N-P-S FERTILIZER EFFECTS ON HERBAGE YIELD AND BRUTE PROTEIN CONTENT IN AN IRRIGATED PERENNIAL PASTURE IN SOUTH PATAGONIA

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ABSTRACT

Little research has been done to determine the effect of fertilization on irrigated pastures in Santa Cruz (South Patagonia). The objective of the present study was to estimate the effects of NPS fertilizing effects on forage yield and quality. The trial was set up in 1994 on a Borolic Haplargid soil characterized by low N content (0.00875% total N), low P availability (9 ppm Olsen) and medium alcalinity (pH 8.4). Pasture was dominated by tall fescue (95%) with 5% of alfalfa. A Complete Radom Design was used and N-P_2O_5-S nutrients were applied at rates of 120-100-50 kg.ha^{-1}. Monthly mowing began in November and finished in March 1995. DM yield, CP and IVDMD were determined. N-fertilization highly increased DM yield. PS-fertilization affected botanical composition by increasing alfalfa proportion, and this determined PS treatment to have the highest BP content. Fertilization had no apparent effect on IVDMD.

KEYWORDS

Irrigated pasture, N-P-S fertilization, herbage yield, protein content, South Patagonia

INTRODUCTION

Extensive sheep production system in southern Patagonia is based almost exclusively on rangeland production. Irrigated pastures are becoming an increasingly important practice to diminish winter mortality risk and to increase meat production. Little research has been done on fertilization effects on pasture yield and quality (Molina, 1978), but some evidences suggested that soil fertility may be a limiting factor in irrigated pastures. The objective of this study was to estimate the effects of N-P-S fertilization on forage yield and forage quality (crude protein) in an irrigated perennial sward, and to determine the best harvest date combining high forage yield and high forage quality.

MATERIALS AND METHODS

The experimental area was located in the central part of Santa Cruz Province (Argentina). Climate in the region is cold with strong winds from the west. Mean temperature in winter (July) is about 1.8½C and in summer (January) 15½C. Annual rainfall ranges from 180 to 250 mm. The trial was set up in 1994 on a Borolic Haplargid soil (FAO Classification) which was leveled out for gravitational irrigation. It was characterized by low total N content (0.0875 %), low P availability (9 ppm, Olsen) and medium alkalinity (pH 8.4).

A Complete Random Desing (n=4) was used, with 10 m^2 plots, and the following treatments: Control (C) without fertilization, phosphorus+sulphur (PS), nitrogen (N), nitrogen+phosphorus (NP), nitrogen+sulphur (NS) and nitrogen+phosphorus+sulphur (NPS). Nutrient rates were: 120 kg N.ha^{-1} (as urea), 100 kg P_2O_5.ha^{-1} (as triple superphosphate) and 50 kg S.ha^{-1} (as bio-sulphur). P- and S-fertilizers were applied early in the growing season (October) with half of the N-fertilizer applications. The rest of the N-fertilizer was applied in January. Botanical composition of the pasture was estimated at each plot at the begining and at the end of the experiment using the dry weight ranking method (t'Mannetje and Haydock, 1963). Vegetation was dominated (95%) by tall fescue (*Festuca arundinaceae*), with a low proportion (5%) of alfalfa (*Medicago sativa*).

Each plot was divided in four sub-plots which were randomized for monthly mowing, from November to February. Forage was clipped, weighed and then oven-dried (60½C). Forage samples were milled with a 1 mm screen (Wiley Lab. Mills, standard Model 4). Dry matter nitrogen was obtained using Kjeldahl method and multiplied by 6.25 to obtain crude protein. IVDMD was also determined (Detergent Method, Goering and Van Soest). Dry matter production was analyzed using ANOVA and Tukey's Test, at the 5% significance level (1988. SAS/STAT User's Guide. Release 6.03. SAS Inst. Inc. Cary, NC).

