Soil Sampling and Nutrient Management in Horse Pastures

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Horse pastures are fertilized to ensure a reliable supply of energy, protein, and other nutrients for a long season of grazing. Management of plant nutrients maintains a balance of improved grasses and legumes and suppresses many pasture weeds. Properly fertilized pastures look good and harm neither animals nor the environment.

The most important part of obtaining fertilizer recommendations is collecting a representative soil sample to send to the lab. Soil test results and fertilizer recommendations are based solely on a few ounces of soil submitted to the lab for analysis, which are assumed to represent several million pounds of soil in the field. If this sample does not reflect actual soil conditions, the results can be misleading and result in costly over- or under-fertilization.

Timing

You can collect soil samples throughout much of the year, although fall (September through December) or spring (February through April) are the best times. With fall sampling, lab results and nutrient recommendations may be returned more quickly because fewer samples are submitted to the lab at this time. Fall sampling will also allow you to apply the fertilizer when prices are generally lower and soils are drier, making them less likely to be compacted by traffic. However, very dry fall conditions can cause erroneously low soil test potassium (K) levels. If possible, do not collect soil samples during a drought. In any case, a field should always be resampled at the same time of the year so you can make historical comparisons.

Fields should be sampled every two years. If you apply horse muck and other manures to your fields, you should sample annually, because manures rapidly raise soil phosphorus, potassium and zinc levels.

Tools

A soil probe, auger, or spade are the tools needed to take the individual cores that make up the field sample. The spade sample should be trimmed with a knife. (Figure 1). You will also need a clean, dry plastic bucket in which to collect and mix the sample cores. Be sure not to use galvanized or rubber buckets; they will contaminate the sample with zinc. Information forms and soil sample boxes/bags for submitting samples are available at all county extension offices.

Figure 1. A soil probe, auger, or spade should be used in sampling soils. The spade sample (shown in the center of the picture) should be trimmed as shown with a knife.

Note to Horse Owners

In 1994, the Kentucky General Assembly passed The Kentucky Agriculture Water Quality Act (AWQA). The AWQA (KRS 224.71-100 through 224.71-140) states that landowners of 10 acres or more who conduct or allow agriculture or silviculture (forestry) production on their land were to be required to develop and implement a water quality plan as of October 23, 2001.

These individual water quality plans should be based upon guidance found in the Kentucky Agriculture Water Quality Plan.

One of the six sections that make up the Kentucky Agriculture Water Quality Plan is Pesticides and Fertilizers (Section 2). This section requires routine soil sampling and appropriate fertilizer/manure applications. A website designed to help landowners write water quality plans can be found at www.ca.uky.edu/awqa.

The following agencies can provide more information about the Kentucky Agriculture Water Quality Act:

- Your county office of the Kentucky Cooperative Extension Service (which can also provide information about Ky-A-Syst publications that apply to your land)
- Kentucky Division of Conservation
- Kentucky Division of Water, regional office
- USDA Natural Resources Conservation Service
- USDA Farm Service Agency
- Kentucky Division of Forestry, district office
- Your local soil and water conservation district office
- Your county health department
- Kentucky Farm Bureau Federation

Collecting Field Samples

An individual sample should represent no more than 20 acres unless your soils, past management, and cropping history are uniform. You can obtain the most representative sample from a large field by sampling smaller areas that vary by soil type, cropping history, topography, and erosion/ past management practices (Figure 2). For example, manure may have been applied recently to one part of a field but not the other. Phosphorus and potassium levels likely will be higher in areas where you have applied manure. If you sample that field as one unit, the soil test will result in the no-manure part of the field being underfertilized. It is much better to collect separate samples from areas that differ because their nutrient requirements are likely quite different. Grid soil sampling, sampling smaller defined areas (grid cells) within larger fields, and prescription fertilizer applications could result in more accurate recommendations and lead to greater fertilizer efficiency. However, such intensive sampling is costly, and to date Kentucky research has not shown an economic benefit. See University of Kentucky Cooperative Extension publication *Taking Soil Test Samples* (AGR-16), for specific details on recommended grid sampling methods.

