hole around the watering place.

IV. Thrush

Thrush is an infection of the frog and is recognized by a black liquid running from the frog.

For treatment the undermined areas of the frog must be trimmed away carefully to avoid bleeding. Then clean the hoof with soap and water or hydrogen peroxide and apply iodine.

V. Cracks in the Hoof

Hoof cracks can be placed in three classifications depending upon their origin. Excess length of hoof wall will cause a split of variable height and depth at the bearing surface of the wall.

Cracks that extend downward from the coronary band are usually most serious. They are usually caused by excess concussion and dry brittle hoofs.

Small cracks on the outer surface of the wall are usually caused by a vitamin deficiency.

VI. Trimming the Hoof to go Barefoot

If the horse is already barefoot or intended to go barefoot his feet need special care. If not kept trimmed his feet will grow to excess length at the toe and heel and will split and cause cracks.

Trim his feet to a normal length and round the wall to one-half its thickness.

VII. Care of Foundered Feet

The rotated coffin bone must be placed in a natural position by trimming away the wall at the heels until the bottom of the coffin bone parallels the ground. The sole and the toe portion of the wall should be reduced very little or not at all. The curled up portion of the toe can be dubbed off no further than the outer boundary of the white line.

VIII. Wounds of the Foot

When dealing with wounds in the hoof the first procedure is to pare away any excess growth around the wound. Poultices may be used to draw the infection and then the foot should be kept clean with disinfectants and bandages until all discharge ceases.

Trail Riding

by

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I. Introduction

Trail riding can be a lot of fun for rider and horse and can be done individually, in small groups or in large organized rides. Trail riding is especially a good training exercise for most types of young horses. All riders and types and sizes of horses and ponies can enjoy this best of recreational activities in the open during all seasons. Trail rides can be held in all areas and through all types of terrain. All horsemen need to continue to work to establish and maintain horse trails on both public and private lands.

II. Kind of Ride

Trail riding can take many forms. The basic form is the individual or group ride on a regular basis, generally over local trails through farms, adjoining property, right-of-ways, etc. Wherever possible, every horse owner should have access to three to ten miles of trail for regular use. No greater recreational opportunity exists for rider and horse than the regular ride three or more times per week. Horses and riders not in condition should limit their outings to three to five miles, mostly at a walk. Longer and harder rides require conditioning for horse and rider. Also, longer and harder rides should be limited to horses five years of age or older.

Group trail rides can be held strictly for fun at a leisurely pace. All saddle groups, youth and adult, should hold several of these fun rides each year. Such rides can be a one-day event or include overnight rides with cabins or overnight camping rides involving campers, tents, etc. These can be excellent weekend recreational events for families or groups. A packing and camping ride might also be included in this category.

Large group trail rides would be similar in nature with emphasis on fun and group outings. Large rides require more planning, work and supervision. Group fun rides are generally held over ten to thirty miles each day, for one or more days. Outdoor cooking, country music; square dancing, etc. may be included in the program. Many of these events develop into wagon trains for a three to six day vacation.

The final category is distance riding which includes two similar but really entirely different categories, competitive riding and endurance riding. The competitive ride involves riding 20 to 40 miles per day for 1, 2, or 3 days. Mileage is completed within maximum and minimum time limits creating an equal test. Condition, soundness and in some rides, manners and way of going determine the winner. No racing factor is involved. Two award categories are involved; one for condition of horse and another for horsemanship. The horse is judged on soundness, condition, way of going and manners. The rider is scored on grooming, in hand presentation, equitation, tack and equipment, stabling, on trail care and trail safety and courtesy.

The endurance ride is generally held in one 24 hour period over 50 to 100 miles with the horse completing the course in the fastest time in acceptable condition to the veterinarians, judged the winner. Condition and soundness of the horse is under veterinary observation throughout both types of rides. At intervals on the trail there are designated examination points including pulse and respiration checks and rest stops. There are other major variations in the two types of rides.

