the exercise surface. For all horses, exercise programs should begin at conservative levels and increase as positive results are achieved. Evidence of mild soreness or joint swelling must be recognized before it becomes severe and the subsequent level of exercise reduced until the horse responds more favorably.

Certain methods of exercise cause leg stress more quickly than others. The more intense the exercise, the less time a growing horse should be exercised in a single bout. Successful forced exercise programs have incorporated a variety of methods. Continual turnout, timed turn-outs with other growing horses, ponying, longeing, mechanical walkers and treadmills are used. Careful monitoring of the horse's response to the type and duration of exercise and periodic adjustments in exercise and nutrition will aid in promoting positive effects while lessening the chance of overexertion and fatigue.

Considerations for Young Horses

1. Feed horses individually so that feed intake can be monitored.
2. Adjust the duration and intensity of exercise for each horse, taking precautions against over-stressing the legs.
3. Make gradual adjustments when changing the level of exercise and nutrition.
4. Know what you are feeding and the horse's requirements.
5. Recognize and respond to slight abnormalities in leg and body development which may be the beginning of irreversible problems if left unattended.

Summary

The promotion of healthy growth must coordinate genetics, nutrition, and exercise for the development of young horses. These factors are interrelated and changes in one will require alterations in the management of the others. Periodic assessment of each horse's development will aid in regulating these factors. Also, the more quantitative the record system, the more accurate the management. Information on weight changes, body condition, nutritional level, and health status will assist in developing management plans for the individual horse.

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Managing Young Horses for Sound Growth

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What is Growth?

Growth of young horses is usually defined as an increase in weight and/or wither height. Weight gain from birth to about 12 months of age is comparatively rapid and more or less linear. The rate of weight gain slows for yearlings, and mature weight is reached between 36 and 60 months of age. Generally, 50 to 60 percent of mature weight is reached by 12 months of age, and 80 to 90 percent of mature weight is reached by 24 months of age. Wither height increases more rapidly than body weight. By the age of two years, 90 percent of the mature body weight and 95 percent of wither height has been achieved.

To define growth, composition of weight gain must be considered. Weight gain results from increases in bone, lean (muscle) tissue, and fat. Little information is available on the composition of weight gain in growing horses because non-terminal methods to determine the percent bone, muscle, and fat are not always accurate. However, it is known from research in other species that muscle deposition takes precedence over fat deposition early in growth, and it is not until later that fat deposits become large. Additionally, the longevity of the equine and its future athletic ability are important considerations in promoting sound musculoskeletal development compared to the desire to maximize average daily gain in food animals.

Influences on the Rate and Composition of Growth

Factors that affect the rate and composition of growth include genetics, exercise, and nutrition.

Note: Growth promoters and repartitioning agents are examples of chemical agents that are used in meat-producing animals to influence growth. Some have been used illegally in horses in an attempt to increase the rate of growth or percent lean tissue, but they have met with few positive results and have had serious adverse effects which limit the future productivity of the horse. Therefore, the use of such drugs is not a reasonable alternative.

Genetics

The genetic constraints on growth rate limit what can be influenced by exercise or nutrition. Each horse has a specific genetic potential for growth rate and mature size. Different breeds of horses have been characterized as being fast growers or slow growers, but it is difficult to generalize because of the large variation between genetic lines within a breed. For example, maturation occurs more rapidly in breeds selected for early development such as racing breeds while sport horses may mature more slowly. Producers sometimes select for fast growth because of the high premiums paid for larger horses at yearling sales and because of perceived advantages they have in competitive events that are for young horses.

It has been suggested that with this selection comes an increase in the incidence of skeletal disorders, as has been shown in other species. Heritability of osteochondrosis, an orthopedic disease of the joint, may be as high as 50 percent in some lines of horses, but disease incidence may still be highly dependent on other management factors. This may be true, but it is difficult to accurately document because of the variation in management, rate of growth, and leg conformation in horses with similar pedigrees. For example, it has long been known that deviations in bone alignment are major causes of lameness, and young horses with bone alignment problems have trouble staying sound at any rate of growth.

Nutrition

Nutrition cannot overcome poor genetics or a poorly designed exercise program, but studies have shown that both the level of intake and ration composition play important roles in altering the rate and composition of gain. For example, processing feeds, such as offering complete pelleted diets, results in a greater average daily gain, presumably due to the increased digestibility of the ration. Restricting intake to achieve a slow increase in wither height in early growth leads to future problems if a young horse is later fed to abruptly increase its size or condition. Moreover, if restriction of feed is extreme, final mature height and weight may be affected. Therefore, maintaining young, growing horses in extremely thin condition may limit sound skeletal growth later in life.

