grass roots

Newsletter of the Grassland Society of Southern Africa

Incorporating the Bulletin of the Grassland Society of Southern Africa
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Grazing your kikuyu pasture

The invasion of slangbos in the grassveld: how did it happen?

How will supplementing maize on kikuyu affect milk production?

Rehabilitating mines with enhanced grass seed

Advancing rangeland ecology and pasture management in Africa

Editorial

Dear Readers

This year's Congress is rapidly approaching, and it looks like it will be a good one. Several people are preparing special sessions or workshops on a variety of topics covering a range of disciplines. Keep an eye on the programme and there'll be sure to be something for you.

This Congress also comes at an exciting time for this country. Our new president has dramatically restructured the cabinet, reshuffling many portfolios. Three important changes that should affect most of our members professionally are: environmental affairs is now joined with water affairs; agriculture, forestry and fisheries have been joined; and higher education has been split from basic education. To me, these changes make a lot of sense, and surveys conducted over a beer or two reveal that at least 80% of respondents agree with me.

Of course, the eating of the pudding is in the proof (or words to that effect) and we'll have to wait and see what the new ministers do with their portfolios. We'll also have to see whether Pres. Zuma's statements that civil servants will have to get down to business are taken seriously. Anyone who has worked in government and had suppliers refusing to deliver because of late, late payments from the finance section can only welcome his words.

Alan Short

The Grassland Society of Southern Africa is dedicated to the advancement of the science and practice of range ecology and pasture management.

We welcome any contributions to the Grassroots*, in the form of news, informative articles, reports, short research notes, scientific papers and letters to the Editor. Email shorta@arc.agric.za or admin@grassland.org.za or fax +27 (0)86 622 75 76*

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Beef cattle on kikuyu pastures at Cedara. What is the optimal interval between grazings for cattle on kikuyu (P. 23)? Photo: Richard Reynolds

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News

SA farmers interested in DRC farming: AgriSA

Hundreds of South African and Zimbabwean farmers have expressed interest in farming in the Democratic Republic of Congo (DRC), according to Agri-SA President Theo de Jager. He says that he has been inundated with requests for more information. The DRC formally requested South Africa to send a fact-finding mission through South Africa's representative in Brazzaville. The DRC intends to increase production of a number of crops including sugar, maize, soya beans, coffee and tea, as well as cattle and goats.

South African farmers wanted information on security, land and labour laws, education and trade relations.

The farmers included South Africans and Zimbabweans farming abroad, foreigners farming in South Africa, as well as a number of farmers who had previously farmed in the DRC but left during the 1997 civil war.

SAMIC newsletter

GSSA Awards

Mr Jacques Cloete (right) received the GSSA award for outstanding academic achievement from Prof. Hennie Snyman (left), at the graduation ceremony of the University of the Free State. This award was for best BSc. final year student in Grassland Science with best continuous performance during all the years of study with an average of at least 70%. He is currently enrolled as BSc Honours student at the University of the Free State.

Vanessa Brueton of Wits University, Biological Sciences, was awarded the GSSA Meritorious Award for research in Range and Forage Science, for her MSc. thesis entitled "Trade in commonly used medicinal bulbs: value and ecological implications". She was handed her prize by Brian Dawson at a ceremony in May.

Request to provide inputs on the draft alien and invasive species regulations

The Department of Environmental Affairs and Tourism (DEAT) published the National Environmental Management: Biodiversity Act (10 of 2004)'s draft Alien and Invasive Species regulations for comment in the Government Gazette on the 3rd April 2009.

As these regulations will be likely to affect agricultural activities, especially in terms of issues relating to aquaculture, veld, pasture and wildlife management, the Department of Agriculture (DoA) is in the process of consolidating inputs and comments on these draft Regulations from the agricultural sector.

The DoA has therefore requested GSSA members and other interested parties to submit their comments on the draft regulations to Victor Musetha at VictorMu@nda.agric.za. The draft regulations can be obtained from Mr Musetha or the GSSA administrator at admin@grassland.org.za

New interim management for SKEP

The succulent Karoo Ecosystem Program (SKEP) has entered its second phase. The first five years of implementation of the programme were focused on catalyzing projects and processes to improve biodiversity conservation in the Succulent Karoo region over a long term, while at the same time enhancing local livelihoods.

Chief Director for SANBI's Biodiversity Planning and Mainstreaming division, Kristal Maze, commented that "the next five years will focus on program consolidation, working to integrate SKEP objectives into national and regional government programmes and thereby ensuring sustainability.

The shift in overall focus of the programme is accompanied by changes at the level of staffing. Director SANBI's Fynbos programme and coordinator of CAPE, Dr. Mandy Barnett, has taken up the SKEP coordinator, Marion Jonhson, left the programme. Lubabalo Ntsholo was appointed to the position of SKEP Programme Developer and began work in this new capacity from April 2009.

Kristal Maze added that SANBI thanked Marion Johnson for all her hard work and fresh new perspectives over the past two years and wished her well for the future.

Contact Mandy Barnett at Tel: 012 799 8875.

SKEP newsletter

New and resigned members

New members

- Anneke Engelbrecht: Agricultural Research Council
- Falko Buschke: Student, University of the Free State
- Marion Holmes: Karoo Pred a Tours
- Monique Salomon: University of KwaZulu-Natal
- Tracey Simpson: Resolute Mining
- Prof Trevor Hill: University of KwaZulu-Natal
- Twakundine Simpamba: Kafue National Park, Zambia
- Mr Wayne Knight: Solar Addicts

Resigned members

- Cedric Mukhatshelwa.
- Kirsten Oliver
- Pierre du Toit
- Renee Andreka

Namaqualand coast role-players plan for sustainability

A group of people from Conservation International, de Beers, Eden Project and Kamiesberg Municipality held a creative workshop bringing together experts ranging from engineers to environmental architects to detail the conceptual plans for the Living Edge of Africa Project (LEAP), a bid to repair the landscape, develop tourism sites and encourage job creation through restoration on South Africa's Namaqualand coast.

The Living Edge of Africa Project seeks to redevelop a 45 kilometre stretch of Namaqualand's coast into a conservation and economic development zone that will recast the legacy of 40 years of diamond mining with a collection of innovative carbon-neutral enterprises that will create a sustainable new economic and job creation engine.

LEAP is envisioned as a model for sustainable low carbon economic development which will deliver a comprehensive, large-scale, replicable model with fully integrated conservation, economic and social development outcomes and addressing climate, food, water and health security issues while also providing a productive reuse of mined out landscapes. The LEAP enterprises will include wind farms, seawater greenhouses, mariculture, and algae production for biofuels and mariculture feed. LEAP will also become a tourism destination which will seek to educate visitors about environmental issues.

The international financial crisis has put increasing pressure on government, the mining industry and NGOs in South Africa to deliver sustainable economic development and job creation. Questions were raised at the workshop about how the landscape has changed and how to incorporate it into an ecologically friendly and tourist-orientated site, without further impacting on the fragile dune environment.

For more information contact Tessa Mildenhall at t.mildenhall@conservation.org

SKEP newsletter

Meritor

GSSA Award winner reaches new heights

Michael Leeuw (17), a grade 12 learner at Louise Botha Technical High School in Bloemfontein, received a silver medal for his research project on the impact of termites on the ecosystem at an international science olympiad. He represented South Africa at the International Sustainable World (Energy, Engineering and Environment) Project Olympiad (ISWEEEP) in Texas.

Michael's project "Termite mounds-no growth" won the GSSA award at the 2008 Eskom Expo for Young Scientists in Bloemfontein last year (*Grassroots*, December 2008).

Mpumalanga farmers warning of showdown with DME over new mines

The department of minerals and energy (DME) is planning the establishment of more coal mines in Mpumalanga, despite the poisoning of rivers in the area from mine leachate, according to a report in the *Star* newspaper (5 May 2009).

An investigation by the University of the Witwatersrand, commissioned by the Mpumalanga Lake District Protection Group, confirmed that chemicals from mines leaching into the lakes and dam were the cause of death of thousands of fish and other fauna last year. Farmers have threatened mass action if the new mines are approved. Farmers' associations are hoping to find an amicable solution to the need for clean water and the urgent need for energy by meeting with the DME and the department of water affairs, but have warned that if the government does not heed their concerns the mines will be a "death blow to agriculture".

Apart from agriculture, poor communities in the area also rely on the same water for drinking and subsistence farming.

Jobs

From www.grassland.org.za

Internships at Heinrich Böll Foundation

Cape Town. Deadline for applications 30 June.

Applicants should be:

- Graduates of political or social science, gender/feminist studies, migration studies, sustainable development, environmental science (other relevant degrees will be considered).
- Post graduate students of the above mentioned fields of study who are working on their research projects

Candidates must have demonstrated English writing skills, be proficient in MS Office and preferably have some qualitative research and field work experience. They should be willing to assist in programme management work as well as in the organisation and documentation of events. Exact tasks and responsibilities will be negotiated individually.

The HBS prefers internship periods of 3-6 months. Monthly stipends will be awarded while interns will be responsible for own travel to Cape Town and accommodation.

We particularly encourage applications from the SADC region.

Applications should include a CV, a letter of motivation, and a writing sample from the applicant's topic of study.

Send applications to info@boell.org.za.

Keren Ben-Zeev
Heinrich Böll Foundation
Regional Office, Southern Africa
1st floor, Avalon Building
123 Hope St, Gardens, Cape Town, 8001
Tel: 021 461 6266
Fax: 086 5511 674 or 021 462 7187
Website: www.boell.org.za

Water Research Commission call for proposal

WRC web is now open for the submission of research proposals for funding to commence in 2010. Please visit our website for more information. Should you require any additional information or should you experience any difficulties with the on□line process, please do not hesitate to contact Pieter Smit at pieters@wrc.org.za or at 012 330 9052. The call for non-solicited proposals will be open until midnight on 3 July 2009. The system will be open for the submission of solicited proposals from 25 May to midnight 3 July 2009.

Research opportunities

MSc and PhD Research Opportunity in Rumen Ecology (2010)

The University of Pretoria, Department of Animal and Wildlife Sciences are looking for three individuals interested and ready to explore the feeding value of fodder trees and shrubs in small ruminant nutrition both at the rumen and the whole animal level.

Requirements:
Qualifications either BSc (Agric) for MSc degree and MSc (Agric) for PhD Degree. Knowledgeable in Animal Nutrition (Rumen fermentation).