III. Trails

A variety of terrain can be used for trail riding. A testing ride might include both soft and moderately rough footing, gravel road, mountain trail, hills, wooden bridges, culverts, streams, logs, slides, brush and steep and flat trails. All obstacles should be natural and not artificial. Plenty of water at various trail crossings should be a consideration in planning long trail rides. Highways should be avoided whenever possible; large group crossings should be supervised by appropriate law officials. Urban horse owners may develop trails through parks, right-of-ways, etc. Permission should be obtained before riding over any property. No littering must apply for all trail riders on all trails.

Large group trail riding events should be carefully planned. The trail should be ridden several times in advance and clearly marked, survey tape makes good markers. Trail observers should be posted at regular intervals and all questionably turns should be clearly marked and/or directed by an observer. Emergency and rescue operations for horse and rider should be planned for in advance. CB radio systems are quite useful. One or more lead riders should lead the ride, re-marking the trail, filling holes, watching for newly made hazards, etc. Trail observers thoroughly familiar with the trail should be stationed throughout the ride. Drag riders then can check with each observer to be sure that each rider has passed that particular point, allowing for a quick search in the immediate trail interval for lost or distressed riders. The trail should allow access for rescue vehicles at several places. A mid-point check place for scoring, resting, meals, farrier, etc. should also permit ready access by vehicles including a rescue trailer for removing exhausted or injured animals.

Trails for groups should be cleared of brush so that a mounted rider can reach up and out without touching any brush or limbs. Groundhog holes, newly washed holes, swampy areas, snakes and bees can be very hazardous. Slides should be clear of large roots and fords should be fairly safe. Lead riders should re-direct the trail if nature has made a new and dangerous situation on the trail, such as flooded streams. Trails should be clear of wire and other materials dangerous to horse and rider. Wherever possible, motor vehicles should be excluded.

Competitive and endurance rides utilize the trot, with some breaks for walk, walking up and down very steep hills, and with limited canter to break the monotony. Riders must plan for time and pace and generally push harder at the beginning with a slackening of pace toward the end. Exhausted or injured animals must be eliminated and cared for.

IV. Planning

Large trail rides for fun or competition should be carefully planned by a knowledgeable committee and supervised by a trail boss.

Some items to be considered include:

1. Objective
2. Kind of ride
3. Scoring
4. Rules, Recognized Approvals
5. Entry
6. Publicity
7. Staff
8. Stabling
9. Lodging
10. Meals
11. Health regulations
12. Trail staff
13. Riding permission
14. Insurance, budget, etc.
15. Safety, ambulance, etc.
16. Veterinary services, farrier
17. Emergency and rescue
18. Preparing and riding the trail
19. Marking and measuring
20. Road crossings
21. Check points, radio
22. Marking check points, mid-point, and distance markers (2 mile to end, etc.)
23. Results
24. Clean up of campsites

V. Education

Regardless of the kind of ride, recreation and education for horse and rider can be involved. Points to be considered include:

1. Conditioning of horse
2. Conditioning of rider
3. Safety
4. Horsemanship
5. Soundness
6. Pulse, respiration
7. Equipment
8. Care of the horse
9. How to ride a trail, time and pace
10. Climbing a hill
11. Forging a stream
12. Negotiating obstacles, slides, etc.
13. Care of the horse at mid-point and end of ride
14. Learning how to ride for time, pace, and distance
15. On timed rides, a rider can set his watch at 12:00 as he is timed out; thus, he can readily calculate time expired and time to finish.

VI. Horses

Depending on kind of ride, all types of horses and ponies suitable for the rider can be used as trail horses. Hard rides require that horses be five year of age or older and in excellent health and condition. Generally, stallions are not recommended for large group fun rides. All animals must be healthy, sound, well-shod about one week before the ride, and meet pertinent health regulations. Well mannered, willing, free and easy moving horses with ground covering walk and trot without interference or forging are highly desirable. Pullers and head tossers and company or barn sour mounts are a torment to ride. You might include chronic shyers, kickers, lazy, jiggers, and other types of horses hard to handle as being undesirable. The feet and backs should be in good shape and well cared for before, during and after the ride.