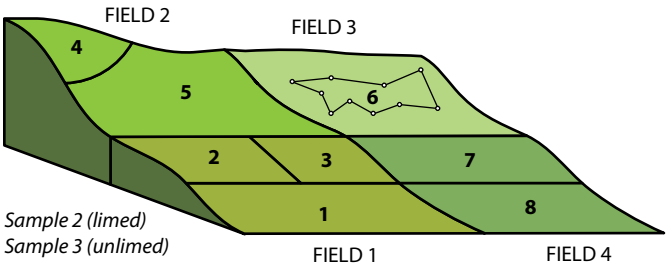
You can also use soil sampling to troubleshoot areas of the field that are visually different or are consistently low yielding when compared to the rest of the field. Take a sample both from the poor-growth area and adjacent, good-growth areas. A handheld GPS unit may be useful in locating sampling sites. Keep good records of where each sample was taken.

Collect at least 10 soil cores for small areas and up to 30 cores for larger fields. Randomly take the soil cores throughout the sampling area and place them in the bucket.

Do not sample:

- dung piles
- old fencerows or under trees
- areas used for manure or hay storage
- livestock feeding areas where lime was previously stockpiled

Figure 2. This figure shows how four fields might require the analysis of one to three composite samples for determining fertility needs. Each composite must contain 10 or more cores, as shown for sample 6 in field 3.



Depth

Sampling at a depth that will give accurate test results is commonly overlooked. Previously applied broadcast fertilizer and surface decomposition of plant residue cause most plant nutrients to accumulate at the soil surface, so soil test values will usually decrease as the sample depth increases. To obtain accurate results that are consistent from year to year, horse pasture samples should be taken to a depth of 4 inches.

Sample Preparation

After all cores for an individual sample are collected and placed in the bucket, crush the soil and mix the sample thoroughly (Figure 3). Allow the sample to air-dry in an open space free from contamination. Do not dry the sample in an oven or at an abnormally high temperature. When the sample is dry, fill the sample container with soil (Figure 4).

Figure 3. Break up clods while the sample is moist, and spread the sample out to air-dry in a clean area.

Sampling and preparing the soil for submission is only half of the process. The other equally important part is filling out a sample information sheet so that the soil analyst can consider desired crop, tillage, and other information when making the fertilizer recommendation (Figure 4). The form contains all the information needed to provide accurate lime and fertilizer recommendations. Sample information sheets for the University of Kentucky soil testing laboratories can be found on the web at http://soils.rs.uky.edu/forms/sampleforms.php. Use the agricultural form when submitting samples from horse pastures or hay fields. Staff at your local county extension office can help you complete the form and will send it with the sample to the UK soil testing laboratory. Results and recommendations will be e-mailed to the county office, usually within one to two weeks, and returned to you.

Figure 4.

Thoroughly mix the air dried sample, fill the sample bag or box, mark it as an agricultural soil sample, fill out the information sheet, and take the form and the sample to your county extension office.

Nutrient and Fertilizer Management

When you get back your soil test results, you should lime and fertilize pastures with phosphorus (P) and potassium (K) according to soil test recommendations so desired forages will grow vigorously and compete against undesirable weeds (Table 1). Maintain soil acidity (pH) in horse pastures between pH 6.0 and pH 6.5 by applying agricultural limestone every four to five years according to test recommendations—typically 2 to 3 tons per acre every four to five years. Soil acidity in this range ensures optimum availability of plant nutrients for pasture growth. Different formulations of P and K fertilizers vary little in performance and availability of plant nutrients; choose the one with the least cost per unit weight, but factor in how easy it is to apply (for example, prill size).

Remember that pasture fertilization is not a sound approach to alleviate macronutrient and micronutrient deficiencies of horses. These problems may be better addressed more directly, by feeding mineral supplements, for example.