Deadline:
Application should be made before end of October 2009.

Foreign applicants are encouraged to apply for a Deutscher Akademischer Austanch Dienst (DAAD) in-country-scholarship by visiting German Embassy in their respective country of origin.

Contact person:
Dr A. Hassen, Agriculture Building 10-32, Department of Animal and Wildlife Sciences, University of Pretoria.
Tel. 012 420 3273,
Email: Abubeker.hassen@up.ac.za

Call for Applications for 2010-2012 funding

The Competitive Support for Unrated Researchers (CSUR) Programme falls within the Human and Institutional Capacity Development (HICD) Directorate of the NRF.

The various programmes and initiatives within the HICD are aimed at the development and support of people, infrastructure, facilities and systems. Investment priority will be given to the achievement of three principal goals, viz. Human research development, Building the research capacity, Development of research/knowledge areas.

To complete an application, access the electronic system at http://nrfinterim.nrf.ac.za All applications should be validated by the respective institutions' responsible Designated Authority (DA), and must be submitted to the NRF by the DA no later than Friday, 3 July 2009.

Contact person
Ms Nthabiseng Motloi
Telephone: (012) 481-4125/4240
e-mail: nthabiseng@nrf.ac.za

Funding Opportunities

From www.grassland.org.za

Charles Stewart Mott Foundation: Environment Programme

The mission of the environment programme is to support the efforts of an engaged citizenry working to create accountable and responsive institutions, sound public policies, and appropriate models of development that protect the diversity and integrity of selected ecosystems in North America and around the world. Letters of enquiry are welcome all year round but at least four months before funding is required.

Website: www.mott.org/programs/environment.aspx

The Royal Society International Joint Projects

Deadline: 17 June 2009, 17 September 2009, 17 December 2009.

Designed to enable international collaboration be providing a mobility grant for researchers to cover travel, subsistence and research expenses.

The collaboration should be based on a single project including two teams or individuals: one based in the UK and the other outside the UK. A relationship between both parties should already be established prior to making an application. The collaboration should involve bilateral visits between the UK and the country in which the overseas collaborator is based.

Subjects covered

All disciplines in which the Society will elect researchers to the fellowship of the Royal Society.

Website: www.royalsociety.org/

Wildlife Conservation Society Research Fellowship Programme

A programme designed to build capacity for the next generation of conservationists through supporting individual field projects that have a clear application to the conservation of threatened wildlife and wildlife habitat.

Deadlines: 15 March and 15 September.

Projects are evaluated on three major criteria:

- Applicant's potential as a conservation professional: the capacity building value of the proposed project
- Relevance to wildlife conservation: a clear application of the research results to an important conservation question
- Scientific merit and value: in particular a clearly expressed research question with appropriate methodology and analysis.

Website: www.wcs.org

Upcoming Events

From www.grassland.org.za

43rd Annual SASAS Congress
Date: 28-30 July 2009
Venue: Alpine Heath, Northern Drakensberg, KwaZulu-Natal
Contact: Trevor Dugmore
Tel: 033 3559 258
Email: Trevor.Dugmore@kzndae.gov.za
Website: www.sasas.co.za/

Fynbos Forum:
Working together for a living landscape
Date: 4—7 August 2009
Venue: Bredasdorp, Gemeenskapsal (Community Hall)
Contact: Wendy Paisley
Tel: 021 799 8824
Email: paisley@botanicalsociety.org.za

10th International Congress of Ecology
Ecology in a changing climate: two hemispheres, one globe
Date: 15—21 August 2009
Venue: Brisbane Convention Centre, Queensland, Australia
Website: www.intecol10.org

SAWMA Symposium
Wildlife Management: Ensuring Sustainability
Date: 13—16 September 2009
Venue: Protea Hotel Black Mountain, Thaba Nchu
Contact: Elma Marais
Tel: 021 554 1297
Email: elma@mweb.co.za
Website: www.sawma.co.za

47th AEASA Conference
Promoting the competitiveness of South African Agriculture in a weakened global economy
Date: 21-23 September 2009
Venue: Southern Sun Elangeni, Durban
Contact: Gaylene Hall
Email: gaylene@findavenaue.co.za
Website: www.findavenue.co.za/AEASA/Aeasa.html

Developing Animal Agriculture Interest Group Symposium
Date: 28 September—2 October 2009
Venue: Gauteng, South Africa
Contact: Heleen Els
Tel: 083 478 1940
Email: Heleen.Els@up.ac.za
Website: www.sasas.co.za

Council News

The Council met on 29 April 2009 at Rhodes University, Grahamstown.

We also welcomed the newest addition to the GSSA family. Congratulations Susi on your baby!

It was reported that all arrangements for 44th Congress, 2009 are firmly on track. The theme – Meeting rangeland, pasture and wildlife challenges in a changing landscape – has sparked much interest amongst members and more than 90 contributions have been received. A number of interesting special sessions have also been organised. Various pre-Congress tours are scheduled for those who believe that all work and no play makes Jack a dull boy.

Please be informed that Expertise Database forms will be available during Congress for those members who have not yet completed them.

Thank you to all who submitted manuscripts for publication in the African Journal of Range and Forage Science. Issue 26(2) promises to be a good read! Also look out for a special issue on desertification and resource degradation. As discussed at the Journal Strategic Planning session the mentorship program will also be initiated this year.

The Professional Affairs Committee (PAC) had a meeting with the new SACNASP (South African Council for Natural and Scientific Professions) Board and various issues were discussed. SACNASP is currently redrafting the requirements for registration and this document will be sent to all voluntary associations for comment. A detailed report will be given at Congress so be sure not to miss it.

Congratulations to all students who received GSSA awards! We are also looking into the possibility of establishing Grassland Clubs at universities to encourage students to follow careers in range and forage science.

Council would like to thank all members for their assistance and support during the previous year. Thank you also to all Council members who are stepping down this year.

Hope to see everybody at Congress!

Comparing enhanced and non-enhanced grass seed types used in re-seeding rehabilitation practices

Y Brits and K Kellner*

*School of Environmental Science and Development, North-West University
Email: klaus.kellner@nwu.ac.za

Introduction

Environmental management considers the restoration and rehabilitation of neglected cultivated pastures, degraded rangelands (due to overgrazing and climatic impacts) as well as mining and industrial areas as top priorities (Bradshaw 1997, Urbanska *et al.* 2000). Highly degraded areas need to be re-seeded to increase re-vegetation cover, density and biomass (van den Berg 2002, Warren *et al.* 2002). Re-seeding activities require high input costs and are influenced by the quality and effectiveness of the seed used, especially with regard to the germination and establishment under natural field conditions (van den Berg, 2002, van den Berg and Kellner 2004, Snyman 1999, Snyman 2003, Edwards and Abivardi 2000). If techniques can be developed to improve the effectiveness of germination and establishment rates the rehabilitation process can be enhanced. Commercially available grass seed has a better germination and establishment rate in comparison with seed locally harvested (which might include many impurities). However, the availability of these seed types, especially of certain ecotypes adapted to specific environments, is poor.

Enhanced and non-enhanced seed

Advance Seed Company (Krugersdorp, South Africa) has taken commercial available grass seed to the next level by enhancing (coating) the seed with AgriCOTE^{GT} (containing a combination of binding material, fungicides, growth stimulants, rhizobia, lime and nutrients) which includes several treatments. Although the seed can be more expensive than non-enhanced seeds in the initial stages of sowing, it may increase the germination, establishment and growth of grasses in the long-term. Benefits of the enhancement include the better handling of the seed, better seed-to-soil contact, insecticides, growth stimulants, fungicides and pesticides, higher seed purity and increased seedling survival.

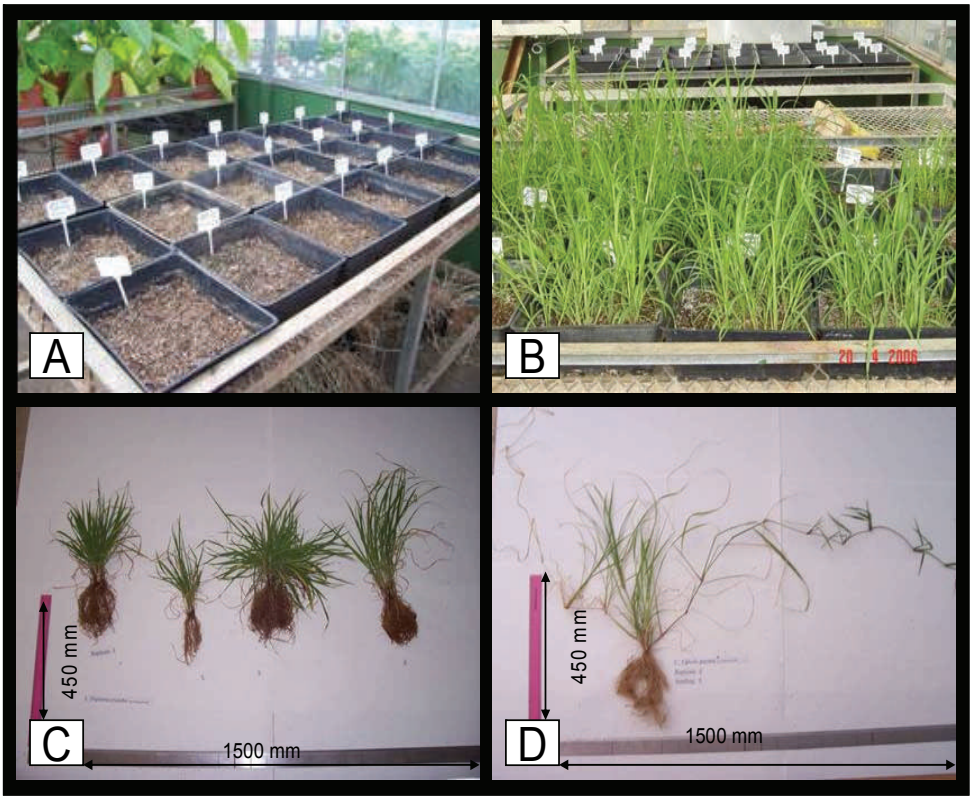

Figure 1 (A). The trays in which seeds were planted in Hygromix growth medium and kept moist; (B) The seedlings in the Hygromix growth medium after a growth period of 7 weeks, just before the first biomass monitoring; (C) *Digitaria eriantha* non-enhanced grass seed type as an example of the uprooted and washed seedlings used in the biomass monitoring; (D) *Chloris gayana* non-enhanced grass seed type as an example of the uprooted and washed seedlings used in the biomass monitoring.