RESULTS AND DISCUSSION

Herbage yield. Fertilization increased pasture yield in all N-treatments (table 1). N-fertilizer effect on forage yield has been discussed by many authors. Curll *et al.* (1985) determined a 20% increase of herbage accumulation due to N supply. Molina (1978) determined a greater than 60% forage yield increase with N-fertilization in many sown grasses in Santa Cruz. Dumont and Lanuza (1993) also determined an increase in forage production with N-supply. Table 1 also suggests that there may exist an interactive effect of N-P-S, although this was not significant. This can be seen when comparing NPS treatment with N, NP or NS treatments. In February dry matter production with NPS is 35% higher than with N, while N, NP and NS produce almost the same. This effect was also noticed for November and January.

Fertilizer application also affected botanical composition. Treatments with and without nitrogen application showed different grass-legume proportion at the end of the study. N-treatments mantained the composition estimated at the begining (95% of tall fescue and 5% of lucerne). T- treatment had 10% alfalfa and a high bare soil proportion (10%), while PS- treatment had the highest proportion of lucerne (25%). This effect of fertilization on botanical composition is similar to data shown by many authors (Curll *et al.*, 1985; Laidlaw, 1985; Semple, 1974; Williams, 1985), who determined that applied nitrogen in grass-legume swards stimulated grass growth at the expense of the legume growth. Nevertheless, Curll *et al.* (1985) determined a slight regeneration of the legume in the second year. Effect of S-P-fertilization on legumes is also well discussed (Black, 1957; Thompson and Troeh, 1980) mainly in assisting N_2 uptake by the legume (Nuttall, 1985a; Nuttall, 1985b).

Forage quality. Fertilization had no apparent effect on IVDMD (data not shown), in agreement with many reports (Dumont and Lanuza, 1993; Paterson *et al.*, 1994; Reece *et al.*, 1994). CP content (Figure 1) was higher in PS-treatment for all the experimental period. This was explain by the higher proportion of lucerne in the mixture (regression analysis not shown) due to its higher quality compared with the grass (Theander and Westerlund, 1993). Although CP content in tall fescue could have been enhanced in the presence of lucerne due to higher N- supply in the grass in mixtures compared with monoculture (Vonboberfeld and Biskupek, 1995) this was not determined in the experience.

In the other treatments, crude protein content was lower from December to February, but NPS- and T- treatments had higher crude protein content in February compared with the others. Within N-treatments, those which had only one or two elements in their composition (N, P or S) produced lowest CP. This could have been due to a dilution effect with N-supply but without PS-combination supply, as discussed by Buxton and Fales (1994).

Harvest date Considering dry matter production and quality of the pasture (data not shown) January seems to be the best harvest date for most of the treatments. Although in November CP content was higher for all treatments (figure 1) dry matter production was low. CP content remained quite constant between January and February for PS-, NPS- and T- treatments, so the best cutting time could be determined at this moment by dry matter production more than by quality.

Dry matter production was increased greatly in the experiment by applying fertilizer because of its effect on the grass. Although better quality was obtained by PS- effect on lucerne proportion in the pasture, total CP/ha was higher in N-treatments. Further experimentation should be taken in order to improve not only dry matter production but the legume proportion in the mixture as well.

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Table 1
Monthly dry matter production (kg/ha) of tall fescue-alfalfa pasture with N-P-S fertilization (november 1994 - march 1995)

	November	December	January	February	March
C	606 b	2899 b	4352 b	3280 b	4888 b
PS	633 b	2571 b	5093 b	6129 a b	6488 b
N	1254 a	5937 a	8310 a	7692 a b	8951 a
NPS	1141 a	4106 a b	9612 a	10380 a	9487 a
NS	996 a	4968 a b	8154 a	6854 a b	8379 a
NP	983 a	5491 a b	8007 a	6818 a b	8003 a

a,b Values on the same column followed by the same letter are not different, P<0.05.

Figure 1
CP (5) in a NPS fertilized pasture in Santa Cruz, Nov '94 - Feb '95