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EFFECTS OF NITROGEN FERTILIZATION ON FORAGE YIELD AND QUALITY OF SMOOTH BROMEGRASS (*Bromus inermis* Leyss.)

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Abstract

This study aimed to determine the effects of five nitrogen doses (0, 40, 80, 120 and 160 kg ha^{-1}) on forage yield and quality of smooth bromegrass (Bromus inermis Leyss.*). Dry matter (DM) yield, crude protein (CP) ratio, neutral detergent fiber (NDF), acid detergent fiber (ADF), total digestible nutrient (TDN) and relative feed value (RFV) were determined. Nitrogen rates significantly affected all components determined in smooth bromegrass. Nitrogen applications increased DM yield, CP ratio, TDN and RFV values but decreased ADF and NDF ratios. At the end of this research conducted in Mediterranean conditions of Turkey, 120 and 160 kg ha^{-1} nitrogen doses are recommended for high herbage yield and quality in smooth bromegrass.*

Key words*: smooth bromegrass, dry matter, neutral detergent fiber, relative feed value.*

INTRODUCTION

Smooth bromegrass (*Bromus inermis* Leyss.) is a high-yielding grass but requires longer recovery periods than other grasses. It is best adapted to well drained soils and is an excellent choice for drought prone areas (Undersander et al., 1996). Because of its highly developed root system, smooth bromegrass is resistant to temperature extremes and drought.

It grows best on deep, well-drained silt or clay loam but may also establish itself in sandier soils. The forage quality of smooth bromegrass is higher than that of most other cool-season grasses such as orchardgrass (*Dactylis glomerata* L.) or tall fescue (*Festuca arundinacea*); crude protein levels in smooth bromegrass often exceed 120 g kg^{-1} if it is harvested in the boot stage.

However, smooth bromegrass recovers poorly from cutting because its tiller apices, or tips, are vulnerable to removal. This leads to lower yields after a first cutting and poor seasonal distribution of yield. In addition, older stands may easily become dense and sod-bound, resulting in markedly lower productivity.

Plant nutrients are the most important, and readily manageable, variables for producing a profitable crop. Nitrogen, because of its high demand in the plant and variability within the soil, is the most intensively managed plant nutrient in crop production (Lingorski, 2000; Lingorski, 2002). Grasses need nitrogen more than many plant groups need it.

Organic matter and nitrogen deficiency could be removed by fertilization in agricultural areas including dry farming in Turkey (Serin et al., 1999; Koc et al., 2004). McGinnies (1968) and Power (1985) reported that increasing N fertilization increased dry matter yield in grasses.

The nutrient contents of the forage have an important role in animal feeding. The factors influencing the nutritive value of forage are many, and the degree to which they are interrelated may vary considerably from one area to another.

These factors may include, alone or in combination, plant type, climate, season, weather, soil type and fertility, soil moisture, leaf to stem ratio, and physiological and morphological characteristics, and may change depending on whether the plants are annuals perennials, grasses or legumes (Turk et al., 2009).

The objective of this research was to determine the effects of different rates of nitrogen fertilizers on yield and nutritional value of smooth bromegrass.

MATERIALS AND METHODS

The research was conducted at Isparta (37°45′N, 30° 33′E, altitude 1035 m) located in the Mediterranean region of Turkey, between 2014 and 2016 years. The major soil characteristics, based on the method described by Rowell (1996) were as follows: the soil texture was clay-loam (clay: 31.2%, silt: 45.1%, sand: 23.7%); organic matter was 1.1% by the Walkley-Black method; total salt was 0.3%; lime was 7%; sulphur was 12 mg kg^{-1}; extractable P by 0.5N $NaHCO_3$ extraction was 3.3 mg kg^{-1}; exchangeable K by 1N NH_4OAc was 119 mg kg^{-1}; pH was 7.1 in soil saturation extract. Soil type was a calcareous fulvisol.

The experiments were evaluated in a randomized complete block design with three replications. Sowing was done by hand on 15 March in 2014. Seeding rates were 25 kg ha^{-1}. Plot sizes were 2.1 x 5 m = 10.5 m^2. Smooth bromegrass fertilized at the rates of 0, 40, 80, 120 and 160 kg N ha^{-1}. Calcium ammonium nitrate 26% was used as fertilizer. Herbage was not harvested during the growing season of 2014 due to the establishment year. All plots had been harvested only once every year (50% flowering stage of smooth bromegrass). Samples taken from each plot were dried at room temperature then dried in an oven at 65°C till they reached constant weight.

After cooling and weighing, the samples were ground for crude protein, ADF and NDF content analyses. Nitrogen content was calculated by the Kjeldahl method. The ANKOM Fiber Analyzer was used for NDF and ADF analysis. ANKOM F57 filter bags were used for ADF and NDF analysis in this study. Total digestible nutrients (TDN) and relative feed value (RFV) were estimated according to the following equations adapted from Horrocks and Vallentine (1999):

TDN = (-1.291 x ADF) + 101.35;

DMI = (120/%NDF, dry matter basis);

DDM = 88.9 – (0.779 x %ADF, dry matter basis);

RFV = %DDM x %DMI x 0.775.