Aims

Investigations on the dry matter biomass accumulation under controlled and natural conditions of selected enhanced and non-enhanced seed types.

Material and methods

Seed types used

We used four species, enhanced and non-enhanced: *Chloris gayana* (C.gay), *Cynodon dactylon* (C.dac), *Digitaria eriantha* (D.eri) and *Eragrostis curvula* (E.cur), (with several enhancements detailed below)

Glasshouse trials

For each grass seed sample, 100 seeds were sown in Hygromix growth medium in seedling trays (four replicates) and kept under controlled conditions at 20°C night and 25°C day temperature (Figure 1

A. & B.). After four months, the above (leaves) and below (root) ground biomass of the dry material was determined for each seed type (Figure 3). The seedlings used in the biomass measurements were randomly selected. The roots and leaves were cleaned form most impurities, before drying (Figure 1 C. & D.).

Natural field trials

Sites were established in March 2006 at the experimental farm of the Agricultural Research Council in Potchefstroom. Three replicates for each of the grass seed types were established. Seeds were sown in rows at seeding rates recommended by Advance Seed Company. Irrigation by means of a dragline sprinkle irrigation system was applied and weeds were chemically and mechanically controlled.

Vegetation surveys were carried out 9 months after establishment (Figure 2 D.). Density of each species per 1m² quadrat was determined. Biomass accumulation was determined by clipping all the above ground leaf material in three 1m² quadrats. Dry matter production was calculated as g/m² and kg/ha for

Figure 2: (A and B) The cultivation and preparation of the natural field before sowing the selected grass seed types; (C) Sowing the seeds in rows by hand; (D) Grass sward after a nine month growth period (January 2007).

each grass species (enhanced and non-enhanced).

Results and discussion

Glasshouse trials

Only the average above and below ground biomass for the enhanced seed types of *C. gayana* was slightly higher (Figure 3). The opposite is true for the above and below ground biomass of *C. dactylon*, *D. eriantha* and *E. curvula* (all treatments). The only significant difference ($p<0.05$) was observed in the case of above ($p=0.025$) and below ($p=0.043$) ground biomass of *D. eriantha*.

Natural field trials

All the enhanced seed types had a higher density under natural conditions, except for *D. eriantha* (Figure 4). The only significance occurred in the *C. dactylon* ($p=0.046$) and *D. eriantha* ($p=0.049$) sites.

All the enhanced seed types indicated higher dry matter biomass (g/m²) under natural conditions, except for *D. eriantha* (Figure 5). The only significance difference occurred in the *C. gayana* ($p=0.049$) and *C. dactylon* ($p=0.049$) sites. The average dry biomass in g/m² were converted to kg/ha.

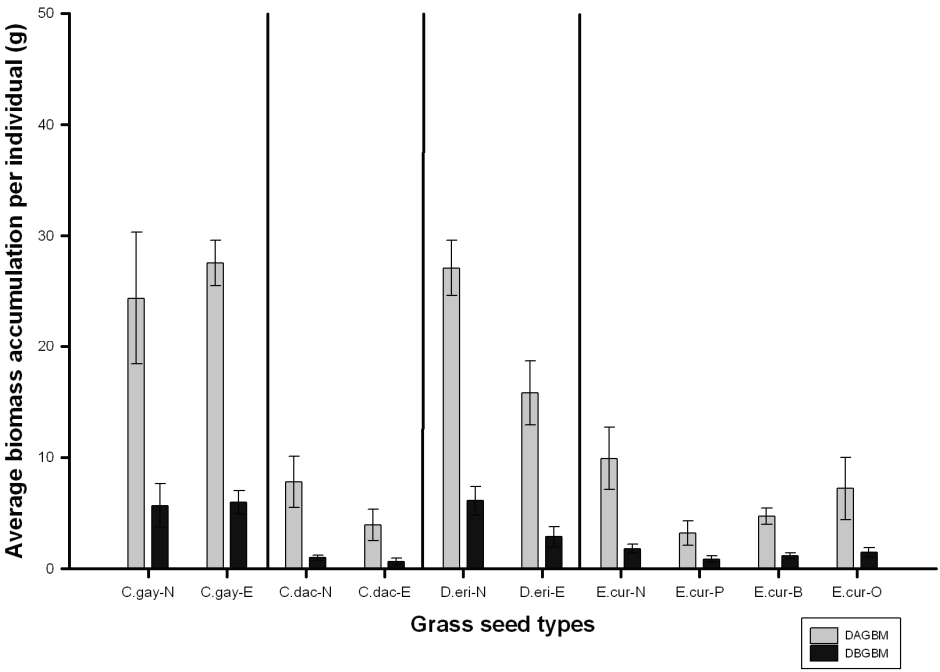

Figure 3: Average dry above (DAGBM) and below (DBGBM) ground biomass (g) of selected grass seed species after 4 months (July 2006) (N -non-enhanced; E – enhanced; P – plain coat (In the case of E. cur); B – insecticide on base of coat; O – insecticide on base of coat and as overspray.

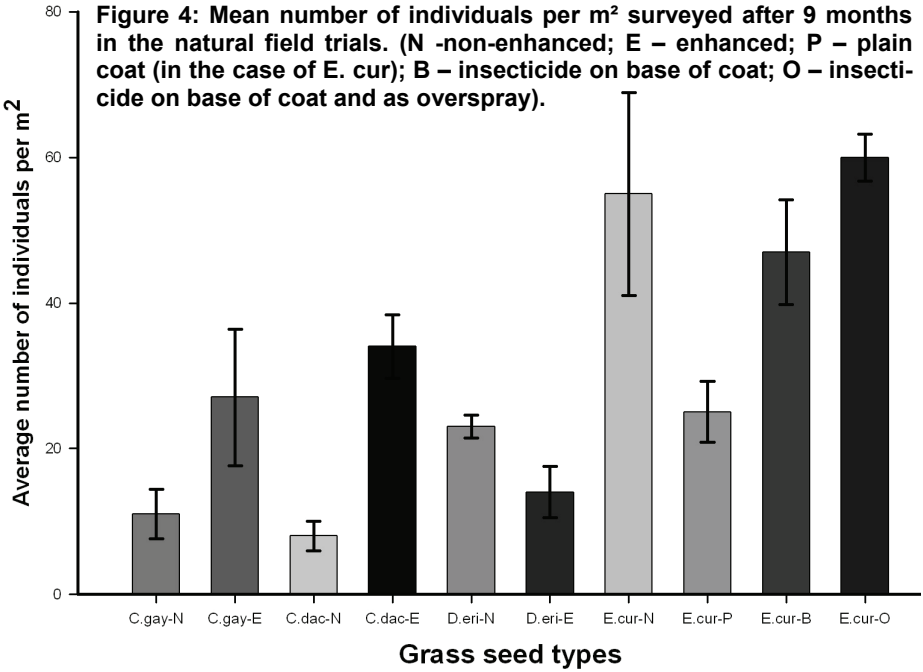

Figure 4: Mean number of individuals per m² surveyed after 9 months in the natural field trials. (N -non-enhanced; E – enhanced; P – plain coat (in the case of E. cur); B – insecticide on base of coat; O – insecticide on base of coat and as overspray).

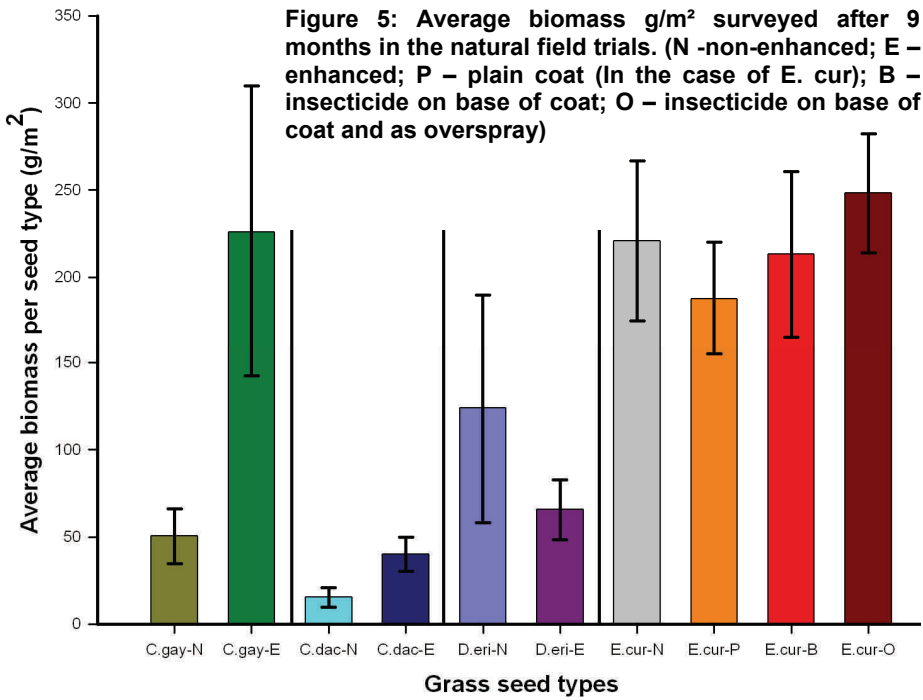

Figure 5: Average biomass g/m² surveyed after 9 months in the natural field trials. (N -non-enhanced; E – enhanced; P – plain coat (In the case of E. cur); B – insecticide on base of coat; O – insecticide on base of coat and as overspray)

Table 1: The average dry biomass yield for the selected grass types (kg/ha)

Grass seed types	Dry biomass yield (kg/ha)
C. gayana (non-enhanced)	504.8
C. gayana (enhanced)	2261.0
C. dactylon (non-enhanced)	153.4
C. dactylon (enhanced)	402.5
D. eriantha (non-enhanced)	1240.0
D. eriantha (enhanced)	656.3
E. curvula (non-enhanced)	2210.0
E. curvula (plain coat)	1876.0
E. curvula (base & over-spray)	2133.0
E. curvula (overspray)	2483.0

Conclusion

The enhanced seed types of *C. gayana* (glasshouse and field trials), *C. dactylon* (field trials) and *E. curvula* (field trials – insecticide on the base and as overspray) had a higher density and dry matter production. For the *D. eriantha* seed types, the non-enhanced seed type had the highest dry matter production and density in the glasshouse and the natural field trials. The biomass accumulation between the glasshouse and field trials do not correspond in most instances. The explanation for this difference can be attributed to the fact that the seeds in the glasshouse trials were sown in a Hygromix growth medium that included a number of nutrients, which could have benefited the non-enhanced seed types. Another explanation to the non corresponding data is that the DM for the glasshouse were measured only four months after establishment under controlled conditions, while the DM production for the field trials were determined after 9 months after being subjected to natural conditions. These results indicate that it is advised to use enhanced seed types of mainly *C. gayana*, *C. dactylon* and certain types of *E. curvula* in seed mixtures to increase the establishment and DM production in the rehabilitation practices of degraded natural fields.

