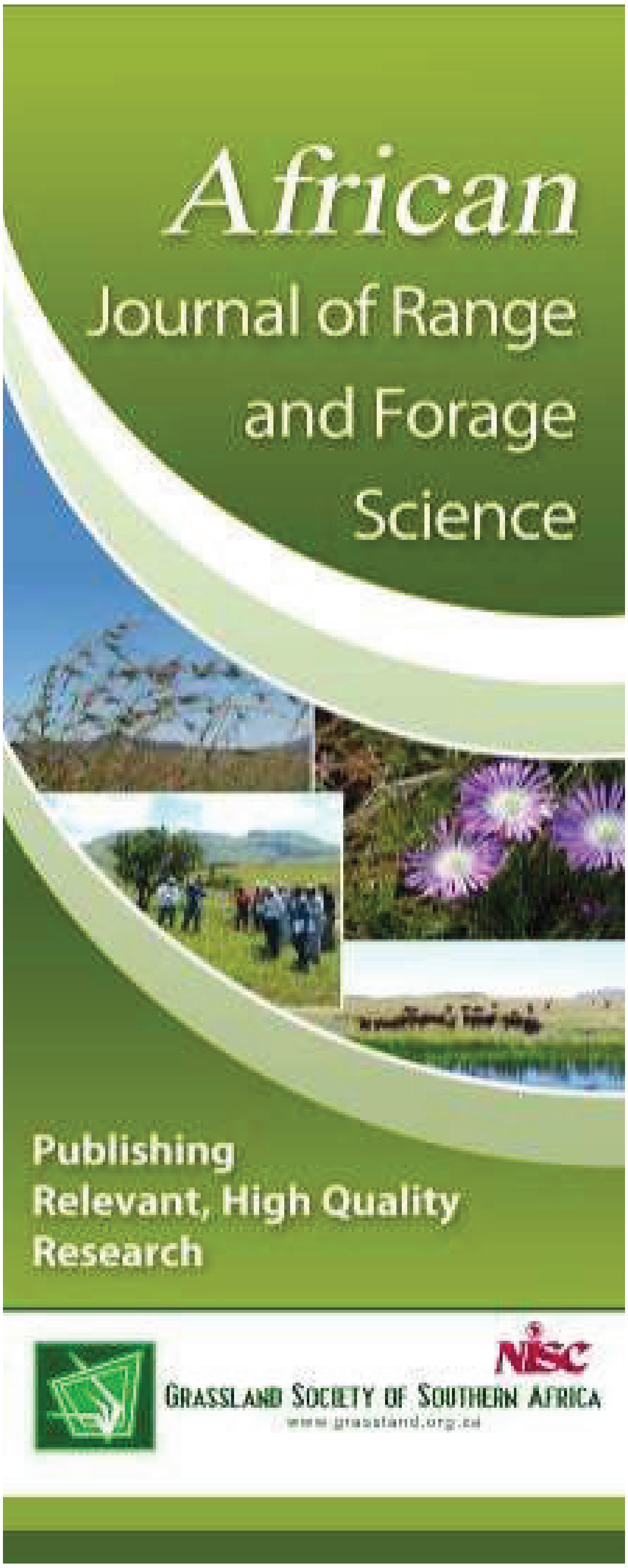


Grassroots

Newsletter of the Grassland Society of Southern Africa

Publication Editor: Pieter Swanepoel
pieters@elsenburg.com
Tel: +27 44 803 3726
Assistant Publication Editors:
Janet Taylor
Keletso Mopipi

Printed by: **LT Printers—Pietermaritzburg**

Published & Distributed By
The Grassland Society of Southern Africa

Website
www.grassland.org.za

Contents

Congress

On the Cover

Ryegrass image courtesy: Janke van der Colf (Western Cape Department of Agriculture)

Awards & Achievements

Regulars

News

Features

Journal News

Editor’s Note

Those of you who attended the 48th Congress of the GSSA will know that it was stimulating and exciting. In this issue you will find reports about the Congress including the very successful fire workshop, numerous special sessions, excursions and awards. The congress raised awareness among young scientists and for first-timers, Denisha Anand and Megan Simons, a very positive congress experience is reported on in this issue. Once again, congratulations to the organising committee of this year’s congress for making it a huge success yet again.

This issue also includes two feature articles. The one article gives practical information on the influence of planting date on the production potential of Italian and Westerwolds ryegrasses, and offers tips which could readily be applied in a farming situation. Likewise, the second article provides valuable information about management of medics in wheat-medic systems in the Swartland (Western Cape).