Broadcasting Nitrogen on Cool-Season Grass Pastures

The need to topdress nitrogen (N) on horse pastures in Kentucky is often less than that for cattle pastures. This difference is because the goal with mature horses is weight/condition maintenance, while the goal on most beef cattle pastures is maximum weight gain. Nitrogen fertilizer is not recommended if the pasture contains more than 25% clover in the stand, since the N needs for the grass will be supplied by the clover. Table 2 and 3 give N fertilization guidelines based on the stocking rates of horses in a cool-season grass pasture.

Cool-season grasses, such as Kentucky bluegrass, orchardgrass, timothy, and tall fescue, grow most vigorously from early spring into early summer and then again in the fall into early winter. When soil moisture, pH (more than 6.0), and soil test levels of P and K (P more than 30, K more than 200) are adequate, fertilizer N will stimulate cool-season grass growth during these peak production periods. The use of N should depend on what is expected from the pasture. Nitrogen fertilization can help increase total production and protein content, extend spring grass growth into the early summer, and extend fall pasture production into early winter. However, unless the increased pasture yield is used, the added N expense yields no return.

Nitrogen fertilization in horse pastures has several disadvantages. Stimulating grass growth in the spring can be helpful in maintaining a high stocking rate, but frequent clipping will be required to maintain pasture quality in a lightly stocked horse pasture. Late spring N application may have the unintended result of promoting the growth of summer weeds, such as crabgrass, yellow foxtail, nimblewill, and common ragweed. In addition, you'll need to be extra cautious when broodmares are on pastures that contain tall fescue. In these pastures, spring N has been known to increase levels of ergot alkaloids, leading to an increased likelihood of symptoms of fescue toxicity (prolonged gestation, difficult birth, and lack of milk production). Fortunately, the potential for fescue toxicity is an issue only with broodmares, since toxicity symptoms related to tall fescue are not known to occur in other classes of horses.

Excessive N applications may result merely in wasted forage. At low stocking rates (more than 2 acres per mature horse) on soils with good productivity, N should be broadcast only in the fall (Table 2). Fall applications stimulate tillering of individual grass plants and produce a denser grass stand, which can suppress weed growth. Fall applications also lengthen the period of active photosynthesis, which promotes root growth and winter survival. If the primary goal is a denser grass stand, one late fall application, between late October and early November, is sufficient. If fall pasture growth is important, also apply N between mid-August and mid-September.

At higher stocking rates (less than 2 acres per mature horse) on soils with good productivity, fertilizer N may be broadcast on cool-season grasses throughout much of the growing season (Table 3). A late winter application will stimulate a growth flush in early spring. An N application in May will help extend the pasture into the early summer, and an application in August will stimulate cool-season pasture grass production in the fall and early winter. The major limitation to summer N fertilization is its stimulation of the growth of summer weeds.

Table 1. Phosphate and potash recommendations (lb/A) for cool-season grass horse pastures when applying annual fertilizer applications.

Category	Test Result: P	P_2O_5 Needed	Test Result: K	K_2O Needed
Very high			>420	0
High	>60	0	321 - 420	0
			301 -320	0
Medium	46 - 60	30	267 - 300	30
	41 - 45	40	240 - 266	30
	37 - 40	50	213 - 239	30
	33 - 36	60	187 - 212	40
	28 - 32	70		
Low	23 - 27	80	159 - 186	50
	19 - 22	90	132 - 158	60
	14 - 18	100	104 - 131	70
	9 - 13	110		
Very low	<9	120	<104	80

Table 2. Topdressing nitrogen (lb/A) on cool-season horse pastures when maintained at low stocking rates (more than 2 acres/horse).

Date	N per Application[1]
Aug. 15 – Sept. 15	30 - 40
Oct. 15 – Nov. 15	30 - 60

[1] Total amount of N to topdress depends on desired result. No N is recommended if clover makes up more than 25% of the pasture. If primary goal is increased tillering for a denser grass stand in winter, then one late fall application is sufficient. If fall pasture growth is important then also apply N in late August-early September. Suggested dates and rates for topdressing with N are shown above.