Acknowledgements

Advance Seed Company is acknowledged for their financial contributions and expert knowledge as well as the North West Department of Agriculture, Conservation and Environment (DACE) Potchefstroom, for the use of the experimental farm and assistance and also the North-West University (Potchefstroom Campus).

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Congress 2009 Special Session

Determining the biodiversity benefits of agricultural good management practices for animal production

World Wildlife Fund-South Africa, in conjunction with South African National Biodiversity Institute's Grasslands Programme and University of Kwazulu Natal's School of Biological and Conservation Sciences, wants to explore the link between agricultural good management practices for animal production systems on natural grasslands and biodiversity conservation

The key question: If agricultural good management practices are implemented, what biodiversity features are well conserved, which ones are not well conserved and which ones need further research?

WWF's work with the Grasslands Programme is focused on mainstreaming biodiversity in the agricultural sector. One of the key deliverables is to explore how biodiversity can be considered more effectively in animal production systems on natural grasslands. Therefore, instead of handing over all possible biodiversity good management practice guidelines for use in the agricultural sector, the approach is to consider what is agricultural good management practice for animal production systems, what guidelines exist, what are the benefits for biodiversity and for ecosystem goods and services (i.e. grazing resources, pollinators, water, carbon, sedimentation), and then to consider what biodiversity good management practice needs to be incorporated into agricultural good management practices.

A Concept Paper will be prepared in advance of the session. This will be emailed out by early July 2009 to those attending the Special Session.

The Special Session will be an open session, but every attempt will be made to identify and invite specific specialists from the agriculture and conservation sectors to participate in the session.

The effect of supplementing maize silage to Jersey cows on kikuyu pasture

Prof. Robin Meeske and Gerrit van der Merwe
Department of Agriculture Western Cape, Institute for Animal Production, Outeniqua Experimental Farm
Email: robinm@elsenburg.com

Introduction

During the past five years the winter rainfall has reduced while the summer rainfall has increased in the southern Cape. More farmers are planting maize as a silage crop during summer as they cannot rely on growth of ryegrass during winter on dry lands. Very limited data is available on the effect of supplementing maize silage to cows grazing on kikuyu under irrigation. The objective of the study was to determine the effect of feeding different levels of maize silage to Jersey cows grazing kikuyu pasture on: Milk production, milk composition, liveweight change, body condition score and rumen pH.

Materials and methods

Maize silage made during 2003 was supplemented at 0, 14 and 28% of total intake to Jersey cows grazing kikuyu pasture as indicated in Table 1. The study was done during March and April 2005.

Sixty cows were randomly allocated to the three treatments (20 cows per treatment). Groups were balanced for milk production four weeks prior to the start of the study, days in milk and lactation number. The average daily milk production of cows four weeks prior to the start of the study, days in milk and lactation number was 16.1 ± 1.67 kg, 16.1 ± 1.64 kg and 16.1 ± 1.67 kg; 89 ± 56.8 days, 85 ± 44.5 days and 83 ±

Table 1. Estimated DM intake (kg/day) of Jersey cows grazing on Kikuyu pasture

	Control	Low Maize Silage	High maize silage
Pasture*	10kg (74%)	8kg (59.3%)	6kg (44.4%)
Maize silage	0kg	2kg (14.7 %)	4kg (29.4%)
Concentrate**	3.6kg (26%)	3.6kg (26%)	3.6kg (26%)

Pasture* = estimated pasture intake, pasture availability should not limit intake
Concentrate** = 15% CP and 11.5 MJ ME/kg on an as fed basis

47.3 days and 3.5 ± 1.5, 4.1 ± 1.5 and 4.5 ± 1.9 lactations for the control, 2kg DM maize silage and 4kg DM maize silage groups respectively. Milk production was recorded daily and milk composition every 14 days during the measurement period. Cows were weighed and condition scored on two consecutive days at the start and end of the experimental period. Samples of pasture, maize silage and concentrate were taken weekly during the measurement period. All cows grazed as one group from 07:30 to 14:00 and from 16:00 to 06:00 the next morning. The silage was fed separately to the low and high silage group before the afternoon milking from 14:00 to 15:30. Cows were milked at 06:00 and 15:30 and were fed 2kg (as is) of concentrate during each milking. The experimental period consisted of an adaptation period of 10 days and a measurement period of 50 days. Nine to twelve hectares of kikuyu pasture were grazed depending on the growth rate of the grass. The total amount of pasture needed per day was estimated at 480kg. At a growth rate of 40kg/day, 12ha of pasture was needed. The average pasture height was measured before and after grazing by taking 100 readings on each grazing strip before and after grazing with a rising plate disk meter (RPM). The DM yield was estimated by using the following equation: Yield (kg DM/ha) = (Average Height RPM X 60) – 360.

Four rumen fistulated cows were added to each of the control and the high silage treatment groups. The cows were adapted to diets for 21 days followed by a measurement period of 8 days after which cows were switched over to high maize silage treatment and the control. The rumen pH of cows was measured with data loggers fitted on the cows and pH electrodes that were inserted into the rumen. The rumen pH was measured at 10 minute intervals for 48h followed by a 48h rest period. This procedure was repeated twice resulting in a total of four days pH measurement.

Results and discussion

The milk production, milk composition, live weight and condition score is presented in Table 2.

The supplementation of maize silage increased milk and fat corrected milk production and decreased the milk urea nitrogen levels. Milk butterfat, protein and lactose content were not affected by supplementing maize silage. Cows on all the treatments lost weight and supplementing of silage did not affect life weight change. The condition score of cows on the low maize silage treatment was lower than that of cows on the high silage treatment at the start of the study. The condition score of cows on the low maize silage treatment increased slightly during the study while that of cows on the high maize silage diet decreased. The condition score did not differ between treatments at the end of the study.

The pasture height, yield and growth and is shown in Table 3. The pasture height after grazing indicates that pasture was not limiting as there was still 512kg and 384kg DM left above a height of 3cm (RPM height

of 6) during March and April respectively. The growth of kikuyu was lower during April compared to March.

Cows on the high maize silage treatment consumed 12kg of wet silage (4kg DM) per cow just after being taken off the pasture. When opening the cannula of cows on the control treatment open space could be seen in the rumen just before milking while the rumens of the high maize silage cows were totally filled and the electrode probe was inserted into the rumen with difficulty. The rumen pH of cows fed no silage and cows fed 12kg of silage (4kg DM) is shown in Figure 1. The intake of silage resulted in a direct decrease in rumen pH. The pH was however not below 6 for longer than 2h.

Conclusions

Maize silage can effectively be used to supplement kikuyu pasture during March and April if pasture demand is higher than pasture supply.

Table 2: The effect of feeding maize silage on milk production, milk composition, live weight and condition score of Jersey cows grazing kikuyu pasture during March and April. Cows were and fed 4 kg concentrate per day. (n=20)

	Control	Low MS (2kg DM)	High MS (4kg DM)	LSD[d]
Milk production (kg/day)	13.8[b]	14.6[a]	14.9[a]	0.69
Fat corrected milk (kg/ day)	14.9[b]	16.1[a]	16.3[a]	0.79
Butterfat (%)	4.58	4.68	4.61	0.308
Protein (%)	3.59	3.54	3.62	0.138
Lactose (%)	4.48	4.59	4.59	0.083
MUN[e] (mg/dl)	18.2[a]	16.0[b]	14.0[c]	1.02
SCC[f] (X 1000)	202	203	254	148
Live weight start (kg)	395	383	391	17.1
Live weight end (kg)	387	376	378	17.5
Live weight change (kg)	-7.7	-7.6	-12.6	9.41
Condition score start	2.31[ab]	2.18[b]	2.43[a]	0.200
Condition score end	2.20	2.20	2.28	0.141
Condition score change	-0.11[ab]	+0.03[a]	-0.15[b]	0.158

[a,b,c] Means in the same row with different superscripts differ (P<0.05) , LSD[d] = Least significant difference, MUN[e] = Milk urea nitrogen, SCC[f] = Somatic cell count

Table 3: Pasture growth and grazing management on kikuyu pasture during March and April 2005 (n=28)

	March	April
Before grazing		
Pasture height (RPM)	38.5 ± 5.84	30.9 ± 5.14
Pasture yield (kg DM/ha)	2141± 379	1266 ± 298
After grazing		
Pasture height (RPM)	13.4 ± 1.46	12.4 ± 1.85
Pasture yield (kg DM/ha)	512 ± 94	384 ± 111
Pasture grazed (kg DM/ha)	1639 ± 357	1266 ± 298
Pasture growth (kg DM/ha/day)	58 ± 12.7	45 ± 10.6

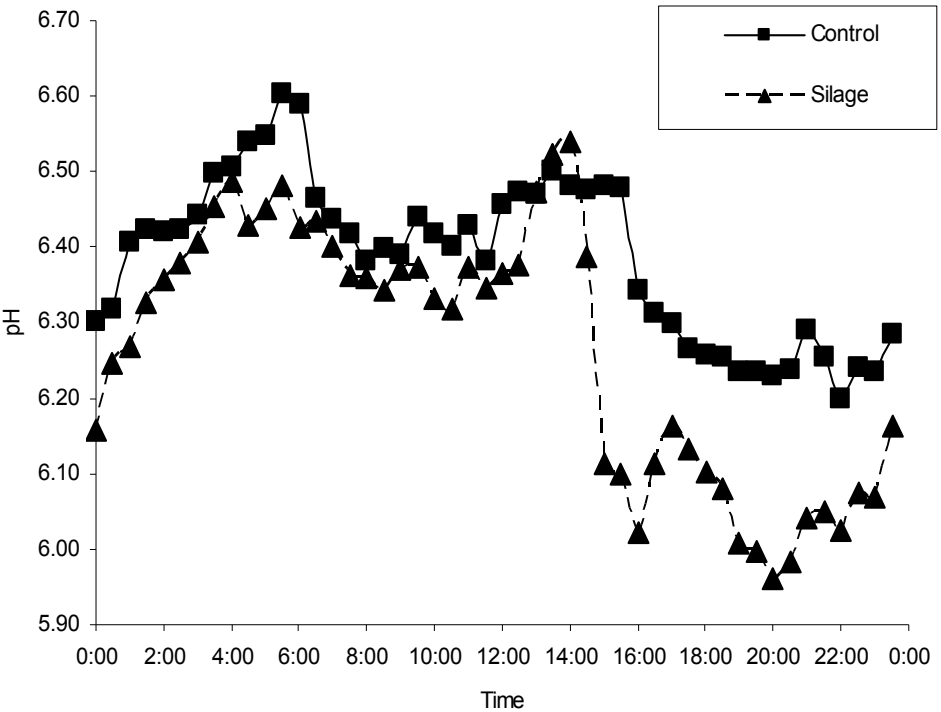

Figure 1. Rumen pH of Jersey cows grazing kikuyu in March 2005 fed 4 kg concentrate with or without the supplementation of 12 kg maize silage (n=4)

Milk production increased when maize silage was supplemented.

