Response of *Poa pratensis* L. to NPK on Shallow Muck Soil

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Summary

There are .5 to .6 million ha of muck soils in northern Indiana which are suitable for agriculture. Areas with muck soils will vary from a few hectare to as much as 1000 ha. The larger areas, when properly drained, are used for high income crops such as mint and potatoes. The smaller muck areas are usually farmed in a similar manner to that of the remainder of the farm. The usual crops are corn (*Zea mays* L.) and soybeans (*Glycine max* (L.) Merrill) since the soils are too wet in the spring for wheat (*Triticum aestivum* L.) production. Unfortunately, yields of corn and soybeans are often reduced to an uneconomical level on these muck soils due to excessive weed competition, late planting due to wet conditions, or early frosts resulting from cold air drainage.

Because of the many problems associated with corn and soybean production some farmers are using these low-lying muck areas for pasture. Kentucky bluegrass (*Poa pratensis* L.) is very well adapted to these muck soils but very little information is available relative to its fertilizer requirements under these conditions.

Since little is known about the NPK fertilizer requirements of Kentucky bluegrass pastures on muck soil an experiment was initiated on a Kentucky bluegrass pasture on the Pinney Purdue Agricultural Center in April, 1979 to study this problem. Dry matter yield and percent crude protein were determined for each of four cuttings taken throughout the 1979 growing season.

It was found that N applied at the rate of 168 kg/ha increased dry matter yield from 6.3 to 8.2 mt/ha. This same rate of N increased crude protein production from 1153 kg/ha to 1983 kg/ha. Phosphorus and potassium had little effect on increasing overall dry matter production.

INTRODUCTION

Very little information is available relative to the response of cool-season grasses, such as Kentucky bluegrass, to NPK fertilizer when grown on muck soil. Tesar and Shepard (5) reported significant increases in dry matter production of orchardgrass, tall fescue, and smooth bromegrass when each was fertilized at rates of 50, 87, and 249 kg/ha of NPK respectively on a well-drained Houghton muck soil.

Research conducted on Edwards muck soil in northern Indiana demonstrated that a mixture of Kentucky bluegrass and birdsfoot trefoil when utilized as a pasture for beef cattle can be a profitable alternative to corn or soybeans on a shallow muck soil (1). However,

the Kentucky bluegrass and birdsfoot trefoil mixture must be properly grazed or the pasture will soon become predominantly Kentucky bluegrass.

The following experiment was conducted to study the response of Kentucky bluegrass pasture to NPK fertilizer since many of these pastures are found in the muck areas of northern Indiana and very little research has been conducted relative to this problem.

MATERIALS AND METHODS

An experiment was initiated in April 1979 on a predominately Kentucky bluegrass pasture located on the Pinney-Purdue Agricultural Center near Wanatah, Indiana to determine the response of Kentucky bluegrass to NPK fertilizer. Eight combinations of NPK were evaluated as follows and expressed as kg/ha of N, P_2O_5, and K_2O: 0-0-0, 0-0-448, 0-224-0, 0-224-448, 168-0-0, 168-0-448, 168-224-0, and 168-224-448, respectively. Three replicates of each treatment were employed giving a total of 24 plots.

All fertilizers were applied as a single application on April 10. The sources of the NPK fertilizer elements were: ammonium nitrate, treble superphosphate, and muriate of potash, respectively.

The plots were established on a permanent Kentucky bluegrass pasture. Each plot was approximately 3.3 m x 33 m. Since the plots were grazed by beef cattle, a 1.5^2 m cage was randomly placed on each plot in order to obtain a yield estimate as well as a forage sample for chemical analysis.

The soil was an Edwards muck. Soil test results provided by the Purdue University Soil Testing Laboratory indicated that the organic matter content was 46%, pH of 5.1, and P and K values of 37 and 209 kg/ha respectively.

The caged areas were harvested 4 times during the 1979 growing season. The harvest dates were May 17, June 22, August 10, and Septimber 18. A Toro lawn mower with a collection bag was used to harvest the caged areas and to provide a plant sample for crude protein analysis. Crude protein concentration was determined on the Kentucky bluegrass samples collected throughout the season using the technique outlined by Nelson and Sommers (4) and Bremmer and Edwards (2).

RESULTS AND DISCUSSION

The response of Kentucky bluegrass to the eight combinations of NPK fertilizer is shown in Table 1. The major increase in dry matter was to 168 kg/ha of N fertilizer which resulted in an increase of nearly two mt/ha. A small increase in dry matter yield resulted from applying 224 kg/ha of P_2O_5 and 448 kg/ha of K_2O either with or without N. The application of N resulted in an increase of 30.2% while NPK increased dry matter yield by 41%.

The crude protein concentration in Kentucky bluegrass also increased markedly with the application of 168 kg/ha of N (Table 2). A very large increase in crude protein, 19.3 to 27.8, was noted for the

TABLE 1. *Effect of NPK on dry matter yield of Kentucky bluegrass in 1979.*

Treatment	Harvest Date				
	May 17	June 22	Aug. 10	Sept. 18	Total
	— mt/ha —				
Control	2.0	0.9	1.6	1.8	6.3
K	1.8	1.1	1.8	2.0	6.7
P	1.8	1.1	1.6	2.0	6.5
PK	2.0	1.3	1.6	2.2	7.1
N	2.9	1.1	2.0	2.2	8.2
NK	2.7	1.1	1.8	2.0	7.6
NP	2.7	1.3	2.0	2.2	8.2
NPK	3.1	1.1	2.0	2.7	8.9

first cutting on May 17 when the Kentucky bluegrass was in the early heading stage. There was a gradual decline in crude protein concentration as the growing season progressed for the forage from the plots receiving N fertilizer. This decline would suggest that Kentucky bluegrass, under these conditions, would respond to an even greater amount of N than the 168 kg/ha. Similar data for Kentucky bluegrass have been reported by Hojjati, *et al* (3) although the experiment was conducted on a mineral soil.

Table 3 shows the very striking increase in total crude protein production on a hectare basis. Averaged over all treatments, the application of 168 kg/ha of N increased the total crude protein per hectare by 72%.

TABLE 2. *Effect of N fertilization on the crude protein concentration of Kentucky bluegrass.*

N	Harvest Date				
kg/ha	May 17	June 22	Aug. 10	Sept. 18	Avg.
	— % Crude Protein —				
0	19.3	19.0	18.0	17.4	18.4
168	27.8	23.8	22.2	20.5	23.6

TABLE 3. *Effect of NPK on crude protein production of Kentucky bluegrass.*

Treatment	Harvest Date				
	May 17	June 22	Aug. 10	Sept. 18	Total
	— kg/ha —				
Control	388	170	283	312	1153
K	321	204	315	346	1187
P	355	196	276	340	1166
PK	413	246	280	369	1307
N	811	266	447	460	1984
NK	686	260	371	424	1742
NP	754	321	435	494	2004
NPK	834	263	414	561	2072

These data indicate that the major limiting fertilizer element for producing Kentucky bluegrass on Edwards muck soil is N with only slight yield increases due to P and K. The application of 168 kg/ha of N resulted in approximately 30% increase in dry matter yield and an increase of 72% in total crude protein. If yields of the magnitude obtained in this experiment were to be produced for several years, or if higher rates of N were to be applied, the response to P and K may increase as the levels in the soil are depleted.

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