Removal of Potassium in Hay Harvests— A Huge Factor in Nutrient Budgets

By C.S. Snyder

Crop nutrient demand is growing in much of North America because crop yields are increasing and with them crop nutrient removal. An overview of the recent nutrient budget (removal minus input) in North America was reported in *Better Crops with Plant Food* last year (2002, No. 2:20-22). In this article, the focus is on K removal by all hay crops in North America.

Evaluation of nutrient budgets reveals that harvested hay crops are responsible for 46% of the potassium (K) removed by all crops in North America. Harvested hay crop K removal is equivalent to 91% of the K fertilizer applied to all crops in North America.

It is estimated that over half of the land area in the U.S. is used for grasslands, to provide feed for livestock and to convert fiber to milk and meat for human consumption. So, it is not surprising that forages are often referred to as "the backbone of sustainable agriculture." A large percentage of these grasslands is specifically targeted for hay production to offset feed expenses during winter and during drought, and surplus forage in grazed pastures is frequently harvested for hay.

Nutrient balance is just as important with forages as it is for other crops. To assure that forage production is indeed sustainable, harvested nutrients must eventually be replaced. Inadequate fertilization and/or nutrient imbalance prevent many producers from achieving desired forage yields and quality, and they can also adversely affect animal health and decrease weight gain and milk production.

Most forage and livestock producers recognize the need for nitrogen (N) fertilization, but often overlook the comparable

Hay harvest removes large amounts of nutrients, particularly K, from fields.

TABLE 1. Nutrient removal by harvest of major forages.

Forage	N	P_2O_5	K_2O
	Dry matter basis, lb/t		
Alfalfa[1]	56	15	60
Annual ryegrass	68	16	67
Bahiagrass	43	12	35
Bermudagrass	46	12	50
Bromegrass	36	13	59
Clover[1]-grass	50	15	60
Fescue	38	18	52
Orchardgrass	50	17	62
Sorghum-sudan	40	15	58
Timothy	38	14	62
Vetch[1]	56	15	46
	67% moisture basis, lb/t		
Corn silage	8.3	3.6	8.3

[1]Legumes obtain most of their N from the air.

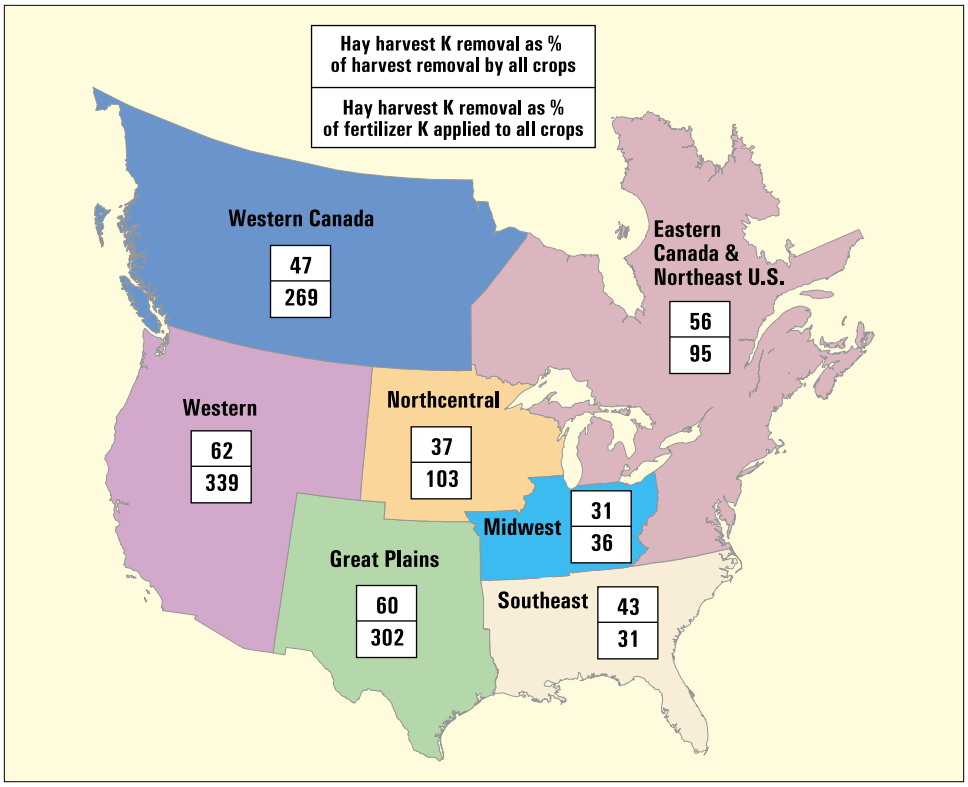

Figure 1. Forage hay harvests are a large portion of total crop K removal and the total K_2O applied annually to all crops.

