INTAKE AND QUALITY OF *PANICUM MAXIMUM* (CV. GATTON) RECEIVING DIFFERENT LEVELS OF NITROGEN DURING AUTUMN

W.A. van Niekerk and N.F.G. Rethman
Faculty of Biological and Agricultural Sciences,
University of Pretoria, Pretoria 0002, South Africa

ABSTRACT

The objective of this study was to investigate the influence of N fertilization on the quality of *Panicum maximum* cv. Gatton (Panicum) and the subsequent intake thereof. Hand cut samples increased in N (1.8 - 2.7%) and NO_3-N content (0.75 - 1.54%) and decreased in WSC (14.6 - 13.9 g/kg) content, but with no changes in IVDOM as N fertilization levels raised from 0 to 150 kg N/ha respectively. No changes occurred in the NDF and ADL values. The animal selected N, and IVDOM values were higher and NDF value lower than the hand cut samples, which was expected due to selective grazing. The lower WSC content together with a higher N as well as NO_3-N level in the highly fertilized treatments, could have been responsible for a lower flow of microbial protein to the duodenum, which could have been partly responsible for the lower DOMI at such levels. Fertilization levels of 125 kg and higher can cause negative animal production results of *P. maximum*, (cv. Gatton) during autumn, due to a drop in intake and too high levels of NO_3-N, which may cause ill health.

KEYWORDS

Sheep, N, intake, quality, water soluble carbohydrates, nitrate-N

INTRODUCTION

Animal production in the tropics and subtropics is most often hampered by a lack of good quality roughage. *Panicum maximum* is one of the most important forage species in the savanna grassland areas of South Africa and is used also as a cultivated dry land pasture to relieve grazing pressure on degraded rangeland.

A high proportion of non-protein nitrogen in the crude protein fraction of pastures could have a negative effect on animal production. An excessive intake of nitrate-N (NO_3-N) was found to adversely affect livemass gain in lambs, tended to reduce milk production, caused roughened coats and digestive upsets in sheep and even abortions in pregnant animals. The effect of high levels of ammonia which can accumulate in the rumen, was suggested as one of the reasons for the poor performance of animals grazing pastures well fertilized with N.

METHODS

The study was conducted at the Experimental Farm at Hatfield, larger Pretoria, of the University of Pretoria. The area has an exclusively summer rainfall of 650 mm average per annum, dry late autumn and winter and has an altitude of 1370 m. Summer temperatures are ± 12½C (min.) to ± 30½C (max.).

P. maximum (cv. Gatton) was established under dry land conditions in paddocks of 0.08 ha. During February (end of summer season) all the camps were cut and fertilized with three levels of N (LAN 28% N), namely 0, 75 and 150 kg N/ha at the end of the active growing season. All the pastures received 300 kg KCl. No phosphate was applied because no shortages occurred, according to soil analysis.

Four Merino wethers, fitted with oesophageal cannulae together with five intact Merino wethers, were used to determine both quality and quantity of dry matter selected by the sheep during the autumn period. Voluntary intake was estimated by the ratio of faeces voided in collection bags and the indigestibility of oesophageal samples calculated from the *in vitro* technique of Tilley & Terry (1963). *In vitro* values were converted to expected *in vivo* digestibility of organic matter (OM), according to regression analysis published by Engels *et al*. (1981). OM intake was estimated by the following ratio:

$$\text{OM intake} = \frac{\text{OM in faeces}}{1\text{-}\textit{in vivo}\text{ digestibility}}$$

The oesophageal collected samples were individually strained through a double layer of cheesecloth to remove most of the saliva before being freeze-dried. All animals had free access to fresh water daily.

Adjacent to the previous mentioned camps, plots were established on the same soil type, sizing 2 m x 5 m each. Seven N levels were applied, the same time of year as previously mentioned with three replicas at each N level, namely 0, 25, 50, 75, 100, 125 and 150 kg N/ha (LAN). The qualitative parameters, as obtained by hand cut samples over a 10 week period were *in vitro* digestible OM (IVDOM), neutral detergent fibre (NDF), acid detergent lignin (ADL), nitrate-N (NO_3-N) and water soluble carbohydrates (WSC). The freshly cut samples were freeze-dried before ground in a mill with a 1 mm sieve. All the analyses were done according to standard analytical procedures (AOAC, 1980).

The PROC GLM programme of SAS was used to test for statistical differences using the one way analysis of variance procedure.

RESULTS AND DISCUSSION

There was a marked increase in the N content of the hand cut samples, as the N application levels raised (Table 1). The NO_3-N also increased with higher N application, but as a proportion of N content, values estimated for the 125 kg and 150 kg N/ha treatment, namely 0.54 and 0.57 respectively were higher than the average of 0.41 of the 0 - 100 kg N/ha treatments. Davison *et al*. (1985) also found a marked increase in the N levels of both leaf and stem fractions of *P. maximum* (cv. Gatton) when it received between 200 and 400 kg N/ha/year. The high level of NO_3-N at the 125 and 150 kg N/ha treatments can present a problem. The literature quotes levels of anything between 0.14 - 1.5% NO_3-N as detrimental to the animal's health, but it will depend on the availability of easily fermentable carbohydrates present in the rumen (Van Leeuwen, 1972). The WSC content decreased with an increase in N application from 125 kg N/ha and upwards, but did not show any real differences up to 100 kg N/ha. Wilson (1973) also found a significant drop in the WSC content of tropical grasses as the N level increased, although this drop was not so drastic in value as that of temperate grasses. Jarrige & Minson (1964) as been referred to by Minson (1990), stated that the lower WSC content of grasses can be responsible for a lower rate of rumen-NH_3-N utilization, which can be expected from highly fertilized grasses, such as the 125 and 150 kg N/ha groups in this study. Aii & Stobbs (1980) supported this by claiming that a too low energy supply to the rumen as well as an unbalanced ratio between N and WSC content of pastures, could be one of the main causes of a reduced flow of microbial protein to the lower digestive tract of grazing herbivores. No real differences were found in the NDF and ADL and IVDOM values in this study between the different N groups and are in accordance with the literature.

