Effect of the Method of Application of Supplementary Phosphorus on the Yield and Nutritive Value of Alfalfa

F. A. SOROUR, A. J. SALMAN, AND J. H. EL-FALEIT[1]

ABSTRACT

Supplementary phosphorus application in the sandy soil of the Faculty of Agriculture Farm, Sidi El Misri, Tripoli, Libya, resulted in a significant increase in the fresh and dry yields of alfalfa. However, the percentage dry matter was not significantly affected by the phosphorus application.

Alfalfa responded better to foliar spray treatment of phosphorus than to soil application treatment. This may be due to the limited root growth and/or phosphorus fixation in the soil.

Phosphorus application resulted in an increase in crude protein, crude fat, crude fiber, mineral matter, and nitrogen-free extract. Such increase was only significant in the case of crude fat.

Percent digestible protein, percent digestible nutrients and nutritive ratio of alfalfa were not significantly different among the different treatments.

INTRODUCTION

The response of alfalfa to phosphorus is well established. The yield of alfalfa was found to increase with phosphorus application (2,3,4,5,6,7). Lutz (3) reported high yield of alfalfa due to phosphorus application. Furthermore, he indicated that there was no difference in plant response when either calcium superphosphate or rock phosphate were used. Phosphorus has a great effect on the chemical composition of plants because the yield quality increases as a result of increased absorption by the plants (8).

Preliminary studies in the Faculty Farm showed a marked decline in alfalfa yield during the third year. Examination of plant roots showed their growth to be limited.

The present experiment was conducted to study the effect of the method of application of supplementary phosphorus by either soil application or foliar spray, on the yield, chemical composition, and nutritive value of alfalfa.

MATERIALS AND METHODS

The experiment was conducted in the Faculty of Agriculture Farm at Sidi El-Misri, Tripoli, during 1972/1973. It was located in a three-year old alfalfa field. The selected

[1] *Faculty of Agriculture, University of Alfateh, Tripoli, Libya.*

field was annually fertilized with 300 kg/ha of a compound fertilizer (12N–24P–12K).

Soil analysis indicated that it was a sandy soil containing 70% sand, 20% silt and 10% clay. Calcium carbonate amounted to 7.5% and the salt content to 0.45 mmhos/cm.

A strip plot design was used. The area was divided into three equal strips. Each strip was assigned to one of the following treatments: control (untreated), foliar spray with 4% solution of calcium superphosphate of 18% P_2O_5 (equal to 40 kg/ha) and soil application with calcium superphosphate at a rate of 40 kg/ha. The experimental treatments started on December 1972 and the harvest was done on 18 February 1973. Four random samples of one square meter each were harvested from each treatment. The fresh and dry weights and the dry matter percentages were determined. The dried samples were subjected to chemical analysis according to Weende method as described in A.O.A.C. (1). The coefficients of digestibility of the different components in alfalfa used in the study to determine the digestible nutrient percent and the total digestible nutrient were: protein 71%, fat 30%, crude fiber 45%, and nitrogen-free extract 70%.

Nutritive ratio was also calculated by using the method described by Morrison (6).

RESULTS AND DISCUSSION

Table 1 shows the effect of phosphorus application on the fresh and dry yields of alfalfa and the percent dry matter. Although the fresh and dry yields were comparable for both the control and the soil application treatments, the foliar application of superphosphate gave significant higher yields than the other treatments. The results also indicated that the percent dry matter was not significantly affected by the different treatments.

Results in Table 2 show the effect of phosphorus treatments on the chemical composition and nutritive value of alfalfa. Phosphorus application, either as a foliar spray or as a soil application, increased the amount of crude protein, crude fat, crude fiber, mineral matter and nitrogen-free extract in comparison with the control. Such increase was only significant in the case of crude fat. The results also indicated that the plant response to additional phosphorus application was more pronounced with the foliar application treatment. This might be due to the limited root growth and/or the phosphorus fixation in the soil.

Table 1 Effect of phosphorus application on alfalfa yield.

Treatments	Fresh weight (ton/ha)	Dry matter (ton/ha)	Dry matter (%)
Control	11.250	2.094	18.65
Foliar spray	14.750	2.756	18.65
Soil application	12.000	2.215	18.48
L.S.D. (0.05)	1.825	0.403	N.S.[a]
L.S.D. (0.01)	2.763	N.S.	N.S.

[a]N.S. = Not significant.

Table 2 Effect of phosphorus application on the nutrient yield of alfalfa (kg/ha).

Treatments	Crude protein	Crude fat	Crude fiber	Nitrogen-free extract	Mineral matter
Control	366.15	64.68	537.60	643.69	261.49
Foliar spray	477.15	92.44	725.90	755.15	353.86
Soil application	432.45	76.05	508.90	658.18	280.94
L.S.D. (0.05)	N.S. [a]	10.28	N.S.	N.S.	N.S.
L.S.D. (0.01)	N.S.	15.56	N.S.	N.S.	N.S.

[a] N.S. = Not significant.

Table 3 Effect of phosphorus application on the nutritive value of alfalfa.

Treatments	Digestible protein %	Total digestible nutrient %	Nutritive ratio
Control	13.05	46.81	2.62
Foliar spray	12.41	47.55	2.84
Soil application	13.96	46.83	2.37
L.S.D. (0.05)	N.S. [a]	N.S.	N.S.

[a] N.S. = Not significant.

On a percentage basis, no significant differences were obtained in digestible protein, total digestible nutrients and the nutritive ratio as indicated in Table 3.

Although the phosphorus treatments increased the fresh and dry yields of alfalfa per hectare, they did not result in a change in the nutritive value. Subsequently, it was concluded that the supplementary phosphorus might be added as a foliar spray treatment to alfalfa since it outyielded the soil application treatment.

LITERATURE CITED

1. Anonymous. 1965. Official Methods of Analysis of the Association of Agricultural Chemists (A.O.A.C.). Washington, D.C., 20044, U.S.A.
2. Lathwell, D. J., and M. T. Vittum. 1962. Response of alfalfa to irrigation and fertility level. Agron. J. 54:195–198.
3. Lutz, J. A. 1973. Effect of partially acidulated rock phosphate and concentrated superphosphate on yield and chemical composition of alfalfa and orchardgrass. Agron. J. 65:286–289.
4. McGregor, J. M., L. Taskvitch, and W. P. Martin, 1961. Effect of phosphate and potash on amino acid content of alfalfa. Agron. J. 53:215–216.
5. Moline, W. J., and L. R. Robinson. 1971. Effect of herbicides and seeding rates on production of alfalfa. Agron. J. 63:614–616.
6. Morrison, F. 1959. Feeds and feeding. Morrison Publishing Company, Clinton, Iowa, U.S.A.

7. Ozanna, P. G., J. Keay, and E. F. Biddis Comb. 1969. The comparative applied phosphate requirement of eight annual pasture species. Aust. J. Agr. Res. 20:809–818.
8. Thurlow, D. L., and F. W. Smith. 1960. Rock phosphate and superphosphate as sources of phosphorus and calcium for alfalfa. Agron. J. 52:313–317.