From now on, an exciting new addition can also be found in Grassroots, i.e. summaries of the latest accepted articles to the *African Journal of Range and Forage Science*. In this issue you will find three summaries which convey their core findings, describe the main discovery and show how the results fit into the bigger picture – in an easy-to-read, popular format. We believe that this may provide an opportunity to improve exposure of the article which might lead to more citations.

That is only a taste of this exciting issue of the Grassroots, the last issue for this year. As this year draws to an end, we wish you a happy festive season and a prosperous 2014. Happy reading!

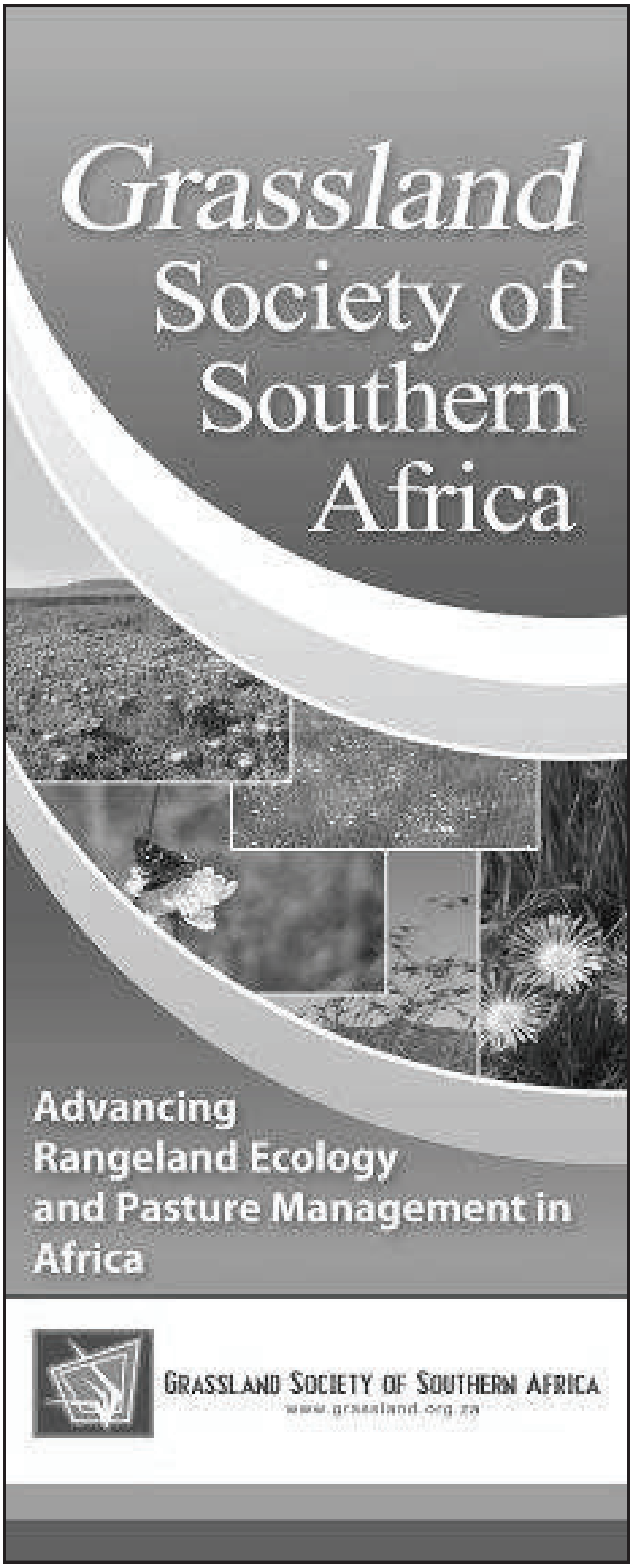
Pieter Swanepoel

Letter to the Editor

After receiving the latest copy of Grassroots (August issue Vol. 13 No. 3), I thought it might be worthwhile to express my opinion on the quality and content of Grassroots. The contents of Grassroots are fresh, to the point and relevant. I am impressed by the quality of Grassroots and commitment demonstrated by the Editor (Pieter Swanepoel) and his team of assistant Editors. It is their tireless contributions that enable us to continue moving towards our vision of being a leading source of knowledge regarding Grassland Science and related fields of expertise.

Pieter, thank you for you and your team's efforts and continue with the great work with Grassroots. Grassroots keeps us well informed and up to date with the latest news, opportunities and research in Grassland Science. It provides an excellent opportunity to reflect on all the great work of the individuals that make our Society so special. In general, we as a society could be very proud about our newsletter.