VII. Riders

The rider should be of appropriate ability and condition for the type of ride being planned. Sportsmanship and horsemanship are the keys to success. The rider should consider several points on a ride including:

1. A ride plan (gait, pace, time, distance)
2. What to take along
3. What to wear
4. A watch
5. Drinking water
6. Pauses and rest periods
7. The last two miles
8. Courtesy and attitude

The rider should be prepared for cold, heat, rain, snow, accidents. On all rides the rider should carry the following: Boy scout knife, hoof pick, thong or cord, a couple of safety pins, sponge or rub rag, and a small first aid kit. A canteen of water is also recommended. Distance riders, however, must travel as light as possible. Heavy equipment including saddle bags should not be used. Riders should carry a poncho or slicker and wear appropriate clothing for the weather, including gloves and head-gear (water proof or cover for rain). Standard stable equipment should be brought to the stabling or camp area for the ride. It is handy to ride the trail with a flat halter and lead shank tied around the neck in addition to the bridle or headstall. Extra stirrup leathers, cinches, shoes, etc. should be brought to the stabling area. Riders may use a variety or even a mixture of tack and clothing if it is safe, comfortable and gets the job done.

VIII. Conditioning

Parasite control, proper nutrition and exercise are all basic to conditioning the horse. Fat horses lacking exercise cannot get the job done. Conditioning will depend on type and distance of the ride. The following training program might be recommended for a thirty to forty mile competitive ride:

Training Program

6th Week before ride, trot one hour per day for 6 days. Rest one day.

5th Week before ride, trot one hour per day for 6 days. Rest one day.

4th Week

Day 1 - trot one hour; day 2 - gallop two miles; day 3 - trot one hour; day 4 - gallop two miles; day 5 - trot one hour; day 6 - distance ride 10 miles; day 7 - rest (turn out).

3rd Week

Day 1 - gallop two miles; day 2 - trot one hour; day 3 - gallop two miles; day 4 - trot one hour; day 5 - gallop two miles, day 6 - distance ride 15 miles in 3 1/2 hours; day 7 - rest (turn out).

2nd Week

Day 1 - trot 1 1/2 hours; day 2 - gallop two miles; day 3 - trot 1 1/2 hours; day 4 - gallop two miles; day 5 - trot 1 1/2 hours; day 6 - ride 20 miles in four hours; day 7 - rest (turn out).

Week Prior To Ride (Saturday ride)

Repeat procedures of 2nd Week but turn out and rest on Thursday.

Travel to trail ride area on Friday.

- a. You will need to know exactly how long it takes your horse to walk, trot, and gallop a mile in order to be able to pace yourself on a ride.
- b. If you gallop your horse for two miles and he cools out when walked for 1 - 1 1/2 miles you have a pretty fit horse.
- c. In cooling out your horse, leave saddle on for about 50 minutes. Loosen girth after about 35 minutes. In the meantime, sponge off from head to tail and rub briskly with towel. After 50 minutes take off saddle but leave blanket on. Sponge girth area and rub with towel. Take blanket off ten minutes later and sponge and rub back. Allow horse to drink small amounts of water every ten minutes.

IX. Riding

The rider and horse must be prepared for the type of ride to be taken. Care of the horse, however, comes at the expense of the rider. The rider should have a ride plan and follow it and observe the rules of the ride. Equipment must be appropriate, clean and in top repair. Riding boots are recommended for all youth riders and even hard hats might be suggested. Safety and courtesy on the trail is paramount to good horsemanship. Horses should be walked over rough or steep ground, provided rest periods and not pushed to exhaustion. On distance rides, the rider must trot most of the distance, providing for walk breaks. Posting or standing trot is recommended. The rider should be off of the back on hills, show ring equitation is not necessary but good horsemanship is a must. The rider must consider time, distance, gait and pace -- and avoid injury to the horse and especially being kind to the back and mouth of the horse. When crossing streams, the rider

may offer a few sips of water. At breaks, the rider should dismount, put up the stirrups, rest and lead the horse to cool out, offer a few sips of water (never allow a hot horse to drink all he wants), pick out and check the feet and check equipment. The rider should ride the horse at a walk the last two miles. At the end of the ride, the rider should repeat the process outlined for rest breaks, leaving the saddle on with a loosened girth after a few minutes until the horse is cooled. After the horse has cooled some, the saddle may be removed and the horse should be walked, groomed, cooled and fed and watered only after properly cooled and dried.

