

Long-Term Effects of annual applications of N and S fertilizers to grassland on forage yield, root mass, and soil pH, organic C and N on a Dark Gray Chernozem in north-central Saskatchewan

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A field experiment on a perennial grass stand was conducted from 1980 to 2005 on a Dark Gray Chernozem (Boralfic Boroll) loam soil at Canwood in north-central Saskatchewan to determine the effects of balanced fertilization on forage dry matter yield (DMY), species composition, and soil properties. The five annual fertilizer treatments were: 1. no fertilizer (Nil), 2. 112 kg N ha⁻¹ (N), 3. 11 kg S ha⁻¹ (S), 4. 112 kg N + 11 kg S ha⁻¹ (NS), and 5. 112 kg N + 11 kg S + 40 kg K ha⁻¹ (NSK). Forage DMY increased considerably with combined application of N and S fertilizers and further improved when K fertilizer was also applied (NSK), while N or S alone had limited effect on the DMY on this soil deficient in both available N and S. The composition of plant species changed markedly in various fertilizer treatments after long-term fertilization. In the Nil treatments, land was covered with bromegrass, fine grasses and herbs (dogwood). The S only treatment had vegetation generally similar to Nil, with slightly more vetches. In the N only treatment, the vegetation changed dramatically and there was virtually no bromegrass in the stands. The grass stand changed towards increasing predominantly bromegrass with combined applications of NS or NSK. Bromegrass is a higher yielding species than other grasses, which may have contributed to increased forage DMY due to combined N and S fertilization compared to other species. Annual applications of N and S fertilizers reduced soil pH in the top 10 cm soil, mainly in the 0-5 cm layer, while there was a tendency for increase in soil pH in some deeper soil layers. Mass of TOC, TN, LFOC and LFN in the 0-15 cm soil increased with NS application. There was a close relationship between DMY improvement and increase in C storage in soil from proper fertilization. The findings suggest that application of balanced fertilization by alleviating all nutrient deficiencies is an appropriate strategy for sustaining high forage yield and increasing C and N sequestration in soil.