Hennie Snyman
University of the Free State
Animal and Wildlife and
Grassland Sciences
snymanha@ufs.ac.za



Report on the 48th GSSA Congress at Modimolle, Limpopo Province

Jorrie Jordaan & Chris Dannhauser
University of Limpopo
jorrie.jj@gmail.com & chriswei@vodamail.co.za

The 48th GSSA congress was held between the 15th and 20th July 2013. It was hosted in the Limpopo Province at the Weesgerus Holiday Resort, Caravan Park and Conference Centre in Modimolle. The resort is situated approximately 150 km north of Pretoria in the Waterberg Mountain Sourveld. The congress had five keynote addresses on various topics, three of which were presented by our invited Australian delegates, as well as 39 platform and 39 poster presentations. Research proposal posters were also displayed at the congress.

Monday the 15th July accommodated a fire workshop hosted by Working on Fire. More than 150 people attended, of which most were farmers. Besides interesting presentations (i.e. legal aspects, veld management before and after fire, the role of fire protection associations, etc.) by various specialists in their fields, the definite highlight was the practical illustrations of spiral and racecourse ignition by helicopter that were demonstrated in the adjacent game camp of the Koro Creek golf estate. One of the highlights on the Tuesday was the session on "Encroachment by woody species", which included several interesting presentations, including a presentation by Jock McMillan on practical veld management and bush control at the Mabula Private Game Reserve and a general summary on the driving forces behind the bush encroachment process by Nico Smit.

As a follow-up on this session, the Wednesday afternoon mid-congress tour to the Mabula Private Game Reserve proved valuable in terms of practical considerations relating to bush encroachment. The behavior of veld subjected to different bush control strategies was highlighted, as well as the reaction of *Hyperthelia dissoluta* on different slashing frequencies over time. In the session on the ecology and control of indigenous and exotic plant species, hosted on the Wednesday, the main focus was on the control of *Seriphium plumosum* (slangbos), a species which featured in the fire workshop demonstration as extremely invasive in the Waterberg and very volatile when burned. Similarly, the mid-congress tour to Andre de Leeuw, who controls *Seriphium plomusum* by slashing, organic fertilizing of veld and high pressure grazing/hoof action, emphasized the subtle underlying theme of the congress, namely the quest to effectively control this invader.

The tour to Wayne Knight's farm linked well to his presentation in the session "Habitats and habits of wildlife" on the Wednesday morning, where his thoughts on and results with holistic veld management were well illustrated. Delegates attending the tour to Jacques Malan's property experienced his spectacular methods of successfully breeding rare game species.

The highlight on Thursday was the special morning session on forage legumes, followed by an afternoon session which focussed on cultivated pastures. Some of the biggest constrains in the past with fodder legumes were mentioned: the lack of farming skills, South Africa being more veld then cultivated pasture orientated, the influence thereof on the limited, fragmented research capacity and the lack of institutional understanding of the importance of forage legumes in pasture-based livestock systems. Recent research in Southern Africa, in collaboration with Australian researchers, showed that there is potential for using the following fodder legumes. More recent and promising research is on track in SA and included various trials on lucerne, seradella and *Lespedeza*.

The nine presentations in the planted pasture section showed an active interest in planted pastures by young researchers. Species included in the presentations included drought tolerant species like *Anthephora, Digitaria, Chloris, Panicum, Pennisetum* as well as temperate species like *Lolium, Festuca*, *Dactylis* and *Festulolium*. In the Southern Cape the importance of healthy soil was illustrated again. The important role of the temperate species in fodder flow planning was also illustrated.

The role of tuber fodder crops, like *Brassica, Beta, Raphanus* and *Cichorium*, are often neglected in South Africa. However with production figures of 5.5 t/ha and higher, obtained from Forage turnip (Barkant), Fodder radish (Nooitgedacht), Chicory (Chico) and Kale (KR 6099) it cannot be ignored.

At the post-congress tour to Nylsvley, Mary Scholes took us back in time to an era of research of which the results, even today, have international impact. A session covering the historical research activities of one of the biggest botanical research projects in the South African history, covering almost 30 years, was followed by a visit to the sites where several of our well-known older colleagues started their careers. Ceremonial procedures on the Monday evening included an opening address by the Vice-councillor of the University of Limpopo, Prof. Mokgalong, the presidential address by Lorraine van den Berg and the keynote address by Koko Khumalo, an economist at Ernest and Young.