The feeding of maize silage did result in a decrease in rumen pH.

Although the results are not shown due to changed economic circumstances, at the time of the study the margin over feed cost increased as the level of feeding maize silage increased.

Do not graze your kikuyu pasture too frequently

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Introduction

Recent research on the effect of cutting frequency on the production and quality of kikuyu pastures indicated that re-growth periods of less than 21 days may decrease total value of kikuyu pastures. Very short re-growth periods may even increase the risk of acidosis in grazing cows. The optimal re-growth period appears to be 28 days.

Materials and methods

A trial was executed at the Outeniqua Experimental Farm to investigate the effect of re-growth stage and cutting frequency of kikuyu pasture on its chemical composition and fermentation characteristics. Four plots of 60m^2 each were randomly selected in an existing kikuyu camp. Each plot was subdivided into six plots of 2 × 5m, thus enabling a trial with six treatments and four replicates. Plots were first cut to ground level and soil samples were taken to determine the mineral status which was used as a guideline for fertilization. All fertilizer and irrigation applications were according to current recommendations.

During a 42 days cycle, plots were cut after the following re-growth periods: 7 days (allowing 6 cuttings), 14 days (allowing 3 cuttings), 21 days (allowing 2 cuttings), 28 days (allowing a single cutting), 35 days (allowing a single cutting) or 42 days (allowing a single cutting). Cycles were repeated 35 days after the end of the previous cycle. Three cycles were completed in one growing season. Thirty five days before the start of each cycle, the pasture was cut to a height of 50 mm. One week before cutting the first treatment, all the plots were again cut to a height of 50 mm and fertilized; this was then regarded as the starting date of the relevant cycle.

Pasture samples were analysed for dry matter (DM), crude protein (CP), crude fibre (CF), nitrogen free extract (NFE), neutral detergent fibre (NDF) and acid detergent fibre (ADF). The samples were also subjected to *in vitro* analyses, including 24h NDF disappearance, 48h organic matter digestibility (IVOMD), and gas production (ml gas/g OM) after incubation times of 0, 1, 2, 4, 8, 12, 24, 48, 72, and 96h. Dry matter yield was determined on each plot at the specified cutting times.

The data are presented in two ways: i) Average values of the multiple cutting treatments (i.e. for each of the 7 days, 14 days and 21 days treatments) and values from the single cutting treatments (i.e. the 21 days, 28 days and 42 days treatments) are compared. ii) Data from each multiple cutting treatment were analyzed to determine the effect of multiple cuttings within a specific cutting frequency (for example, the six cuttings in the 7 days frequency treatment were compared with each other, the three cuttings in the 14 days frequency treatment with each other, etc.).

Results and discussion

The effect of cutting frequency on DM content and DM yield is presented in Figure 1.

It appeared that up to 35 days, the dry matter content of kikuyu pasture decreased when re-growth period increased. The DM content of the pasture increased again in the 42 days treatment. Although the differences between treatment means were statistically significant, they were small. However, it could have an impact on total DM yield per hectare in the long term.

Although the DM yields per cutting provide interesting information, there is no purpose in comparing the data between treatments because of the difference in re-growth time. However, when values are expressed as total DM yield over the 42 days cycle, it is of importance to note that the efficiency of DM production increased significantly as

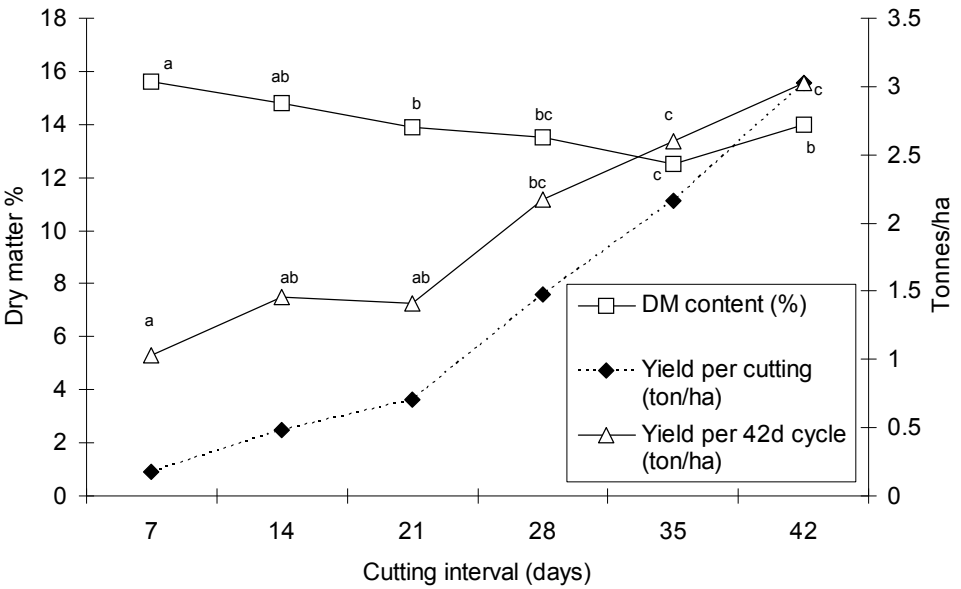

Figure 1. The effect of cutting frequency on the DM content and DM yield of kikuyu pasture. Points with letters in common were not different (P<0.01). The yield per

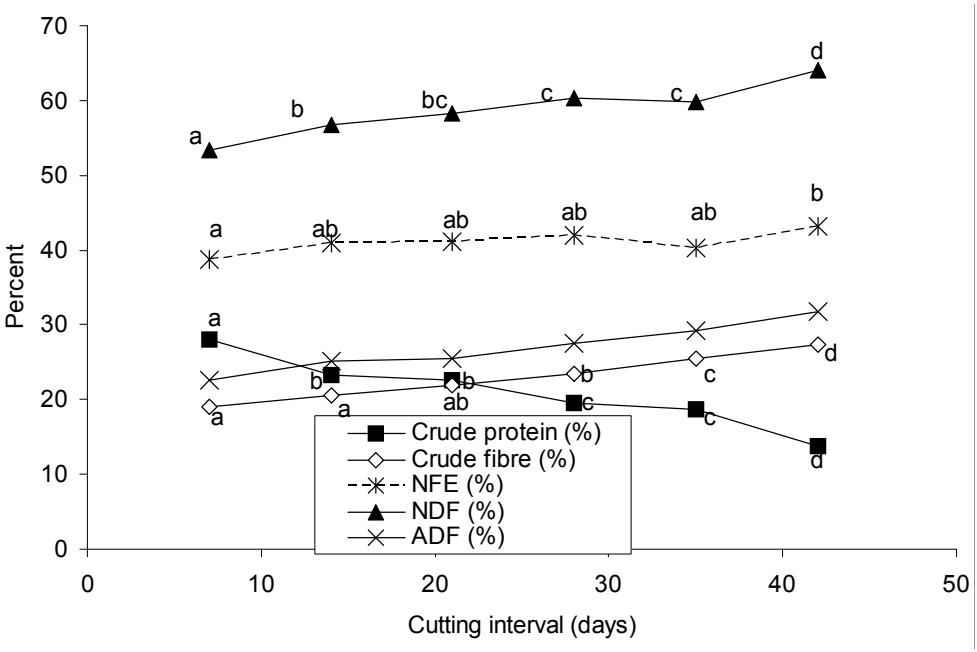

Figure 2. The effect of cutting frequency on the chemical composition of kikuyu. Values are on a dry matter basis. Points with letters in common are not significantly different (P<0.01).

cutting frequency decreased. These results suggest that too frequent grazing of kikuyu pasture could have a significant negative impact on pasture production. It must be added, though, that pasture yield estimations were based on small sample sizes taken at the respective cutting frequencies and that extrapolations might not be very accurate.

Results on the chemical composition of the pasture are presented in Figure 2 and Table 1. The average values of each multiple cutting treatment were calculated and compared with values from the single cutting treatments; these are presented in Figure 2. The within-treatment results, where results between the different cuttings in a multiple cutting treatment were compared, are presented in Table 1.

The CP content decreased as the re-growth period increased from 7 to 42 days, while the crude fibre and NDF contents increased. The NFE content (mostly sugars) also increased, but the effect is not as apparent as with CP and fibre; only the 7 days and 42 days treatments differed in NFE content.

The effect that frequent cutting had on the quality of the next cutting is indicated in Table 1.

In all cutting frequency treatments, the protein content decreased from one cutting to the next, while the fibre fractions and NFE increased. The shorter the re-growth period, the greater the effect was. It

is interesting to note that the chemical composition of kikuyu obtained from the last cut in each of the multiple cutting treatments was quite similar. The last cut of the three multiple cutting treatments (7, 14 and 21 days) coincided with the 42 days cutting treatment. In the multiple cutting treatments the CP content of the last cutting was higher and crude fibre and NDF lower than those in the 42 days re-growth treatment. The last cutting of the three multiple cutting treatments were, however, not that much different from the 28 days cutting. In terms of DM yield and average quality, 28 days thus appears to be the cutting frequency of choice.