On the other hand, excess fat creates more weight stress on the legs and reduces the horse's athletic ability. As a growing horse becomes older, its rate of bone and muscle growth slows. As a result, high nutritional planes will result in the deposition of more fat. Yearlings on high planes of nutrition are more susceptible to laying down larger quantities of fat than weanlings and they require close regulation of intake and exercise level. High rates of gain achieved with higher levels of concentrates and thus sugars and starches, may also predispose the young horse to other disorders, such as equine gastric ulcer syndrome.

The exact body condition and rate of gain needed to promote sound growth of muscle and bone is debatable and perhaps somewhat flexible. Individual differences in genetic makeup create so much variation that general recommendations are limited in scope and accuracy. Also, because there may be differences in the rate at which bone and muscle mature, some horses may need to be developed at a slower rate than others to allow for a coordinated development of both systems.

In most cases, young horses should be maintained in moderate condition to promote the development of bone and muscle. Extremes in body condition created by under- or overfeeding must be avoided. While it is recognized that extremely thin or fat body condition or an abrupt change in the growth rate can lead to unsound growth in horses, most nutritionally related leg problems result from feeding unbalanced rations.

The Meaning of "Moderate Body Condition." Body condition refers to the percent of body fat. It can be determined visually by estimating fat cover on a horse's body. Indications of moderate body condition are that individual ribs cannot be seen but they can be easily felt, the backbone is level with surrounding tissue on the back and loin, and the area around the tailhead is slightly rounded in appearance. The tailhead should not have a sunken appearance or large amounts of spongy feeling fat deposits. Individual changes in the body condition of each horse should be monitored because young horses differ in the amount of fat that is deposited at similar feed intake and exercise levels.

Rate of Gain for Horses in Moderate Body Condition. Expected mature size affects the estimation of desirable rate of gain for horses. Weanlings expected to mature at 1,100 to 1,200 pounds have been shown to gain 1.25 to 2 pounds per day while maintaining moderate body condition. Typically, yearlings will gain less per day or will show an increase in fat.

General Recommendations for Daily Feed Intake. Individual differences are of primary importance when regulating feed intake. Nursing foals may consume about 1 to 1.5 pounds of creep feed per 100 pounds of body weight per day. Weanlings may consume 1.5 to 2.5 pounds of grain mix per 100 pounds of body weight per day, and yearlings may consume 1.0 to 2.0 pounds of grain mix per 100 pounds of body weight per day. These ranges assume the weanlings and yearlings are also consuming 0.75 to 1.0 pound of hay per 100 pounds of body weight per day. The level of exercise will also affect the nutrient requirements. At any level, the nutrients in the feed must be balanced to ensure that the needs for the absolute amounts of energy, protein, and minerals are being met.

Required Nutrient Densities. Growing horse nutrient needs are influenced largely by body weight, age, growth rate and level of physical activity. For example, larger horses or those growing at rapid rates require more nutrients than smaller horses or those growing more slowly. Intake needs of a ration depend on the needs of the horse and the concentration of nutrients (primarily energy) in the ration. Nutrient densities, such as percentages expressed on a feed tag, are formulated to supply the needed amounts of nutrients at expected intake level of the total ration. Typically, ration densities are developed to meet nutrient needs of growing horses consuming 2.25 percent to 2.75 percent of body weight in total daily ration. These formulations relate to feeding a 450-pound weanling 10 to 12 pounds of total ration per day. However, energy densities of rations vary greatly from those diets using energy-dense grains as compared to rations relying predominantly on less energy-dense forage intake.

Table 1. Estimated Daily Nutrient Needs for Young Horses[a].

Type of Horse	*Digestible Energy Megacalories*	*Crude Protein pounds*	*Lysine grams*	*Calcium grams*	*Phosphorus grams*
Weanling					
(5 months of age, 460 pounds, gain of 1.9 pounds per day)	16	1.6	32	43	24
Yearling					
(12 months of age, 775 pounds, gain of 1 pound per day)	20	2.0	40	41	23

[a] These values are estimates based on average needs. Growth rate, body weight and individual differences between horses largely influence actual needs.

Table 2. Estimated Nutrient Densities of Total Rations[a] for Young Horses[b].

Type of Horse	*Intake lbs/day*	*Crude Protein %*	*Lysine %*	*Calcium %*	*Phosphorus %*
Weanling					
(5 months of age, 460 pounds, gain of 1.9 pounds per day)	11.5	14	0.6	0.8	0.5
Yearling					
(12 months of age, 775 pounds, gain of 1 pound per day)	19.5	11	0.5	0.5	0.3

[a] Total rations includes all sources of feed.
[b] Densities are based in intakes of 2.5% of body weight per day.