We had the privilege to have the MEC of the Limpopo Department of Agriculture, Mr. Jacob Marule, as the guest of honour and presenter of the awards at the Gala Dinner on the Thursday evening. This year, two awards were presented. The Peter Edwards award was presented to Jock McMillan (Mabula Private Game Reserve), with Wayne Knight the runner up. For the first time, the GSSA award for the best upcoming farmer was given to Rachel Mamonare Mathabathe, a local livestock farmer from Mookgopong. Other awards include:

Meritorious Award – Justin du Toit
Peter Edwards - Jock McMillan
Best Presentation - Izak Smit
Best Presentation by Young Scientist - Paul J Gordijn
Norman Rethman Planted Pastures – Janke van der Colf
Best Poster - Janke van der Colf
Best Research Proposal Poster - Megan B Simons

Overall, the congress was a success, both in terms of the presentations and the venue. A big positive was the number of young scientists that participated in this years' congress, especially in the sessions where research proposals were presented. In the interactive research proposal session, 16 research proposals were presented, indicating that the GSSA is growing stronger each year.

Justin du Toit Receives the GSSA's Meritorious Award for his Exceptional Contribution to the Society

Susi Vetter
Rhodes University
s.vetter@ru.ac.za

Susi Vetter honoured one of the Grassland Society of Southern Africa members who has made an exceptional contribution to the GSSA. Those who have been around for the last ten or more years will know how much the Society has grown and changed in the last years. The credit goes to several committed and dynamic Council members, including presidents, the organising committees of the Congresses which have gone from strength to strength, our superhuman administrator Freyni and her team, and the members who support the Society and the annual Congress. But among the members, she singled out one person in particular, who has devoted an inordinate amount of time and energy serving the GSSA and promoting it, and who can take a good chunk of the credit for the healthy state the GSSA is in today.

It all started in January 1998, when a cohort of students (among them Freyni and myself) first attended the GSSA Congress. Those who were at Cedara that year will remember it fondly. For the first-timers, it was a heady mix of exciting science, new friendships and all-night partying that had us hooked immediately. One student stood out in particular for his leadership skills, though at that stage they were largely focused on the social side of things, and included masterminding the dance-floor set-up consisting of Derick Swart's Audi reversed up to a patch of grass with the back open and the sound turned up. His John Travolta impersonation is now the stuff of legend.

Four years later, in 2002, Justin du Toit was recruited to the GSSA Council, fittingly as Public Relations Officer. He has served on Council ever since, and really blossomed in his portfolio as Honorary Treasurer, which he assumed in 2005, initially as acting Honorary Treasurer. It was his vision and leadership that helped bring the GSSA back from the brink of financial disaster and has assured that our financial situation has remained sound and healthy.

Justin joined the African Journal of Range & Forage Science as Assistant Editor in 2006 and has proven himself as one of the best and most dependable members of the team. He has done two 6-month stints as acting Editor-in-Chief while Susi was on sabbatical and maternity leave.

But what Susi really appreciated about Justin as Assistant Editor is that she could always get him to tackle the manuscripts she was too scared to assign to anyone else, knowing that he would tackle them with energy and good judgement – including manuscripts on esoteric topics like fuzzy logic modelling, epic review papers and any other material not for the faint-hearted. But Justin has gone beyond doing a great job in two challenging portfolios. He has also spearheaded and organised several successful symposia and workshops that have brought credit (and income) to the GSSA. More importantly perhaps, these events have contributed to research dissemination and capacity building, something the GSSA is committed to but which takes considerable commitment, vision and hard work to actually put into practice. Justin has convened three symposia on grasslands in SA, including on grasslands, timber and fire and on rehabilitating grasslands, all of which were well-attended and well-received. He also conceived and convened the very successful Research Skills Workshops, the fifth of which is planned for 2014.

It is safe to say that most of us intend to contribute to our discipline and the GSSA. But we all know how hard it can be as professionals with demanding jobs and busy lives to make the time to play an active role and keep it up over several years. Without Justin's efforts, the GSSA would be nowhere near as thriving as it is today. I hope that Justin will continue to play this role and that other young members will follow his example.

Justin du Toit received the GSSA's Meritorious Award for his exceptional contribution to our Society at the 48th Congress in Modimolle.

The Grassland Society of Southern Africa Congress The Experience of a First-timer

Denisha Anand
University of the Western Cape
denishaanand@gmail.com

As an inexperienced first timer, the prospect of attending the GSSA congress and showcasing my poster was honestly quite daunting at first but after spending the week from 15-19 July 2013 at the congress in Modimolle with the society and other delegates, I had a totally different outlook on the whole event. The congress was the perfect platform for me as a young researcher to network, socialise with like-minded people and expand my body of knowledge where rangeland ecology was concerned.