The effects of cutting frequency on *in vitro* fermentation parameters are presented in Table 2.

Mean 24 h NDF disappearance decreased with increased re-growth periods, but only when re-growth periods were longer than 28 days. This would suggest that the fibre became less digestible as plant ma-

Table 1. The effect of cutting number per treatment on the chemical composition of kikuyu. Values are on a dry matter basis

Nutrient	Re-growth period and cutting number							
	7 d, 1	7 d, 2	7 d, 3	7 d, 4	7 d, 5	7 d, 6	SEm	P
Crude protein (%)	33.2^{a}	31.3^{ab}	30.8^{ab}	26.6^{bc}	24.5^{c}	22.1^{c}	1.18	<0.01
Crude fibre (%)	17.2^{a}	17.5^{a}	17.2^{a}	19.6^{b}	20.3^{b}	22.2^{c}	0.37	<0.01
NFE (%)	33.9^{a}	35.9^{ab}	38.0^{ab}	40.4^{bc}	42.5^{c}	41.4^{c}	1.25	<0.01
NDF (%)	48.6^{a}	50.3^{a}	51.1^{a}	55.3^{b}	56.7^{bc}	58.6^{c}	0.60	<0.01
ADF (%)	21.2	22.3	20.0	23.0	23.4	25.7	0.38	<0.01
	14 d, 1		14 d, 2		14 d, 3		SEm	P
Crude protein (%)	27.0^{a}		23.1^{ab}		19.4^{b}		0.90	0.17
Crude fibre (%)	18.6^{a}		20.3^{ab}		22.6^{b}		0.51	<0.01
NFE (%)	39.8		42.5		43.5		1.05	0.08
NDF (%)	53.4^{a}		57.1^{b}		59.8^{c}		0.56	<0.01
ADF (%)	25.2		24.0		26.5		1.52	0.55
	21 d, 1			21 d, 2			SEm	P
Crude protein (%)	23.7			20.9			2.32	0.43
Crude fibre (%)	20.7			23.1			0.55	0.02
NFE (%)	40.8			41.3			2.08	0.87
NDF (%)	55.0			61.4			1.05	<0.01
ADF (%)	23.9			27.0			0.79	<0.03

Table 2. The effect of cutting frequency on *in vitro* fermentation parameters of kikuyu

Parameter	Cutting frequency (re-growth period)							
	7 d	14 d	21 d	28 d	35 d	42 d	SEm	P
24 h NDF disapp. (%)	70.0^{a}	67.8^{a}	65.6^{a}	63.7^{a}	53.7^{b}	53.7^{b}	1.86	<.01
12 h gas prod. (ml/g OM)	77.3^{a}	79.4^{a}	65.3^{b}	64.5^{b}	39.3^{c}	59.0^{b}	3.13	<.01
96 h gas prod. (ml/g OM)	292.5^{a}	303.9^{a}	291.1^{a}	295.8^{a}	261.9^{b}	279.3^{ab}	5.73	<.01

terial was removed less frequently than once a month. According to Figure 2, the NDF content increased with increasing re-growth periods; this increase would probably be related to an increased ADF content. The differences between the 7, 14, 21 and 28 days treatments were not significant.

The 12h gas production values give a fairly good idea of how fermentation rates compared between treatments. It can be seen that rates decreased as the re-growth period increased. The fact that the fermentation rate was so low in the 35 days treatment cannot be readily explained, but it is possible that environmental conditions played a role. The 96h values are an indication of the extent of fermentation, which was not significantly different between treatments, except for the 35 days treatment where the value was

Table 3. The effect of treatment (within cutting frequencies) on *in vitro* gas production of kikuyu

Parameter	Re-growth period and cutting number							
	7 d, 1	7 d, 2	7 d, 3	7 d, 4	7 d, 5	7 d, 6	SEm	P
24 h NDF disapp. (%)	69.0	68.2	71.6	68.9	72.8	69.5	1.41	0.20
12 h gas prod. (ml/g OM)	28.8^{a}	63.2^{b}	76.0^{bc}	92.8^{cd}	106.6^{d}	96.6^{d}	4.32	<.01
96 h gas prod. (ml/g OM)	201.8^{a}	268.4^{b}	297.3^{c}	312.7^{cd}	342.1^{e}	332.6^{de}	5.87	<.01
	14 d, 1		14 d, 2		14 d, 3		SEm	P
24 h NDF disapp. (%)	65.6		71.3		66.6		3.72	0.53
12 h gas prod. (ml/g OM)	70.9^{a}		84.8^{ab}		90.3^{b}		5.15	<.064
96 h gas prod. (ml/g OM)	271.2^{a}		319.2^{b}		321.4^{b}		7.4	<.01
	21 d, 1			21 d, 2			SEm	P
24 h NDF disapp. (%)	64.6			66.6			3.72	0.53
12 h gas prod. (ml/g OM)	40.4^{a}			90.2^{b}			3.3	<.01
96 h gas prod. (ml/g OM)	261.3^{a}			320.9^{b}			8.22	<.01

much lower.

Within-treatment effects on *in vitro* parameters are indicated in Table 3.

Mean 24h NDF disappearance did not change much from cutting to cutting in any of the multiple cutting treatments and differences were not significant. However, 12h and 96h gas production increased significantly from the first to the last cutting in all three multiple cutting treatments. With the increase in NDF content observed from cutting to cutting (Figure 2), and the fact that the NDF digestibility appears to remain constant between cuttings, it would appear that more fermentable material (g/g) become available from cutting to cutting. With the rapidly increasing rate of fermentation in the multiple cutting treatments, and especially the 7 days re-growth treatment, it can be concluded that very frequent grazing would result in increased forage fermentation rate, which could potentially increase the risk of acidosis in cows. The lower NDF content of frequently cut kikuyu would further increase the risk.

Results from the current trial would suggest that multiple cutting of kikuyu pasture results in higher nutritive value, when looking at the average values of each of the multiple cutting treatments. However, the chemical composition (especially CP% and NDF%) of the last cutting of each multiple cutting treatment did not differ that much from the 28 days and 35 days treatments. The high CP content of younger material is not necessarily an advantage because a significant portion of the CP may be in the form nitrates and the high CP content of pastures usually contributes to abundant N-intake by pasture-based cows. Frequent cutting appeared to have lowered total DM yield per hectare significantly. Increased fermentation rates of frequently grazed kikuyu may even increase the risk of acidosis. It should therefore be kept in mind that pasture dry matter yields and effective fibre intake must be taken into account before deciding on an optimal grazing system.

Cattle strip-grazing kikuyu at Broadacres, Cedara

A philosophical approach to the distribution and spread of *Seriphium plumosum*

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Introduction

The encroachment of *Seriphium plumosum* (commonly known as slangbos, bankrupt bush or vaalbos) in productive grassland annually increases in severity. The name *Seriphium* is derived from seriph, a stroke or line of a letter; *plumosum* means feathery (Badenhorst 2009). The origin and causes of this encroacher plant will continue to be a controversial topic for a long time. This shrub, about 0.6 m high, might be better known to many as *Stoebe vulgaris*. A common view is that *S. plumosum* evolved from *Stoebe cinerea* by mutations which changed its character and enabled it to invade the grassveld (Roux 1969). This encroachment severely decreases the grazing capacity of grasslands and decreases of up to 75 to 80% have already been found in certain parts of South Africa (Richter 1989). Without knowledge of its actual origin, thousands of rands are spent annually on the chemical control of this plant.

Annually, every shrub produces thousands of seeds that are very light and easily carried by wind over long distances (Snyman 2009). There is speculation whether the common name slangbos is derived from the fact that the flower heads look like a snake rearing its head or from unsuspecting individuals finding a cobra curled up under it (Badenhorst 2009). The CARA-legislation (Regulation 16 of the Conservation of Agriculture Resources Act 43) listed *S. plumosum* as a proclaimed encroacher plant, requiring that where the natural vegetation is encroached upon, the land owner is obligated to control it (Jordaan and Jordaan 2007).

The species' light colour, which reflects sunlight, woolly covering and small leaves (Koekemoer 2001), which reduce water loss, are adaptations to survive long, dry summers. It is an aromatic plant, yielding volatile oil, which is also a protective measure as the plant is seldom eaten by

livestock and then only when the plant is young (Badenhorst 2009). This is the prime reason why it has become such a problem in parts of this country where it proliferates in disturbed or overgrazed areas, explaining its common name, the bankrupt bush. Initially, most scientists assumed that it only invades in cases of overgrazing, but many examples show that when this plant first appears on a farm, the plant can even encroach on climax grassland (Snyman 2008). It prefers a sandy soil with low pH. For optimal growth, an annual summer rainfall of 620-750 mm is needed (Wepener 2007).

Figure 1 shows the present *S. plumosum* encroachment in grassland in South Africa. The Biomes in Figure 1 were taken from Rutherford and Westfall (1994). This is only a crude presentation to indicate its extent and may exclude certain grassland areas where *S. plumosum* does not yet dominate. The probability of further encroachment is indicated by arrows in Figure 1. Significantly, *S. plumosum* encroachment includes almost half of the Grassland biome. It remains to be seen whether we will eventually get to the bottom of and understand the reason for spread and manner of distribution of this plant so that scientifically based solutions can be found for its control. The following is a philosophical consideration of possible tendencies leading to its current distribution in South Africa. Though indigenous to South Africa, it has already spread to other countries in Africa (Figure 2).

Distribution from high mountains

In 1966, Prof. Brian Roberts, former departmental head of Grassland Science at the University of the Free State in the 1970s, conducted an ecological study on Thaba Nchu mountain, looking at vegetation/habitat relationships (Roberts 1966). *Seriphium plumosum* plants were found in 61 out of a total of 520 monitoring sites set out on the mountain. All the *S. plumosum* plants were found only on the southern slopes at higher altitudes. It is postulated that this is due to the higher rainfall and cooler temperatures higher up the mountain, and therefore moister. Mist also occurs regularly in the mornings higher up the mountain. The soil pH and fertility also decrease with altitude with more sour grasses dominate high up the mountain. Roberts' (1966) results show that *S. plumosum* is most closely associated with the unpalatable grass *Cymbopogon dieterlenii*. Fynbos vegetation increases enormously with altitude. Unfortunately, there is no record of the botanical composition of the vegetation at the foot of the mountain in 1966. Whether *S. plumosum* plants did occur at that time in the valleys surrounding the mountain, is an open question. Most of the older local farmers are of the opinion that no *S. plumosum* plants occurred around the mountain at that time. One can only theorize that the serious distribution below the mountain probably occurred over the past four decades.