Estimates for the daily needs of digestible energy, crude protein, lysine, calcium and phosphorus are provided for weanling and yearling horses of expected mature size of 1,200 pounds in Table 1. Crude protein is needed to supply amino acids. Lysine is an amino acid of major concern as it is an essential amino acid needed in relatively large amounts for growth. Calcium and phosphorus are minerals with important roles in bone development and maintenance.

Nutrient densities for crude protein, lysine, calcium and phosphorus, based on a targeted intake of the total ration of 2.5 percent of body weight per day, are provided in Table 2. Densities required to meet the nutrient needs would be less if more total ration is consumed, or greater if less total intake is consumed.

Other Nutrients. Zinc, copper and Vitamins A, D and E are additional nutrients that are typically balanced for in growing rations. Zinc and copper needs are much less than calcium or phosphorus. Estimates for densities of these minerals are expressed as parts per million, or milligrams of mineral per kilogram of ration intake. Zinc needs are estimated at 40 parts per million and copper at 10 parts per million for growing horses, although rations are typically formulated with higher levels to ensure adequate intake.

Vitamin needs are expressed as international units (IU). Daily needs are estimated to be about 10,000 IU Vitamin A; 4,500 IU Vitamin D; and 450 IU Vitamin E for weanlings. Yearlings require 16,000 IU Vitamin A; 7,100 IU Vitamin D; and 700 IU Vitamin E. Estimating vitamin levels of feedstuffs is beyond the scope of most horse owners. Because of the variability in feedstuffs, rations formulated for growing horses will routinely include vitamin and mineral supplements. Horse owners should read the feed tag or contact the feed supplier to determine if supplements have been added to balance mineral and vitamin needs. Most on-farm problems arise when hay and grain are fed without mineral or vitamin supplements, or when commercially prepared grain mixes with balanced amounts of minerals and vitamins are over-supplemented with on-farm addition of mineral and vitamin premixes.

Other factors

Exercise

The level, type, and duration of exercise can cause differences in the rate and composition of gain. This has been shown in numerous human and laboratory animal studies and to a limited extent in livestock. The research concerning the effects of exercise on young horses is limited; however, controlled, forced exercise has been shown to increase bone density in weanling and yearling horses. Conversely, forced exercise can also have a detrimental effect on articular cartilage. Free pasture exercise has been shown to be most advantageous for conditioning of the musculoskeletal system for foals, including tendon and articular cartilage. It is important to not confine young horses, as the first five months may be critical in the formation of the supportive structure of articular or joint cartilage.

It is important to determine the level at which exercise becomes too stressful and the type of exercise that best promotes sound skeletal and muscle development. The exercise level must be great enough to stimulate the proper development of the muscle and skeletal systems without stressing either to the point of fatigue or failure. One recommendation has been to keep exercise intensity low by working young horses at a slow speed, such as a trot. However, recent information indicates that the length of the exercise bout is more important than the speed at which the horse is worked. Evidence supports the idea that a long bout of exercise at any level can cause bone failure and breakdown of the skeletal system.

It is recommended to keep single exercise bouts short in duration and to apply enough stress to stimulate sound muscle and bone growth without overexertion. For example, 10-minute workouts at a fast trot on firm surfaces have shown to increase bone strength, while being short enough to limit the incidence of failure. The length and intensity of exercise is difficult to generalize because of the highly individual nature of growth in young horses, differences in the ability to respond to stress, and environmental variables, such as the hardness of

Stalls vs. Pastures

The decision to keep young horses in stalls or to turn them out in pastures will be affected by the facilities available and the goals of individual operations. Stalled horses generally receive more individual care and can be kept in shorter hair condition. If you plan to show or sell weanlings and yearlings, the horses may require stalling and individual care. Access to daily exercise is important.

Young horses that are stalled are usually on a high plane of nutrition. The combination of stored energy with limited access to exercise may cause unnatural strides and bone fatigue if single exercise bouts are too intense or long in duration. One practical method has been to combine short-duration, forced exercise bouts with free access to longer turnouts. Again, exercise programs must be adjusted to the development of each horse.

Some producers have been more successful raising sound foals in the pasture. This is probably due to a combination of factors related to free access to exercise and nutrients in the pasture forage. Free access to exercise may benefit bone and tendon strength and hoof formation because of the self regulation in the amount and intensity of exercise. Moreover, horses are frequently managed at slower growth rates in pastures, which requires less intense monitoring of the nutritional and exercise programs.

Most horses kept in pastures require grain and hay supplements. One approach used on farms with few horses is to use pastures with access to a barn with individual feeding stalls. With this method, grain intake and subsequent growth can be precisely regulated. Farms with a larger number of growing horses usually group feed, using individual feeders spread over a large area to ensure proper intake for each horse.