Effect of Fertilizer and Brush Control on Soil Fertility

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Abstract

Seven years after herbicide application was applied to reduce woody vegetation and increase native grass, there was no change in total available soil NO_3-N, P, and K in the surface 15 cm. However, the area of native grass conversion had more soil K in the surface 5 cm and a higher pH in the surface 15 cm than the area supporting woody vegetation. Brush control followed by seeding of tall fescue *(Festuca arundinacea)* and annual fertilization with N, P, and K increased total available soil P and K in the surface 15 cm. Most of the P increase was in the surface 5 cm. Fertilizer applied to areas seeded to fescue appeared to reduce soil pH from that of native grass conversion.

Eastern Oklahoma has several million hectares of rangeland presently dominated by woody vegetation. Over the past 30 years some of these lands have been cleared of brush by herbicide and mechanical means to increase grass production. McMurphy et al. (1976) described a method of converting such land to a tall fescue *Festuca arundinacea)* pasture through aerial herbicides, controlled burning and aerial seeding with fertilization.

The objective of this study was to evaluate some of these fertilizer and herbicide effects upon soil fertility.

Study Area and Methods

The study site was near Lamar in eastern Hughes County, Okla., at the western edge of the Ouachita Highland resource area. The mean annual precipitation is approximately 105 cm and reasonably well distributed throughout the year with only the month of January receiving less than 5 cm. The soils are of the Hector-Hartsells association (Lithic Dystrochrepts and Typic Hapludults). The stony outcrops, low water holding capacity, and 5 to 30 percent slopes place it in Capability Class VII as a Shallow Savannah range site.

The dominate overstory vegetation is blackjack oak *(Quercus marilandica)* and post oak *(Q. stellata)*. Understory woody species are winged elm *(Ulmus alata)*, hickory (*Carya* spp.), and tree huckleberry *(Vaccinium arboreum)*. The major grasses are broomsedge *(Andropogon virginicus)* and little bluestem *(Schizachyrium scoparium)*.

Studies were initiated in 1970. Four areas of over 30 ha each were studied and are hereafter referred to as (1) brush, (2) native grass, (3) fescue 1970, and (4) fescue 1973. The brush was an untreated area with a heavy wooded cover as described above. Native grass area was sprayed in 1970 and 1972 for brush control and the resulting increase of native grass. Fescue 1970 was sprayed for brush control in 1970 and 1972 followed by seeding of Kentucky 31 tall fescue *(Festuca arundinacea)* in the fall of 1970 and fertilized annually. Fescue 1973 was sprayed for brush control in 1973 and seeded to Kentucky 31 tall fescue followed with fertilization of about one half as much total fertilizer as fescue 1970 received.

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The general methods of the aerial seeding and fertilization of tall fescue has been described by McMurphy et al. (1976) and details of the herbicide treatments have been published by Stritzke et al. (1975). Basically, treatments involved aerial herbicide application in early June, a controlled burn in September, followed by aerial seeding of fescue and fertilization. Total fertilizer applied to the fescue 1970 treatment was 746 kg of N, 100 kg of P, and 220 kg of K/ha, while fescue 1973 treatment received a total of only 328 kg of N, 59 kg of P, and 116 kg of K/ha.

Ten soil samples were taken from each area in July, 1977. Each of these 10 samples was a composite of 6 sub-samples, which were then fractioned into depths of 0–5 cm, 5–10 cm, 10–15 cm and 15–30 cm. While the major soils in the area were of the Hector-Hartsells association, samples were taken only from the Hartsells fine sandy loam. The rocky nature of the Hector soils prevented sampling at these depths.

Available phosphorus was extracted with the Bray-P1 extractant using a 20:1 solution to soil ratio. Exchangeable potassium was determined on an atomic absorption spectrophotometer. Soil pH was determined on a 1:1 soil to water paste.

Results

Conversion from brush to native grass had no apparent effect on soil fertility 7 years later (Table 1). However, there was a difference in distribution of soil K with a significant increase in the surface 5 cm in the native grass area (Fig. 1). The amount of P and K in soil from these two unfertilized areas would be considered low and less than 50% sufficient for growth of warm-season grasses (Tucker 1977).

Table 1. Mean soil test results for different land uses (surface 15 cm) and different soil depths.

	Kg/ha of available		
Item	Soil P	Soil K	pH
Land Use			
Brush	10	95	5.1
Native Grass Release	11	108	5.5
Fescue 1970	63	176	5.2
Fescue 1973	45	203	5.0
LSD (P=0.05)	6	36	0.2

Both tall fescue areas had significantly greater quantities of soil P than the unfertilized areas (Table 1). This accumulation of soil P was related to the amount of fertilizer P applied and would be about 95 and 90% sufficient for optimum tall fescue production in fescue 1970 and fescue 1973, respectively (Tucker 1977). It is also significant that most of the applied P was still in the top 5 cm (Fig. 2). This emphasizes the need for good soil conservation practices on these land areas since any loss of top soil would result in significant P loss.