The data were analyzed together using the Proc GLM (SAS 1998). Means were separated by LSD at the 5 % level of significance.

RESULTS AND DISCUSSIONS

The results of ANOVA summarized in Table 1. The results of variance analysis showed that DM yield, CP, ADF, NDF, TDN and RFV values in smooth bromegrass were influenced significantly by nitrogen treatments (Table 1).

Table 1. Results of Analysis of Variance Traits Determined

	df	DM Yield	Crude Protein	ADF	NDF	TDN	RFV
Block	2	ns	ns	ns	ns	ns	ns
Nitrogen	4	**	**	**	**	**	**
Error	8						

**Significant at 1 percent level, ns: non-significant.

The highest DM yields were obtained from 120 and 160 kg ha^{-1} N rates (3.55 and 3.56 t ha^{-1}), while the lowest DM yield (2.81 t ha^{-1}) was obtained from control plot (Table 2). Lauriault et al. (2002) reported that N is the most important fertilizer nutrient required for growing grasses. Increase in DMY due to N application is well documented by many authors (McGinnies, 1968; Power, 1986; Hall et al., 2003; Scarbrough et al., 2004). Crude protein content of forage is one of the most important criteria for forage quality evaluation (Holechek et al., 1989; Vogel et al., 1993). Increasing N fertilization rates resulted in an increase in CP ratio of smooth bromegrass (Table 2). The highest CP ratio was obtained from 160 kg ha^{-1} N rates (12.02%), while the lowest CP ratio (8.91%) was obtained from control plot (Table 2). These results are in agreement with those reported by Jacobsen et al. (1996) and McCaughey and Simons (1998).

Other important quality characteristics for forages are the concentrations of NDF and ADF (Haferkamp et al., 1987; Karn et al., 2006). The effects of nitrogen fertilization on ADF and NDF contents of smooth bromegrass were found statistically significant. In present study, increasing N fertilization decreased ADF and NDF concentration. The highest ADF (45.11%) and NDF contents (59.55%) were obtained from the control treatment, while the lowest ADF (36.38%) and NDF contents (51.49%) were obtained from the 160 kg ha^{-1} N treatment (Table 2).

The TDN refers to the nutrients that are available for livestock and are related to the ADF concentration of the forage (Sürmen et al., 2011). As ADF increases there is a decline in TDN which means that animals are not able to utilize the nutrients that are present in the forage (Aydın et al., 2010). The highest TDN values (54.38) was obtained from 160 kg ha^{-1} N rate, while the lowest TDN values (43.11) was obtained from the control treatment (Table 2). Similar results were reported by Albayrak and Türk (2011).

The RFV is an index that is used to predict the intake and energy value of the forages and it is derived from the DDM and dry matter intake (DMI). Forages with an RFV value over 151, between 150-125, 124-103, 102-87 and 86-75, and less than 75 are considered as prime, premium, good, fair, poor and reject, respectively (Lithourgidis et al., 2006). The highest RFV value (109.38) was obtained from 160 kg ha^{-1} P rate, while the lowest RFV values (83.96) was obtained from the control treatment (Table 2). Similar results were reported by Albayrak and Türk (2011).

Table 2. The DM yield, CP, ADF, NDF, TDN and RFV values of smooth bromegrass at different nitrogen doses

Nitrogen fertilization (kg ha^{-1})	Dry Matter Yield (t ha^{-1})	Crude Protein (%)	ADF (%)	NDF (%)	TDN	RFV
0	2.81 d	8.91 e	45.11 a	59.55 a	43.11 e	83.96 e
40	3.13 c	9.88 d	43.34 b	58.01 b	45.40 d	88.40 d
80	3.40 b	10.33 c	42.01 c	56.14 c	47.12 c	93.06 c
120	3.55 a	11.11 b	39.15 d	53.21 d	50.81 b	102.07 b
160	3.56 a	12.02 a	36.38 e	51.49 e	54.38 a	109.38 a

CONCLUSIONS

Smooth bromegrass has adequate mineral content for ruminant animal requirements for production in the Mediterranean region of Turkey. Increasing N rates resulted in increased forage yield and quality. The highest DM yields were obtained from 120 and 160 kg ha^{-1} N rates. The content of CP increased while increasing N treatments. As N rate increased from 0 to 160 kg ha^{-1}, ADF and NDF contents decreased, TDN and RFV values increased. At the end of this research conducted in Mediterranean conditions of Turkey, 120 and 160 kg ha^{-1} nitrogen doses are recommended for high herbage yield and quality in smooth bromegrass.

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