



Demonstration results from the Lower Missisquoi Water Quality Project in Franklin County, Vermont

Phosphorus and Potassium for Alfalfa-grass Forages: Soil Tests, Crop Response, and Water Quality

Background and Summary:

Fertilizer used for topdressing legume-grass forages in Vermont commonly includes both phosphorus and potassium (e.g., 0-10-40 or 0-10-30). While these analyses approximate the ratio of uptake of P_2O_5 and K_2O by the crop, they are appropriate only if both phosphorus (P) and potassium (K) are needed by the crop. Results from the following field demonstrations show that top yields can be maintained with application of just potash on soils testing “optimum” or higher in phosphorus. Avoiding unnecessary phosphorous applications reduced P use by as much as 60 lb P_2O_5 per acre in these trials, which could save the farmer \$10 to \$15 per acre and lower the potential for P runoff from the field.

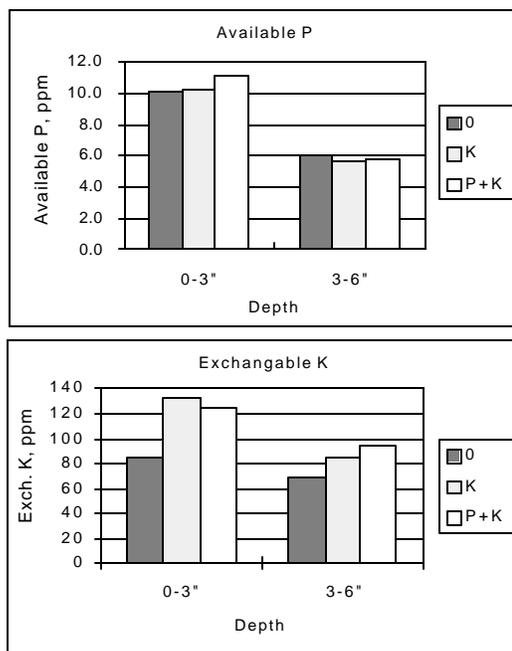
Demonstration Sites:

In order to demonstrate this principle, we established field trials at three locations during the 1993-1996 period. Treatments were a) no fertilizer, b) potassium only, and c) both phosphorus and potassium. One site, established in 1993 on the Steve Harness farm, was a pure alfalfa stand on a Deerfield loamy fine sand. The study was ended after two years when severe overwinter stand loss caused the farmer to plow the entire field. Two alfalfa-grass trials were established on Georgia stony loam soils on the Wyn Paradee farm, Site #1 in 1993 and Site #2 in 1994. All three sites tested medium or higher in both P and K. At all sites, plots 5 by 15 ft were arranged in a randomized complete block design with four replicates. Fertilizer treatments were applied by hand in early May except for the first year of the Paradee #2 site, in which

fertilizer was applied after first cut. Fertilizer rates were 30 lb P₂O₅ and 120 lb K₂O/acre at the Harness site and 60 and 180 at both Paradee sites. Soil samples were analyzed with modified Morgan's extract (ammonium acetate, pH 4.8), the standard soil test at UVM. Optimum range for crop production is 4-7 ppm P and 101-130 ppm K.

Soil Test Levels

Initial soil tests at the Harness site were high in P (12 ppm) and excessive in K (204 ppm) in the 0-3 inch depth. Soil tests results in the fall of 1994 after two years of fertilizer application showed little change from initial levels and no significant difference in available soil test P among treatments (Fig. 1). This reflects the relatively low plant uptake of P compared to the high soil levels, as well as the low amounts added as fertilizer. Soil test K decreased each year, reflecting the large uptake of potassium by high-yielding alfalfa, typically more than 50 lb K₂O/ton/acre, and the sandy soil at this site. However, fertilized treatments still tested high after two years.



At the Paradee farm initial soil test values for the 0-3 inch depth were medium for both P

Figure 1. Soil test results for Harness site, Fall, 1994.

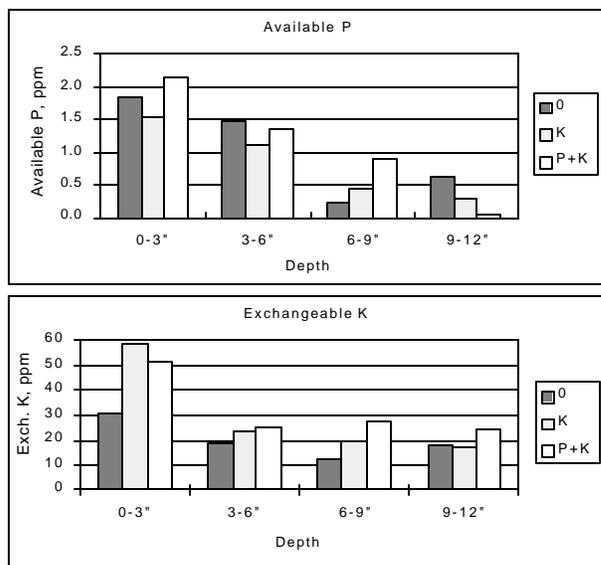


Figure 2. P and K soil test results for Paradee Site #1, Fall, 1995.