The amount of soil K was also significantly increased on the fescue converted areas (Table 1) and this is estimated to

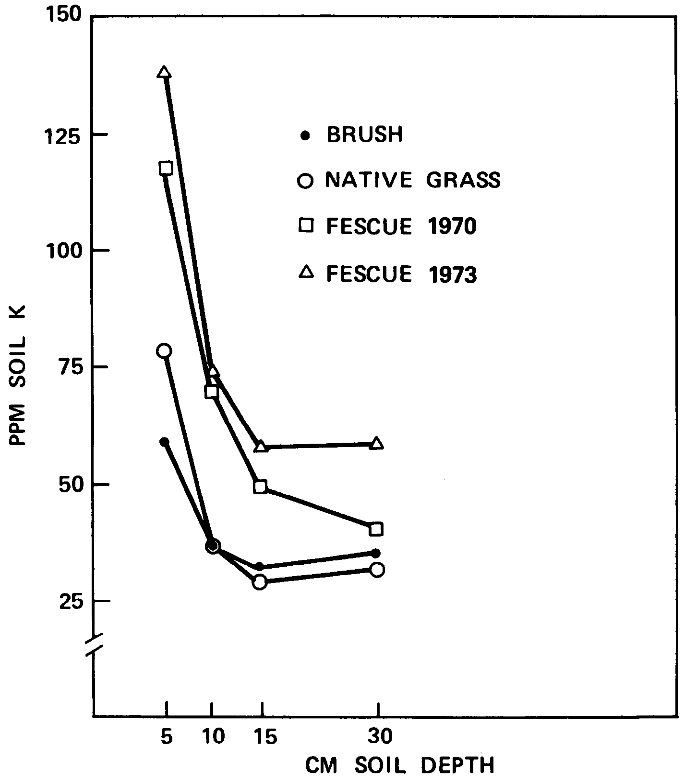

Fig. 1. *Available soil K (ppm) at different soil depths as affected by fertilizer and brush control. LSD (P=0.05)=12.8 ppm.*

be 80% sufficiency for tall fescue (Tucker 1977). This represents essentially a doubling of soil K and an increase was generally reflected at all depths (Fig. 1).

The treatments affected soil pH (Table 1). Converting the brush area to native grass resulted in a significant increase in soil pH. However, converting to tall fescue and fertilizing resulted in a pH no different than the brush area. It is possible that the resulting increase in pH that occurred with native grass was offset in fescue by the acidifying effect on the applied N fertilizer (McMurphy et al. 1975).

Available soil N was determined by the NO_3-N analysis.

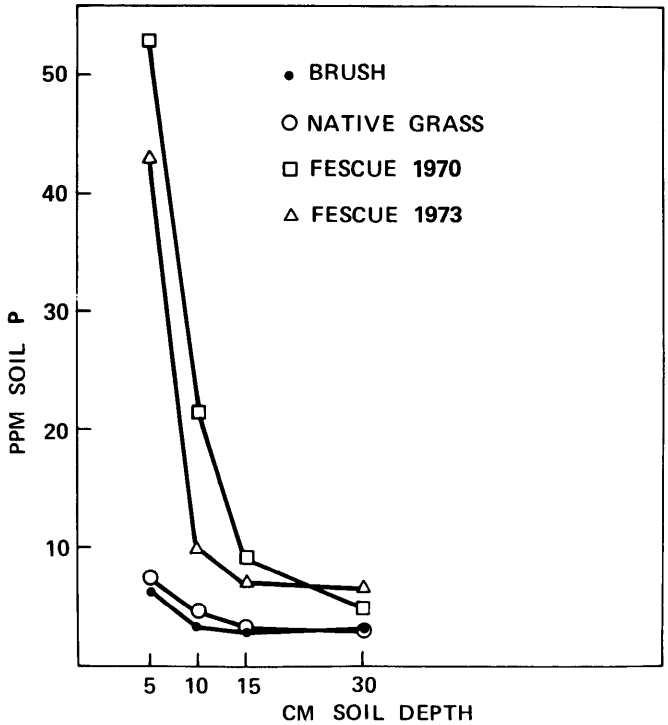

Fig. 2. *Available soil P (ppm) at different soil depths as affected by fertilizer and brush control. LSD (P=0.05)=4.4 ppm.*

All samples contained less than 6 kg of available N/ha with no significant difference among treatments.

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