It is probable that *S. plumosum* which occurred on Thaba Nchu mountain in 1966 (Roberts 1966),

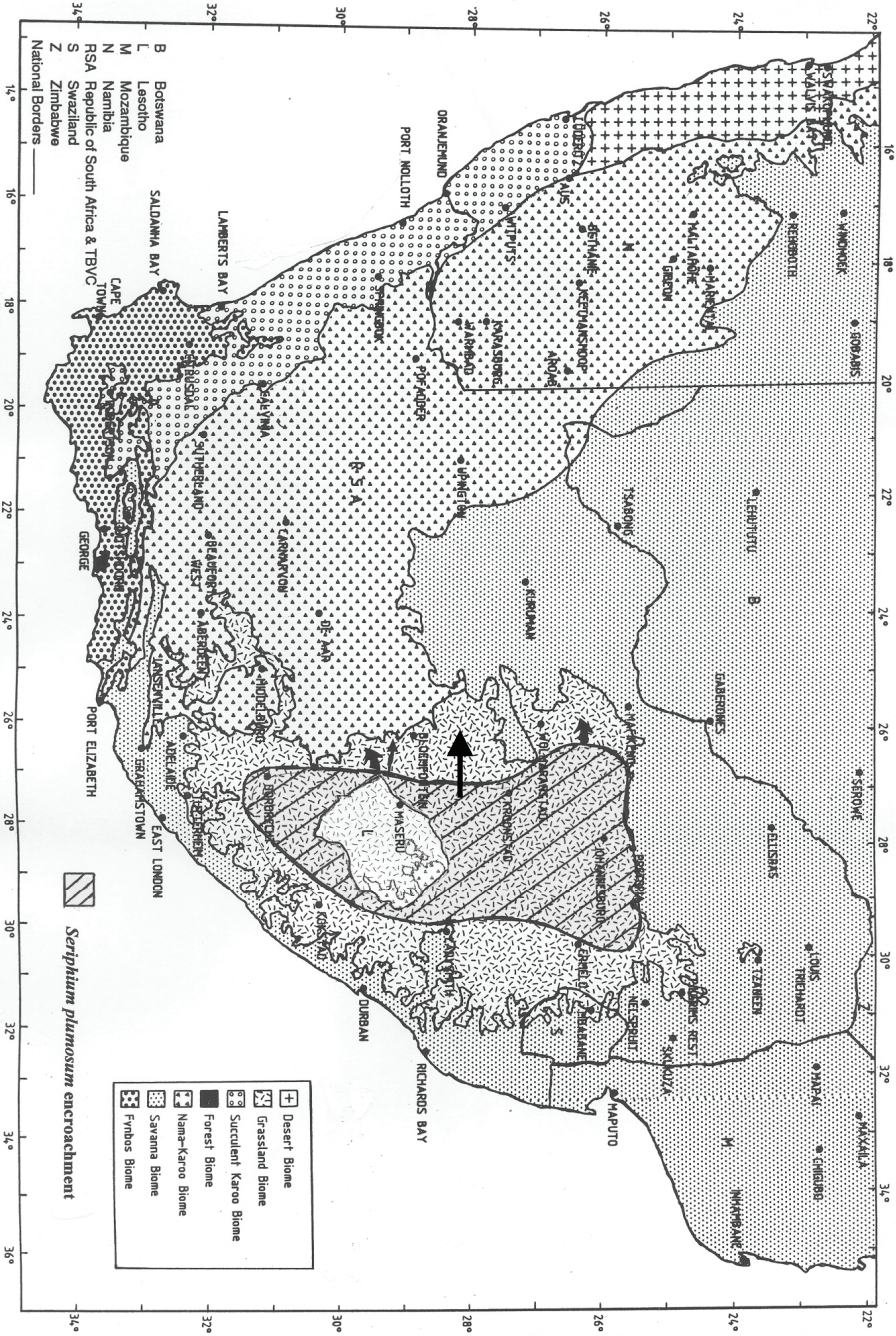

Figure 1: Biomes of South Africa and *Seriphium plumosum* encroachment in grassland areas. Map of biomes from Rutherford and Westfall (1994).

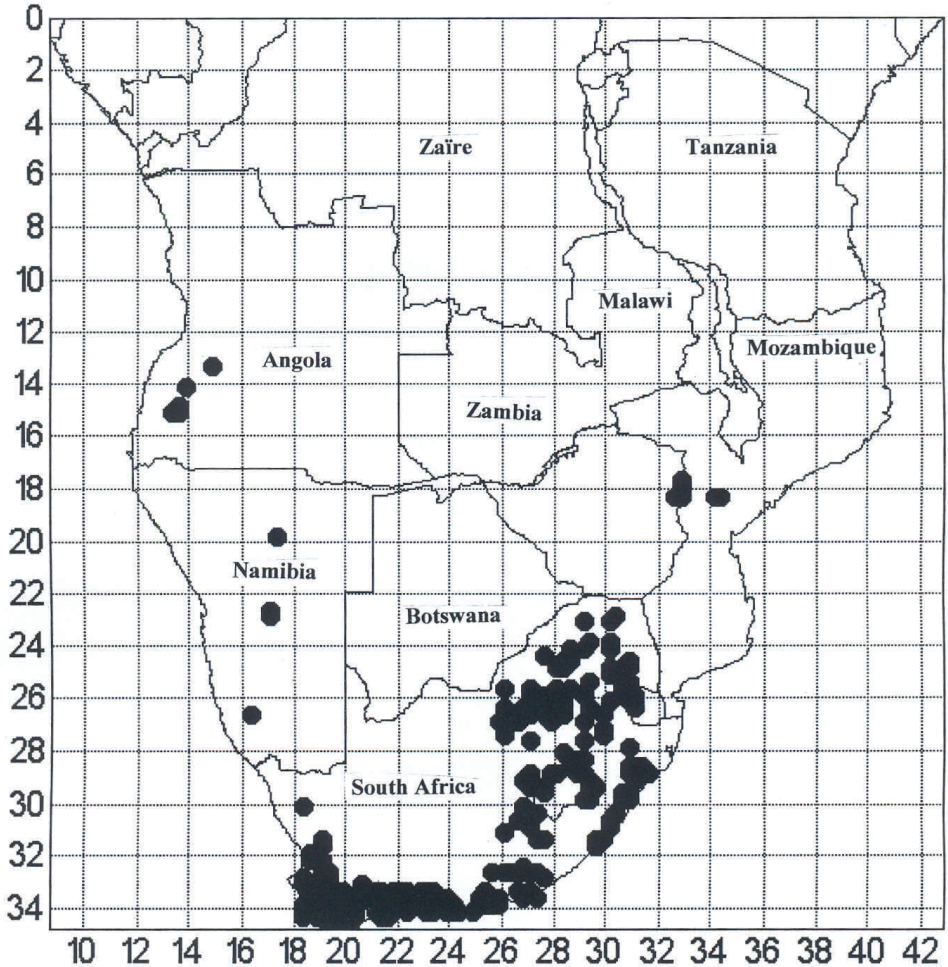

Figure 2: *Seriphium plumosum* distribution over Africa (Koekemoer 2001).

spread down the mountain by means of the very light seed over the years. It is further interesting that scientists divide the area of the mountain into two different land types, namely the part west of the mountain in the direction of the town of Thaba Nchu/ Bloemfontein and the eastern part towards Tweespruit/Ladybrand (LTSS 2008), Each land type is characterised by its own unique soil forms and climate (rainfall and temperature). The mountain range stretching north/south forms a rain shadow, so that less rainfall is received by the western land type which is dominated by sweeter grasses like *Themeda triandra* and soil with a higher pH than the eastern land type, where the grassland and soil are more acidic due to sandier texture and the higher rainfall.

Interestingly, no *S. plumosum* plants have been found in the western land type, in contrast to the severe encroachment in the eastern land type. This presence or absence can figuratively be cut with a knife as observed when the mountain range is crossed between the towns of Thaba Nchu and Tweespruit. This noticeable phenomenon is a clear illustration of the habitat preferences of this encroacher plant.

It can further be hypothesised that in areas where *S. plumosum* is presently found, it has always occurred on the higher mountains and only over years spread down the mountains to the lower-lying areas where it is found today. The seed was possibly spread by wind over long distances. So, the higher mountains in the *S. plumosum* encroached areas possibly carried an ancient fynbos component of which *S. plumosum* was one species. The genus *Seriphium* consists of 34 species with *Seriphium plumosum* known as the most aggressive grower and encroacher (Wild 1980). It first established on the southern cooler/more moist slopes and later spread to the valley with sandy/ acidic soil and high rainfall. With the ridges first occupied, its distribution snowballs further onto the plains. It is seldom found in the wet (vlei) areas where the clay content and fertility of the soil may be too high (Snyman and Le Roux 2009). Cultivated areas withdrawn from cash crops are also favourable encroacher areas.

In the past, scientific advance has been impeded by the uncritical acceptance of easy generalizations. This is well illustrated in the case of *Seriphium plumosum*

Another good example is Aasvoëlberg near Zastron where *S. plumosum* also possibly only occurred on the high mountain as part of the fynbos component historically. Presently the foot of the mountain is infested with the densest *S. plumosum* stands found to date. In the 1970s, the only *S. plumosum* encroachment in the whole district was observed around the south/western side of Aasvoëlberg on a low potential cultivated area, the first one withdrawn from cash crop cultivation. Those days all cultivated areas were planted with maize or wheat and not with pastures. This *S. plumosum* distribution on the disturbed area perhaps occurred from the mountain tops (western slopes of Aasvoëlberg) over years and therefore the first large seed source for further distribution to other areas.

It is perhaps not farfetched to assume that *S. plumosum* over the past few years has spread from the tops and slopes of many other high mountains to lower-lying areas leading to the present widespread encroacher problem, as is the case with Thaba Nchu and Aasvoëlberg.

The very light *S. plumosum* seed which can be taken high up in the air with dust storms, also has the ability to spread over vast distances to areas where it previously did not occur. The period that these small seeds can survive in the soil without losing viability, is presently being investigated in depth.