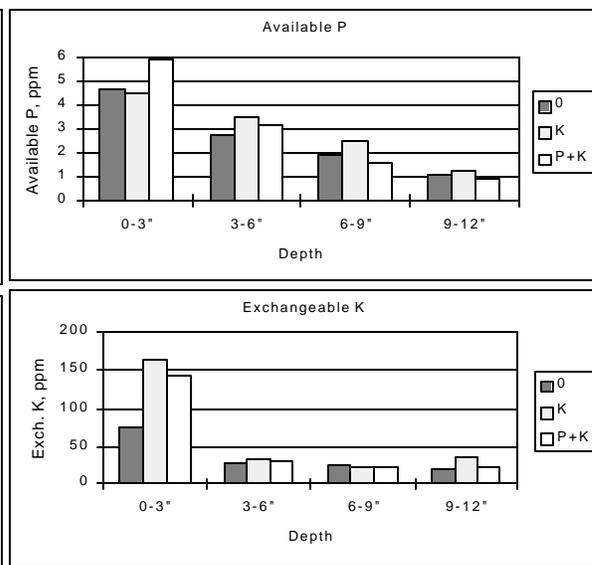


Figure 3. P and K soil test results for Paradee Site #2, Fall, 1996.

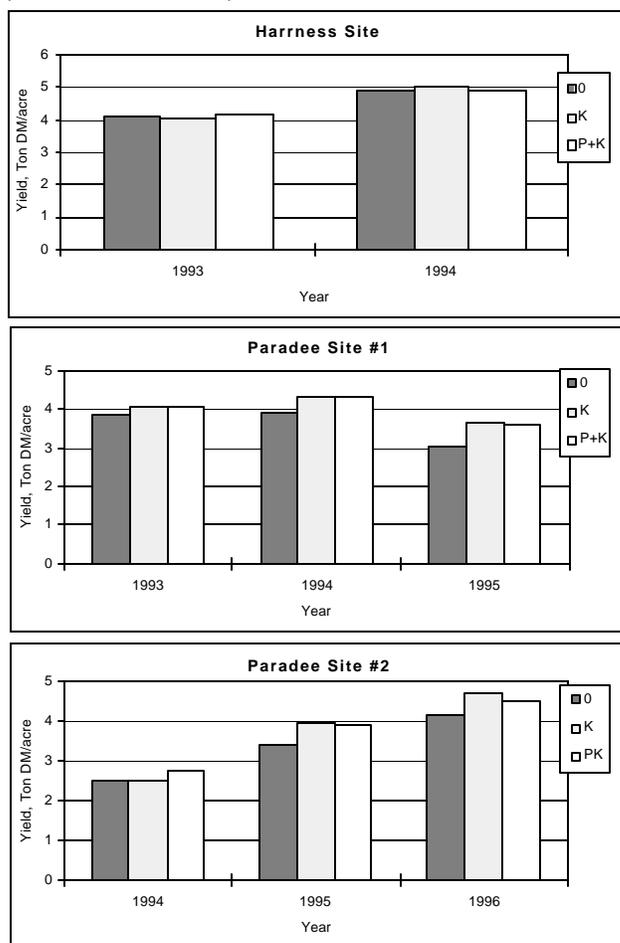
and K at Site #1 (2.2 ppm K and 79 ppm K) and optimum in P (6.7 ppm) and medium in K (54 ppm) at Site #2. After three years of fertilizer application soil test P levels were maintained by the P fertilizer treatment, resulting in higher levels than non-P treatments (Figs. 2 and 3) . There were no significant differences in lower depths.

Potash applications resulted in a K soil test almost twice that of the control in the 0 to 3 inch depth at both sites. It showed smaller but significant differences in the 3 to 6 inch depth at Site #1. Even with annual additions of 180 lb K_2O /acre, the soil test K on Site #1 decreased with time, but it did stay in the medium range.

Yield Results

The Harness site produced yields of over 4 tons dry matter per acre in the first year (1993) and almost 5 tons per acre in 1994, with no increase from the application of potash or phosphorus fertilizer in either year (Fig. 4). The lack of a fertilizer response

Figure 4. Yields of alfalfa (Harness) and alfalfa-grass (Paradee #1 and #2). 1993-1996.



was expected because soil tests were high and no P or K fertilizer was recommended. Despite the drop in soil test K, there were no effects on yield in the two years of the study. (Soil test K was still high after one year.) It is unfortunate that the study could not have been continued for a third year to determine if yields would have been affected when soil test K had decreased into the medium range.

Neither site on the Paradee farm showed yield increases from fertilizer in the first year or in the first harvest of the second year. However, yield increases in some harvests of the second and third years at both sites resulted in about a half ton per acre total yield increase from both fertilizer treatments. These yield responses are a result of the potash application, because there was no further yield increase from the addition of P in the 0-60-180 treatment.

Conclusions

- P fertilizer did not increase yields when soil test P was medium or higher.
- K fertilizer produced significant yield increases when K soil test had dropped to medium or lower, but not when it was high or excessive.
- P soil test levels were maintained by low to moderate additions of P fertilizer and declined only modestly without P application.
- K soil test levels eventually declined even with moderate fertilizer additions and decreased dramatically without K application, especially on the sandy soil.
- On many well managed soils, fertilizing with K only will save dollars and reduce the potential for P runoff.

Project Coordinators

The Lower Missisquoi Water Quality Project is a cooperative effort among, the following participants:

- ☒ Missisquoi Watershed Project Area Farmers
- ☒ UVM Extension
- ☒ USDA Farm Services Agency
- ☒ USDA Natural Resource Conservation Service
- ☒ Vermont Department of Agriculture, Food and Markets
- ☒ Franklin County Natural Resource Conservation District

For More Information:

This factsheet is one in a series on the Lower Missisquoi Water Quality Project. For information on obtaining other factsheets or for more information on the project, contact:

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