forage demand for K. Potassium utilization by forage grasses exceeds utilization by any other agronomic crop in the world. Most forage crops have a K concentration ranging from 1.6 to 3.2% of the dry matter.

Table 1 illustrates nutrient removal by some of the major forages in North America. High yields of these forages result in high nutrient removal. For example, harvesting 6 t/A (dry matter) alfalfa removes about 360 lb K_2O...and bermudagrass removes about 300 lb/A. This can lead to a significant decline in soil fertility levels over time if soil fertility is not properly managed.

About 78 million grassland acres are harvested for hay yearly, which is about 19% of the total grain, fiber, and oilseed crop acreage in North America (**Table 2**). (***Note:*** *non-hayed grassland acreage is not reported by national agricultural statistics services*). In some regions, hay acreage accounts for at least one-third of the total crop acreage. Crop harvest in North America removes over 21 million lb of K_2O annually. It may be surprising that harvested hay crops account for 46% of all K consumption in North America, and that it dominates all crop K removal in three regions (**Table 2**).

In several North American regions, hay harvests are mining soil K reserves. **Figure 1** illustrates regional differences in the magnitude of the annual hay harvest removal compared to annual K fertilizer sales. In all of North America, annual hay harvests alone remove K equivalent to 91% of all fertilizer K sold and applied to all crops annually.

The impact of hay harvest K removal on forage nutrient budgets at the national, regional, and local levels is clear. Continued under-replacement of K will take a toll on the productivity and competitiveness of the forage-livestock system, as soil test levels

TABLE 2. Hay acreage and K_2O consumption among U.S. and Canadian regions.

PPI region	All hay acres[1], thousand acres	Total crop acres (incl. all hay), thousand acres	All hay/ total crop acres, %	All hay K_2O removal, million lb	Alfalfa K_2O removal/ all hay K_2O removal, %	Total crop (incl. all hay) K_2O removal, million lb	All hay K_2O removal/ total crop removal, %	Fertilizer K_2O applied to all crops (incl. all hay)[2], million lb	All hay K_2O removal/ all fertilizer applied, %
Eastern Canada & Northeast U.S.	12,482	34,985	36	1,511	47	2,612	58	1,586	95
Great Plains	11,130	64,390	17	1,479	43	2,468	60	490	302
Midwest	9,170	66,336	14	1,183	41	3,821	31	3,319	36
Northcentral	15,600	111,419	14	2,291	78	6,164	37	2,214	103
Southeast	7,085	35,690	20	754	2	1,741	43	2,415	31
Western	9,357	28,769	33	1,926	81	3,119	62	568	339
Western Canada	13,103	76,585	17	786	71	1,658	47	292	269
North America Total	**77,927**	**418,174**	**19**	**9,930**	**58**	**21,583**	**46**	**10,884**	**91**

Sources: U.S. National Agricultural Statistics Service; Statistics Canada; and PPI/PPIC/FAR Technical Bulletin 2002-1.
[1]Acreage information based on 2001 data from Canada and 2000 data from the U.S.
[2]Crop K consumption is average of 1998-2000; K applied to all crops from PPI/PPIC/FAR Technical Bulletin 2002-1.

decline below the optimum range.

Forage and livestock producers, fertilizer dealers, and crop advisers have many opportunities to relieve chronic K shortages with progressive K management. Soil testing can be used in concert with forage and hay analyses to develop nutrient budgets for individual pastures and hay meadows, or management zones within grasslands. Good K fertility management can benefit farmers, livestock, rural communities, and the urban public. **Optimum forage K management can lead to increased forage production, greater farm profitability, and protection and preservation of soil and water resources.** BC

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