

**The influence of nitrogen fertilization, physiological stage and season on
qualitative and quantitative characteristics of *Panicum maximum* cv Gatton
for sheep.**

by

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DECLARATION

I declare that this dissertation
for the degree MSc (Agric) at the University of Pretoria,
has not been submitted by me for a degree at any other University.



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SUMMARY

THE INFLUENCE OF NITROGEN FERTILIZATION, PHYSIOLOGICAL STAGE AND SEASON ON QUALITATIVE AND QUANTITATIVE CHARACTERISTICS OF *PANICUM MAXIMUM* CV GATTON FOR SHEEP.

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The aim of this study was to evaluate the nutritional value of *Panicum maximum* cv Gatton for sheep under different levels of nitrogen fertilization during different stages of maturity and in different seasons.

Four different experiments were conducted. The aim of the first experiment was to study the influence of nitrogen fertilization and stage of maturity on the dry matter yield and chemical composition of *Panicum maximum* cv Gatton. The experiment was conducted during autumn and repeated during the subsequent summer. The second part of the study was a partial digestibility study, aimed at the estimation of the influence of the fertilized grass at different stages of maturity on the animal. This experiment was conducted during autumn and repeated during the subsequent summer.

Seven levels of N were used, namely 0, 25, 50, 75, 100, 125, and 150 kg N/ha, and three stages of maturity namely vegetative stage, early bloom and full bloom. Measurements included dry matter (DM) yield, nitrogen (N) content, total nonstructural carbohydrates (TNC), neutral detergent fibre (NDF), acid detergent lignin (ADL) and *in vitro* digestibility of organic matter (IVDOM).

In this treatise no comparisons between seasons were made, only within seasons.

Dry matter yield increased linearly in both seasons with increased level of N fertilization and with maturity. Nitrogen fertilization increased the N content of grass in both seasons, while N concentration decreased as the grass grew older. Total nonstructural carbohydrate content decreased as the N fertilization level increased, but as plants matured TNC showed, over all fertilization levels, a tendency to increase. Neutral detergent fibre and ADL seemed to decrease as N fertilization levels increased, but increased markedly with advancing stage of maturity. Organic matter digestibility showed no change with increasing levels of N fertilization, but decreased as grass matured.

In the partial digestibility study it was found that N fertilization did not have a statistically meaningful influence on rumen pH, while stage of maturity increased rumen pH significantly in both autumn and summer.

Nitrate nitrogen content in the rumen increased sharply shortly after N fertilization was applied to pastures, but it decreased as plants matured so that no differences could be observed between sheep grazing on pastures fertilized with 0 and 150 kg N/ha respectively.

Total volatile fatty acids (VFA) were increased by level of N fertilization during the vegetative stage in summer, while no change was seen during early bloom or full bloom stages. Total volatile fatty acids were, however, significantly increased during all stages in the autumn. As grass pastures matured, the VFA concentration decreased in both seasons.

Nitrogen fertilization did not appear to have a very strong influence on the flow of organic matter through the digestive tract of the sheep.

OPSOMMING

DIE INVLOED VAN STIKSTOF BEMESTING, FISOLOGIESE STADIUM EN SEISOEN OP DIE KWALITATIEWE EN KWANTITATIEWE EIENSKAPPE VAN *PANICUM MAXIMUM* CV. GATTON VIR SKAPE

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Die doel van hierdie studie was om die voedingswaarde van *Panicum maximum* cv Gatton onder verskillende vlakke van stikstof (N) bemesting, verskillende stadiums van volwassenheid en in verskillende seisoene, vir skape, te evalueer.

Vier verskillende eksperimente is uitgevoer. Die doel van die eerste eksperiment was om die invloed van N-bemesting en stadium van volwassenheid op die droë materiaal opbrengs en die chemiese samestelling van *P. maximum* cv Gatton te bestudeer. Die eksperiment is gedurende die herfs uitgevoer en gedurende die daaropvolgende somer herhaal. Die tweede eksperiment is gedoen om die invloed van die bemeste gras, by verskillende stadiums van volwassenheid, op die dier is te bepaal. Hierdie eksperiment is gedurende die herfs gedoen en weer gedurende die daaropvolgende somer herhaal.

Sewe stikstof peile naamlik 0, 25, 50, 75, 100, 125 en 150kg N/ha, en drie stadiums van volwassenheid, naamlik vegetatiewe, vroeë blom en laat blom stadiums is geëvalueer. Droë materiaal (DM) opbrengs, stikstof (N) inhoud, totale nie-strukturele koolhidrate (TNC), neutraal bestande vesel (NDF), suurbestande lignien (ADL), nitraat-stikstof ($\text{NO}_3\text{-N}$) en verteerbaarheid van organiese materiaal (IVOMD) is bepaal. In hierdie verhandeling is daar nie tussen seisoen vergelykings gedoen nie, maar wel binne seisoen vergelykings.

Die DM opbrengs het in beide seisoene liniêr toegeneem soos wat N-peile verhoog is, asook met toenemende veroudering van die weiding.

Stikstof bemesting het die N-inhoud van die gras in beide seisoene verhoog, terwyl N-inhoud verlaag het soos wat die gras verouder het.

Die TNC-inhoud van die gras is verlaag met 'n verhoging in N-vlakke, terwyl dit toegeneem het met veroudering van die gras. Die NDF- en ADL-inhoud van die gras is effens verlaag deur toenemende N-peile, maar met veroudering het dit tot 'n groot mate verhoog.

In die partiële verteringstudie is gevind dat N-bemesting nie 'n betekenisvolle invloed op rumen pH gehad het nie, terwyl stadium van volwassenheid in beide die herfs en somer die rumen pH betekenisvol verhoog het.

Nitraat-stikstof is kort na die toediening van N-kunsmis in die rumen verhoog, maar het verlaag soos wat die gras verouder het, sodat daar later geen verskille was tussen die $\text{NO}_3\text{-N}$ konsentrasie in die rumen van skape wat gras beweï het wat onderskeidelik met 0 en 150 kg N/ha bemes was nie.

Totale vlugtige vetsure (VVS) is gedurende die vegetatiewe stadium in die somer deur verhoogde peile van N-bemesting verhoog, terwyl geen verandering tydens vroeë blom of vol blom waargeneem was nie. Totale vlugtige vetsure is betekenisvol verhoog gedurende al die groeistadiums in die herfs. Soos plante ouer geword het, het die totale VVS konsentrasies in die rumen afgeneem.

Dit blyk dat N-bemesting nie 'n groot waarneembare invloed op die verdwyning van OM deur die spysverteringstelsel van die skape gehad het nie.

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