K-STATE Research and Extension | Wildcat District

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Unaccounted Costs: Nutrients in Hay

Hay is not cheap, then again, neither is grain right now, but often the full cost of hay goes under realized. Much of the value in hay remains in unaccounted soil nutrients that is removed from hay fields and is redistributed in over wintering pastures or concentrated in lots. The production of hay has soil nutrient removal that is more often, not replaced with fertilizer or manure. This can be easily seen in the red hay fields of broomsedge (also called poverty grass), that grows in acidic soils with low phosphorus and potassium levels. It's not that broomsedge grows best in these soils, it's that the other grasses have such a low production that the broomsedge can outcompete. It often leads one to wonder, when these hayed fields are being rented, purchased, or managed, is the someday cost of fertilizer fully being realized?

Soil Nutrient Removal

Hay, of any type, is a nutrient intensive crop. Wendie Powell, Livestock Agent for K-State Extension Wildcat District says, "When we look at fescue, bermudagrass or other non-native grasses, we can see a direct response of hay yield in comparison to the nitrogen application. But only applying nitrogen is not going to give you much if other nutrients in the soil are not present." Giving the importance of having a balance of all soil nutrients and pH, Wendie states, "A plant can only grow to the height of its most limited nutrient. If the soil phosphorus level dictates that a plant can only grow six inches, no amount of nitrogen is going to change its mind."

Common hay crops of fescue, bermuda, alfalfa, and native have similar phosphorus (P) removal between 10 to 15 lbs. P per ton, with 12 lbs. P per ton being a frequently used average. Native grass tends to be more efficient with phosphorus but removal factors are a fairly consistent amount hay type and level of production. However, potassium levels in hay can vary. Average potassium (K) uptake for fescue and bermuda are around 40 to 45 lbs. K per ton and 50 lbs. K per ton for alfalfa. When hay yields can be four tons or more, potassium removal is in the hundreds of lbs. Also, while phosphorus is only taken up on an "as needed" basis, potassium can

be “luxury consumed” in quantities greater than plant needs. (Note the above mentioned values are upon a completely dry basis.)

Finding the nitrogen value in hay is less straight forward because not only is the quantity of nitrogen (N) change based upon fertilization but also because nitrogen can’t be “stored” in the soil from season to season. The quantity of nitrogen can be determined directly by protein percentage as protein is 16 percent nitrogen. That means there is 3.2 lbs. of N for each 1 percent of protein in a dry ton of hay. Of course, this doesn’t take into account nitrogen losses in the field. To account for this, we can use a simple approximation that in a fertilized field it takes 50 lbs. of N for each additional ton of hay.

Notice in table 1 below that a fertilized fescue bale can have up to $25 of N, P and K involved. While an unfertilized native bale in table 2 is closer to $10. The higher production and protein of the tame grasses like fescue and bermuda have their price, but even hay off native range takes nutrient value. Also, between the storable nutrients of phosphorus and potassium, phosphorus is the cheaper one hay by nearly three times.

Nutrients in 1,000 lbs. dry hay	Value fertilizer per lb., $	Total value of nutrient, $
25 lbs. N	$0.54 /lb.	$13.50
6 lbs. P_2O_5	$0.49 /lb.	$2.94
20 lbs. K_2O	$0.45 /lb.	$9.00
	Total	$25.44

Table 1. 1,200 lb. bale of fertilized fescue at 16% moisture =~1000 lbs. dry

Nutrients in 1,000 lbs. dry hay	Value fertilizer per lb., $	Total value of nutrient, $
5 lbs. P_2O_5	$0.49 /lb.	$2.45
15 lbs. K_2O	$0.45 /lb.	$6.75
	Total	$9.20

Table 2. 1,200 lb. bale of unfertilized native at 16% moisture =~1000 lbs. dry

Accounting for Removal

To fully realize the value of element nutrients in hay, all hay crops should be considered a fertilizer loss to that field. Wendie Powell states, “Undernourished hay meadows lead to low quality hay. For example, I often hear that native grass makes poor hay. Well, that’s because it’s all too common to see land turned to a hay field after being used for something else, and soil testing and applying fertilizer at the correct rate has either been overlooked or not in the budget.”

There are many long term hay fields that are effectively depleted of phosphorus and potassium, with P levels below 5 ppm and K levels below 80 ppm. Agronomic optimum, or a "full" nutrient profile, is P levels at 20 ppm and K levels at 130 ppm. Although grass hay crops can efficiently grow at lower values then the agronomic optimum, it gives a benchmark of standard. Using an approximation that is, takes 20 lbs. of P and 12 lbs. of K to move the respective nutrient 1 ppm in the soil, that depletion represents 350 lbs. of P and 700 lbs. of K. When adding in the cost of micronutrients and spreading, that value difference could be $1,000 or more. Rightfully, this is something to consider when purchasing land or when rented ground is hayed without compensating for nutrient loss as well.

There is no such thing as "free hay," be it in a farmer's own pasture or one that is rented. The value of forage is a sum of the labor and materials in baling, the land value or opportunity costs on the land which it was grown, and finally, the soil nutrients contained within the bale itself.

If there are any questions about soil and pasture fertility, Wendie Powell and myself can be reached at any K-State Research and Extension Wildcat District office. Altamont's office number is 620-784-5337 or email jcoover@ksu.edu.

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