The oesophageal selected material showed the same trend as the hand cut samples in terms of N, NDF and IVDOM, although the values obtained by the animals, were of a higher quality. This is expected, because of the ability of sheep to select a better quality while grazing. The drop in DOMI between 0 kg N and 150 kg N, was drastic and did not follow the trend in IVDOM. The high NO_3-N, specially judged as a proportion of N content as well as the lower WSC of the 150 kg N/ha treatment, were most probably the main cause of the lower DOMI, as Aii & Stobbs (1980) claimed that a too low WSC and a too high N content in grasses could hamper rumen microbial activity and less amino acids may flow through to the duodenum. A higher rate of amino acid absorption in the duodenum can raise intake (Hennesy *et al*., 1981) and this may result in a higher production of growth hormone (Oldham, 1980) which will lead to a higher efficiency of amino acid utilization (Bines *et al*., 1980).

CONCLUSION

It was concluded that the application of N does not have any real effect on the cell wall content of *P. maximum* (cv. Gatton) but a direct effect on the N, NO_3-N, WSC and DOMI. Intake was most probably negatively influenced by an unbalanced N and WSC content of the grass, which may hamper microbial activity in the rumen. N application levels higher than 125 kg N/ha during early autumn can have a detrimental effect on the quality and most probably on the intake of *P. maximum* (cv. Gatton).

REFERENCES

Aii, T. and **T.H. Stobbs. 1980.** Solubility of the protein of tropical pasture species and the rate of digestion in the rumen. Anim. Feed Sci. Tech. **5:** 183.

AOAC. 1980. Official methods of analysis (1st ed.). Association of official analytical chemists. Washington, D.C.

Bines, J.A., I.C. Hart and **S.U. Morant. 1980.** Endocrine control of energy metabolism: The effect on milk yield and levels of some blood constituents of injecting growth hormone and growth hormone fragments. Br. J. Nutr. **43:** 179.

Davison, T.M., R.T. Cowan, R.K. Shephard and **P. Martin**. **1985.** Milk production from cows grazing on tropical grass pastures. 1. Effects of stocking rate and level of nitrogen fertilizer on the pasture and diet. Aust. J. Exp. Agric. Husb. **25:** 505.

Engels, E.A.N., H.O. de Waal, L.C. Biel and **A. Malan. 1981**. Practical implications of the effect of drying and treatment on nitrogen content and *in vitro* digestibility of samples collected by esophageally fistulated animals. S. Afr. J. Anim. Sci. **11:** 247.

Hennessy, D.W., P.J. Williamson, R.F. Lowe and **D.R. Baigent. 1981.** The role of protein supplements in nutrition of young grazing cattle and their subsequent productivity. J. Agric. Sci. (Camb.). **96:** 205.

Minson, D.J. 1990. Intake of forage by housed ruminants. Ch. 2. In: Forage in ruminant nutrition. Ed. by Minson. Academic Press, Toronto.

Oldham, J.D. 1980. Amino acid requirements for lactation in high yielding dairy cows. In: Recent advances in animal nutrition. Ed. by Haresign. Butterworths, London.

Tilley, J.M.A. and **R.A. Terry**. **1963.** A two-stage technique for the *in vitro* digestion of forage crops. J. Brit. Grassl. Soc. **18:** 104.

Van Leeuwen, J.M. 1972. The effect of sublethal doses of $NaNO_3$ given in concentrations or by capsule on blood and vitamin A status of young Red and White females. Neth. J. Agric. Sci. **20:** 35.

Wilson, J.R. 1973. The influence of aerial environment, nitrogen supply and ontogenetical changes on the chemical composition and digestibility of *Panicum maximum*. Aust. J. Agric. Res. **24:** 543.

Table 1
The mean chemical composition of hand cut samples of *P. maximum* (cv. Gatton) during autumn (DM-basis)

	Treatment (level of kg N/ha)							
Parameter	0	25	50	75	100	125	150	MSE*
N (%)	1.8[a]	1.9[a]	2.1[b]	2.3[bc]	2.4[cd]	2.5[d]	2.7[e]	0.1
NO_3-N (%)	0.75[a]	0.77[a]	0.87[ab]	0.88[ab]	1.04[bc]	1.34[c]	1.54[d]	0.08
WSC (g/kg)	14.6[a]	14.4[ab]	14.9[a]	14.6[a]	14.6[a]	14.3[ab]	13.9[b]	0.3
NDF (%)	63	62	62	62	62	62	61	1.1
ADL (%)	4.2	4.1	4.3	4.0	4.1	4.1	4.1	0.1
IVDOM (%)	69	70	70	70	70	69	71	4.6

*MSE = Mean square error.
[a,b,c,d,e] = Means in a row followed by a different letter, differ significantly (P-0.05).

Table 2
The qualitative and quantitative intake of *P. maximum* (cv. Gatton) by sheep at three levels of N during autumn (DM-basis)

	Treatment (level of kg N/ha)			
Parameter	0	75	150	MSE
N (%)	1.9[a]	2.6[b]	3.3[c]	0.07
NDF (%)	60.4	61.2	60.6	1.2
IVDOM (%)	71.4	69.5	70.7	1.1
DOMI (g/kg $W^{0.75}$/d)	43.9[a]	35.1[b]	32.2[c]	1.1