Table 3. Topdressing nitrogen (lb/A) on cool-season horse pastures when maintained at high stocking rates (less than 2 acres/horse).

Date	N per Application[1]
Feb. 15 – Mar. 15	up to 40 - 80
May 1-15	up to 30 - 40
Aug. 15-30	up to 40 - 80

[1] Total amount of N to topdress should depend on how much additional production is needed. Late spring N applications may have the unintended effect of stimulating unwanted summer weeds. Little or no N is recommended if clover makes up more than 25% of the pasture. Suggested dates and rates for topdressing with N are shown above.

The stocking rates are estimates for Kentucky soils of average productivity. The soils of highest productivity in Kentucky will support one mature horse on 2 acres or less, while those with the lowest productivity (often with significant slopes) require 10 or more acres per horse. It is important to determine the recommended stocking rate for your soil type. See your county extension agent for the average stocking rates for the soil types found in your area. Or, go to USDA's Web Soil Survey at http://websoilsurvey.nrcs.usda.gov.

Often, stocking rate information in soil surveys is given in animal unit months (AUM). To convert animal unit months to recommended acres per horse, use the following formula:

(12 ÷ AUM) x (wt of horse ÷ 1000) = acres required per horse

Nitrogen Sources

Kentucky research has shown that in late fall, late winter, and early spring, little difference exists among the N sources commonly used for topdressing cool-season grasses. After May 1, risk increases that broadcast urea will not be as effective as other N sources. Average efficiency values for urea N applied after early May ranged from 51% to 78% of that observed for ammonium nitrate, depending largely on the length of time between urea application and the next rainfall. When a urease inhibitor is used along with urea, the urea efficiency is comparable to that of ammonium nitrate. For urea without an inhibitor applied after early May to be an economical substitute for ammonium nitrate, the cost per pound of nitrogen probably would need to be 15% to 20% less than that for ammonium nitrate-nitrogen.

Research indicates that efficiency of liquid urea-ammonium nitrate (UAN) applied after early May is more efficient than urea but less efficient than ammonium nitrate. A urease inhibitor can also be used along with UAN. See University of Kentucky Cooperative Extension publication *Nitrogen Transformation Inhibitors and Controlled Release Urea* (AGR-185) for specific information on products designed to reduce N loss.

To avoid burning symptoms on leaves of grasses, apply any granular N source when the leaf surface is dry. Also, avoid leaving piles of granular N in the field, either from misapplication or improper equipment operation. Ingestion of significant amounts of N fertilizer can be toxic to horses.

Phosphorus Fertilization in Central Kentucky

Most soil in the Inner and Outer Bluegrass Region of Kentucky has been formed from limestone that is naturally high in phosphorous. Plant-available phosphorus is high (often exceeding 200 lb/acre), and these fields may never have a need for phosphorus fertilization. Adding fertilizer phosphorus in these high-phosphorus fields simply increases the chances for eutrophication—algae-like blooms that may cause fish kills (Figure 5) and can diminish the uptake of other essential plant nutrients like zinc. Since fertilizer analysis is given in N%-P_2O_5%-K_2O%, make certain that the center number in a fertilizer product is 0 (example 23-0-30) when soils are already high in phosphorus.

Conclusion

Conducting routine soil sampling and applying appropriate rates of fertilizer are the best steps in achieving your long-term goals for productivity in your horse pasture. Applying excessive rates of fertilizers is expensive and can cause undesirable weed growth and micronutrient deficiencies and could negatively impact the environment. Further advice on fertilizing your horse pastures is available from your county cooperative extension agent. To locate your extension office go to www.ca.uky.edu/county.

Figure 5. Excessive phosphorus in surface water bodies (ponds and streams) can cause eutrophication (algae-like blooms that may cause fish kills).

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