SHORT-TERM EFFECTS OF NITROGEN FERTILIZATION UPON PRODUCTION OF MOOSE FORAGE IN ALASKA

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Abstract: Nitrogen fertilizer was applied to small plots in spruce and spruce-birch forest types in southcentral Alaska. The fertilized areas had burned 30 years before and been mechanically crushed 1 year before treatment. Nitrogen (N) was applied as ammonium sulfate or urea at rates of 66 or 133 kg of N per ha. Production of graminoid species increased after fertilization, but growth of forb and shrub species was not changed. N fertilization is not recommended as a method of increasing forage production for moose in this area.

The potential of increasing production of moose forage in the northern boreal forest zone by application of N fertilizer was investigated. Few fertilizer experiments have been conducted in this zone and all have emphasized increasing lumber yields rather than understory vegetation. However, these studies indicated tree growth, seed production and nutrient content of foliage can be increased by N fertilization (Van Cleve 1973, Coyne and Van Cleve 1977, Cayford and Jarvis 1967, Salonius 1977). Wildlife managers have used N fertilization in attempts to increase nutritional quality and biomass production of shrub species at more southern latitudes (Gibbens and Pieper 1962, Abell and Gilbert 1974, Anderson et al. 1974, Grenier et al. 1978). Results have been conflicting, most likely due to differences in soils, climate and plant species. Field experimentation is necessary in each area before management recommendations can be made.

METHODS

The study was conducted at the Moose Research Center (MRC) in southcentral Alaska on the Kenai Peninsula. Vegetation in this area is dominated by black spruce forest (Picea mariana) or white spruce-paper birch mixed forest (Picea glauca - Betula papyrifera). The study areas were located within pen 1 at the MRC in an area which had been burned by wildfire in 1947 and disturbed by Le Tourneau tree crushers in December 1976. Soil in the study area was comprised of well-drained Podzol soil derived from loess overlying glacial till (Stephens 1967). This soil is friable and porous with a low fertility rating. Total N in the soil averaged 1.5% in the O_2, 0.15% in the A_2 and 0.11% in the B_2 horizons (Stephens 1967).

Fourteen experimental plots (each 30 m on a side) were established; seven were located in birch - spruce regrowth and seven in spruce regrowth vegetation types. Six plots in each vegetation type were fertilized and one plot served as an unfertilized control. Ammonium sulfate (28% N) was applied to two plots in each type on April 12, 1977, four plots in each type were treated, half with ammonium sulfate and half with urea (56% N). Rates were the same as the spring application. All fertilizer was applied using a whirlybird backpack fertilizer spreader. Spring application was made during a period of rapid snow melt with a snow cover of about 8 cm. Soil was moist from rain during the autumn application.

Vegetation was measured in each plot in late August, 1978. Five subplots (1x5 m) were randomly located in each plot. All birch, aspen, (Populus tremuloides) and willow (Salix sp.) plants rooted within the subplot were counted, height recorded and current annual growth (CAG) leaders counted and measured for length. Numbers and heights of other shrubs and tree species were recorded. Standing crop biomass was measured by clipping ten randomly located subplots (0.5 m^2) within each plot. All vegetation within or overhanging a subplot was clipped at ground level. Shrub, forb and graminoid species were sacked separately, dried at 105 C for 48 hours and weighed to the nearest 0.1 g.

RESULTS

Vegetation measurements were made two growing seasons after fertilizer application on plots treated in the spring and one growing season on plots treated in the fall. Shrub density was not altered by fertilized treatments. Only one shrub species (Rosa acicularis) had a significant $P<0.05$) increase in height (average of 8 cm) on fertilized plots regardless of rate, type or application date of fertilizer. Height of paper birch plants averaged 35 cm on control plots and 35.2 on fertilized plots.

Paper birch was the only species with sufficient sample size for statistical analysis of length and number of CAG leaders. Fertilization had no significant effect on either measurements. Birch plants in control areas had an average of 8 CAG leaders and leaders averaged 16.0 cm in length. Average values in fertilized plots were 6 CAG leaders with 14.9 cm of length.

Total standing crop biomass was similar in each vegetation type following fertilization, 574 kg/ha in the spruce type and 586 kg/ha in the spruce-birch type. However, the spruce-birch type was dominated by shrub species (67% of total biomass) while the spruce type was comprised of 30% shrubs, 28% forbs and 46% graminoids. These differences were not due to the fertilizer treatment but apparently inherent differences in the vegetation types based on data from control plots. Still, both types responded to the fertilizer in a similar manner. Grass production was increased up to 4-fold while production of forbs and shrubs was not altered (Table 1). Statistical tests between types of fertilizer, rates and season application were all insignificant ($P < 0.05$) due to high variability within plots and treatments. The only trend occurred with grass production. It was greatest at the high rate and two years after treatment.

DISCUSSION

This was a small pilot study to determine the potential of N fertilizer to enhance moose habitat and assess the need for further research on this subject. Results indicated N fertilization would not be an effective treatment for short-term improvement of forage production.

Long-term effects may be different and the plots will continue to be monitored. Only grass species (mostly Calamagrostis canadensis) increased due to fertilization. This may have a detrimental effect on moose because grasses are seldom eaten and they compete with preferred forbs and shrubs.

Table 1. Standing crop biomass of vegetation (kg/ha) on fertilized plots at the Moose Research Center in August, 1978.

Treatment	Grasses	Forbs	Shrubs	Total
Spring Application	204	152	358	714
Fall Application	166	106	242	514
Ammonium sulfate	202	138	270	618
Urea	132	80	298	508
66 kg N per ha	142	142	272	542
133 kg N per ha	232	96	288	622
Control Plots	52	132	266	552

Our results are surprising since the soil in this area has a low N level and most plants are stimulated by the addition of N. The absense of a response could be due to a variety of factors which we will not speculate upon. Our results do agree with those of Grenier et al. (1978) in Quebec.

If future studies of this type are conducted, pretreatment data should be collected. This would allow covariance analysis of variance to be utilized which would better identify treatment effects.

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