Distribution through stock feed and animals

The possibility must not be excluded that the distribution of *S. plumosum* could also have taken place by means of animals and stock feed. The following is speculation on how the plants seed could have reached Thaba Nchu mountain years ago, as an example.

In 1836/37, the Voortrekkers Retief, Trichardt, Potgieter and Cilliers spent many months on the southern slopes of Thaba Nchu mountain. They came from the sourveld of the Amatole and Winterberg mountains of the Eastern Cape province where *S. plumosum* occurred abundantly. The question is whether the wheels of their wagons were clean of *S. plumosum* seed before their departure and whether seed could possibly have been transported in the wool and hair of their animals. They could also have brought forage for their draft animals, containing *S. plumosum* seed. Perhaps when Retief left for Natal with his 1 000 wagons from Thaba Nchu he took some Chrysocoma over the border? There are certainly other such examples where earlier missionaries and other travellers exploring the land could have spread the *S. plumosum* seed.

Future problems

In experimental sites at Bloemfontein (530 mm rainfall, sandy/loamy soil with a pH of 5.8) where no *S. plumosum* plants have ever been found, *S. plumosum* seedlings were planted which established very well and are presently growing actively. It is not unreasonable to predict that this problem plant will continually encroach outside its present favourable habitat over the years ahead. When more favourable habitats are encroached on, it may even spread to the lower rainfall areas, as the successful artificial establishment in the Bloemfontein area shown. For example, the more arid land type to the west of the Thaba Nchu mountain range, where no *S. plumosum* is presently found, could perhaps be invaded over a number of years if *S. plumosum* encroachment is not actively controlled. It is expected that cultivated areas and disturbed areas will be the first to be encroached on. There is thus cause for concern that the more arid grassveld areas may not escape *S. plumosum* encroachment in the medium term.

Earlier research

In the past, scientific advance has been impeded by the uncritical acceptance of easy generalizations. This is well illustrated in the case of *S. plumosum* (Roux 1969). As with all deleterious changes, the spread of this perennial in rangeland was attributed by ecologists of the old school to the twin evils of burning and overgrazing. From 1933 on-

Table 1: Mortality of *Seriphium plumosum* after different times of burning

Month of annual burn	Mean % mortality of *S. plumosum*
June	3.73
July	2.31
October	7.87
November	85.30
December	82.81
January	52.32
Control (no burnt)	2.58

wards, researchers from the University of the Witwatersrand under the direction of Prof. John Phillips devoted much attention to the problem of *S. plumosum* encroachment. Nearly all the conclusions they reached were subsequently questioned by later workers, who were able to benefit from long-term experiments actually laid out by Phillips (1930), Gillman (1934) and Van Rensburg (1941) from 1932 to 1933. The first published report on the subject was made by Cohen (1935). He described the general characters of the plant, its root system and the germination of its seeds. He reported no success in attempts to eliminate it by burning. He attributed its spread to overgrazing. Reporting in 1936 on some of the seed tests carried out, Cohen (1935) made the interesting statement that "the influence of direct sunlight depressed germination of *S. plumosum*". This observation, confirmed by Lecatas (1962) many years later, might have led to the conclusion that overgrazing, which reduces the grass cover and therefore increases light intensity at ground level, would discourage the germination of the seeds. Viewed from this angle, overgrazing could not be a cause of *S. plumosum* encroachment, and would be more likely to have the opposite effect. Van Rensburg (1941) reported briefly on methods of destroying the plant by poisoning and mattocking. No further reports on *S. plumosum* occurred for the next thirteen years, but the comprehensive experiments laid out in 1937 began to produce interesting results, which were reported by Hatting (1953) and by Smit (1955). Hatting (1953) found little evidence that overgrazing is a direct cause of *S. plumosum* encroachment. Regarding burning at different seasons, Hatting (1953) found that burns during the winter months have little effect, but burns in the spring and summer prevent the establishment of *S. plumosum* seedlings and therefore the encroachment of the plant. A subsequent report by Smit (1955), who set out new seasonal-burn experiments, confirmed Hatting's findings. A full report on the *S. plumosum* experiment was made by

Krupko and Davidson (1961). Annual burning in August showed appreciable increases in *S. plumosum,* but nothing like that in the unburnt plots. This was not the end of the *S. plumosum* experiments, however. By 1953 it had become evident that burning was a possible method of controlling the seed. The reduction in the degree of re-infestation resulting from August burns was considered to be due to the distribution of young seedlings by fire. The conclusion drawn was that the mature plants could resist an August burn but eventually succumbed to old age. The average life-span of individual plants appeared to be about fifteen years.

A further *S. plumosum* experiment was laid out by Davidson in 1953, looking at the effect of regular burning at different times. Replicated plots were burnt every year in one of the following months: June, July, October, November, December and January. Ordinary burning in the summer months, November to January, was sometimes difficult, but was achieved by means of a flame-thrower. The results obtained after six years are summarized in Table 1.

The *S. plumosum* problem, as studied at Frankenwald the University of the Witwatersrand's Botanical Research Station over a period of thirty years, illustrates the tremendous value of long-term experiments on rangeland (Roux 1969).

Discussion

The above theorizing is offered only as a means of increasing the level of awareness of the seriousness of the *S. plumosum* problem. I prefer the first approach where the distribution of *S. plumosum* is assumed to have occurred on high mountains to the theory of its distribution by stock feed or animals. There may be many other opinions on the serious spread of this plant, especially over the last 10 years. It is hoped that when all these thoughts are combined, a solution to this problem can be found, hopefully in the near future.

The control of this invader is not being seriously addressed at present. Contributing to this is the widely diverging opinions regarding its control and eradication. It is currently impossible to single out a "best" method of *S. plumosum* control as various factors influence its practical application in different districts, for example topography, accessibility and negotiability of the terrain. The effectiveness of *S. plumosum* control is also determined by factors like time of year, clay content of the soil and density or stand of the shrubs. The control measures chosen must be economically, financially and ecologically justifiable. The danger is that after cleaning a farm from *S. plumosum* encroachment, it can take over again from seeds coming from the neighbouring farms. The following are a few short comments on its control.

Unfortunately, no biological control measures are currently known.

There are many opinions on mechanical control (chopping action), which is labour intensive and does not show lasting success. If the plant is not cut underneath the soil surface, it definitely regrows. A follow-up or post-treatment is also nec-

essary to control those seedlings emerging after the removal of the mother plant. As lots of seeds are further spread during the chopping-out process, the chopped shrubs must be removed and burnt or the problem can intensify.

No scientifically based fire control measures are known, except the work done in the 1950s. The wrong time of burning can also increase the problem.

Seriphium plumosum can be very successfully controlled chemically (granular formation or suspension) with agents even having a residual effect of a few years to control those seedlings which may emerge later on. This is naturally an expensive process to be addressed correctly.

It is very important to concentrate initially on those areas with sparse or moderate encroachment, to prevent further spreading, then to treat the denser stands later.

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Impact of the removal of black wattle (*Acacia mearnsii*) in the Tsomo Valley in Eastern Cape: Consequences on the water recharge and soil dynamics (an ongoing study)

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Black wattle (*Acacia mearnsii*) is a fast growing leguminous (nitrogen fixing) tree and it is often used as a commercial source of tannins and a source of fire wood for local communities (DWAF 1997). Riparian ecosystems are widely regarded as being highly prone to invasion by alien plants, especially *A. mearnsii*, largely because of their dynamic hydrology, nutrient levels, and ability to disperse propagules (Galatowitsch and Richardson 2004). Disturbing native vegetation also causes invasion as this often prepares a seed bed for invader species (DWAF 1997). Native fynbos tree species lack mycorrhyzal associates and therefore are less efficient at nutrient uptake (Smita 1998), leading to them being out-competed by the invasive tree species.

Acacia mearnsii is now considered to be a major invasive tree species in South Africa covering an estimated 2.5 million hectares of land and it is among the top ten invading species in South Africa (Galatowitsch and Richardson 2004). *Acacia mearnsii* ranks first in water use among invasive species, using 25% of the total amount, and is estimated to reduce mean annual runoff by 7% in South Africa (Dye and Jarmain 2004). The invasive ability of this species is partly due to its ability to produce large numbers of long-lived seeds (which may be triggered to germinate by fires) and the development of a large crown that shades other vegetation (Nyoka 2003).

Acacia mearnsii threatens native habitats by competing with indigenous vegetation, replacing grass communities; reducing native biodiversity and increasing water loss from the riparian zones (Nyoka 2003). Non-indigenous species, like *Acacia mearnsii*, with evapotranspiration rates higher than those of the native flora significantly alter hydrological regimes and lower water tables (Dye and Jarmain 2004). Soil under *A. mearnsii* becomes desiccated more quickly than it does un-

A natural well occurring near *Acacia* stands

der grass (Dye and Jarmain 2004).

The presence of other *Acacia* species of Australian origin in stream bank habitats throughout the subcontinent suggests that their ability to take advantage of more than adequate soil water at some season (and to survive the intervening drought) favors their proliferation (Bromilow 1995). These species often form dense stands, maintain a high green leaf area throughout the year, and replace seasonally dormant grasslands, permitting continuously high rates of total evaporation (Hess *et al*. 2006). *Acacia mearnsii* stands can displace native species by hybridisation and altering the behavior and abundance of native plant pollinators (Chornesky and Randall 2003).

The invasion of grassland by tree species is known to have some negative effects on the sustainability of the grassland globally but the effects of this encroachment on ground water and salt fluxes remains poorly understood (Jobbagy and Jackson 2004). *Acacia mearnsii* stabilises sediments by colonising deposits but its shallow root system is easily washed out during floods, releasing sediments and blocking bridge arches and storm drainage systems (Surridge 2006). Once *A. mearnsii* is established, it alters the ecosystem function through its high evapotranspiration rate and as such

Woody detritus near water path

affects soil microbial functioning (Galatowitsch and Richardson 2004).

Our ongoing research work aims at determining the effect of the removal of *A. mearnsii* on the recharge of natural wells. This is in order to quantify the potential loss and or gain of the scarce water resources that could accrue with the removal of the trees. Furthermore, we aimed at determining the effect of the *A. mearnsii* on the soil chemical and biological properties. This will help us to provide information on the effects of *A. mearnsii* control on the regrowth, regeneration and species structure of native grass species.

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