On the trail, riders should pass with caution, not "hot rod", and not crowd other riders. Riders should move quickly into and away from fords and obstacles and not crowd other horses. After clearing a river bank, the rider should move quickly away so that the next horse can scramble to safety. All horses should be walked on hard pavement and across highway intersections.

X. Scoring

Many systems may be set-up to score trail rides for competition or awards. The system used should be clearly explained to all contestants and judges well in advance of the ride. For the competitive ride, the N.A.T.R.C. points for scoring the horse are as follows:

Soundness	40%
Condition	40%
Manners	15%
Way of going	5%

Time penalty points
Other penalty points

Detailed specifications for scoring are available in the N.A.T.R.C. rule books. For example, obstacles may be scored under manners. Score cards should be made available to the contestants.

XI. Tips For Overnight Campers, Riders and Packers (Backcountry areas)

Riders, Packers

1. Use of stock is not permitted in some areas and some trails are impassable to stock. Ask before you go to avoid inconvenience.
2. Stock have the right-of-way on trails, but riders should be careful when meeting hikers.
3. Grazing of stock is not permitted in some areas. Stock users should always pack feed such as grain or pellets.
4. Hitch stock to hitch racks where provided. Where there are no hitch racks, tie a rope between two trees and hitch the stock to the rope. This avoids damage to the tree and trampling around the root system.
5. Horses and mules that are nervous "diggers" and "pawers" should be hobbled when tied. This will prevent unnecessary damage to the terrain.
6. Except to load and unload, stock are not permitted in camping areas.

Tips For Overnight Campers

1. Obtain a Backcountry Use and Fire Permit at the Ranger Station or Visitor Center nearest your point of departure. Here discuss your planned itinerary, see and obtain park maps, and get the latest trail and weather information.
2. Do not pollute streams by washing dishes, clothes, or by bathing. Remove water for these purposes in a container and wash away from open water courses. Likewise, dispose of this wash water away from the campsite - and not back in or near the stream.
3. Disposing of human waste where there are no outhouses is very important and becomes a sanitation problem if it is not done correctly. By carrying a small digging tool such as a light garden trowel, sanitary disposal can be easily accomplished. Select a spot at least 100 feet from any watercourse and dig a hole 8 to 10" in diameter, but no deeper than 6 to 8". Bacteria and other organisms live in this soil level and will naturally decompose wastes in several days. After use, fill in the hole with loose soil and tramp in the removed sod.
4. A lightweight backpacking stove is recommended for convenience as well as helping to cut down on the number of manmade fire scars in the backcountry.

Tips For Users of Pack or Saddle Stock

1. Take no more horses than you actually need. The less the better - 25 is enough for any party. This will lessen the impact on the country.
2. Because of wet, boggy conditions, some trails may be closed to horse use until mid-season, or until they are dry enough to accommodate horses without being excessively chewed-up and damaged.
3. Stay on the trail - don't shortcut. Repeated horse use can make a new trail thus confusing others coming later.
4. Free trailing or loose herding is not allowed on park trails. All animals not ridden must be led. This is both for safety of other trail users and to keep new, unnecessary trails from being cut into meadows.
5. Don't camp or picket stock on or near the trail, and always at a reasonable distance from lakes and streams. Change pickets frequently. Don't overgraze one area or a particular campsite. Pull all picket pins when leaving, as they are an eyesore to later comers and tempt others to overuse the same spot.
6. Don't tie stock to trees for extended periods. This not only causes the surface and roots to be torn up, but also causes the trees to be girdled and to die. Don't build corrals and drift fences.
7. When you break camp, clean out and scatter any horse droppings from the area. Pack out empty cans and unburned trash.
8. If you lose an animal and cannot find it by the end of your trip, be sure to report its loss to the nearest Ranger Station.
9. Fire safety is a must. You should not cut growing trees except for an extreme emergency. Deadwood may be used where fires are safe and permitted.
10. Backcountry areas should be left as found - for the enjoyment of all citizens, present and future.

XII. Conclusion

Fun rides need not be scored and not all rides should be competitive nor involve awards. To ride with nature and for enjoyment is the main objective.