The congress has undoubtedly facilitated my choice in pursuing a career in this field and has opened doors to so many opportunities that would not have been possible without the exposure endorsed by the GSSA. The keynote, platform as well as poster presentations were all informative and helped me gain insight into current problems that our country is facing in terms of rangeland resources and the sustainable use thereof. Since then I've been sifting through my notes trying to apply what I've learnt to my current honours project and can sincerely say that my concern and passion towards the area I'm working in has grown. The tools I've been equipped with through attendance have sparked even more enthusiasm in me as a junior researcher and I look forward to working with Dr Igshaan Samuels as we try to extend my honours project into a possible masters research thesis. I took a keen interest in the work presented by Dr Susi Vetter on the Richtersveld as well as the presentation delivered by Devan McGranahan on fire regimes. Susi Vetter's work in particular has urged me to gain a better understanding about what exactly is happening behind the scenes in my study area and how this may be influencing the face value image we have of the rangeland. I hope that through my research in the future I will be able to give back to the communities that I'll be working with and help them to improve their understanding and use of their rangeland.

To conclude, I take my hat off to the GSSA for sponsoring young South Africans like myself and providing me with the opportunity to engage in a culturally diverse venture like this one. This congress will eventually pave the way for a generation that not only wants to conserve and protect what we've been blessed with as country, but also showcase what young South Africans have to offer the world in terms of sustainable rangeland use and production. GSSA definitely ROCKS!

My First GSSA Congress

Megan Simons
University of the Western Cape
meganbrigettesimons@gmail.com

When I think about my first GSSA congress, I have a stream of flashbacks of all the wonderful experiences I had. I never thought the experience would be so enlightening and pleasant at the same time. I still cannot stop talking about all the people I met and all the activities we did. The fire course, which was on the Monday, was so educational. When Professor Winston Trollope presented I had no idea who he was. My supervisor informed me that he was the "father of fire", and after reading about him I now realized that I was in the presence of a legend.

I never thought that so much planning went into burning a veld. I always thought that one just lit a match, threw it in the veld and hoped for the best. That was one of the highlights of my week. I thoroughly enjoyed the fire management course and would attend again. I learned so much. The highlight of the fire course was the field demonstration. I was so excited and once we got to the field I could not wait for the demonstration to begin. In a matter of seconds, once the helicopter arrived, the veld was burning and even though we were warned about the heat being extreme, I thought the demonstrator was trying to scare us. To my surprise it felt as though I was next to the sun! It was really an "out of body" experience. I had the shivers, and could not wait to tell everyone about it. Even when my friend (Denisha Anand) and I assisted with some of the administrative work, we enjoyed it. We also met an extremely adorable five year old, Max Du Toit, whom we still talk about today. We really had an enjoyable and memorable GSSA congress. Another highlight would be our mid-congress tour to the Jacques Malan Game Farm. It definitely gave me a new perspective on game farming and a taste of the farm life. The Safari drive was by far the best, as it was my first and I literally do not have the words to explain how much I enjoyed the experience.

Thursday during our poster session, I felt extremely intimidated by all the academics when I had to present my poster, as they are all experts in their field. I remember the nerves kicking in once I presented to the first person, at my station, I was a complete mess but after apologizing he allowed me to start again. And after that I could not stop talking about my poster. If I saw someone staring at it for less than five seconds, I roped them in and explained my poster to them. I gained so much from doing that session that I would gladly do it all over again. The Gala dinner ended the week on a very pleasant note; it was by far the best night of the week.

My first GSSA congress was a mind blowing experience, something that I would never have expected. I learned so much, met many different people, and GSSA has been one of my "2013 highlights". This has been my first, but certainly not my last GSSA.

Grootfontein College of Agriculture Student Award

Minette van Lingen
Grootfontein College of Agriculture
MinetteVL@daff.gov.za

A GSSA trophy, together with a certificate, is awarded to a deserving third year student at Grootfontein Agricultural College. This award is made to a final year student who achieved the highest marks for rangeland, pasture and environmental management modules, with an average of at least 70% for all modules.

In 2012 this prestigious award was presented to Suné Mentz during the diploma ceremony at Grootfontein. Suné was also the third year dux student and excelled in all other fields within the diploma programme. She is currently working at Oos Vrystaat Kaap Operations Limited (OVK) in the Burgersdorp central region as an assistant branch inspector.

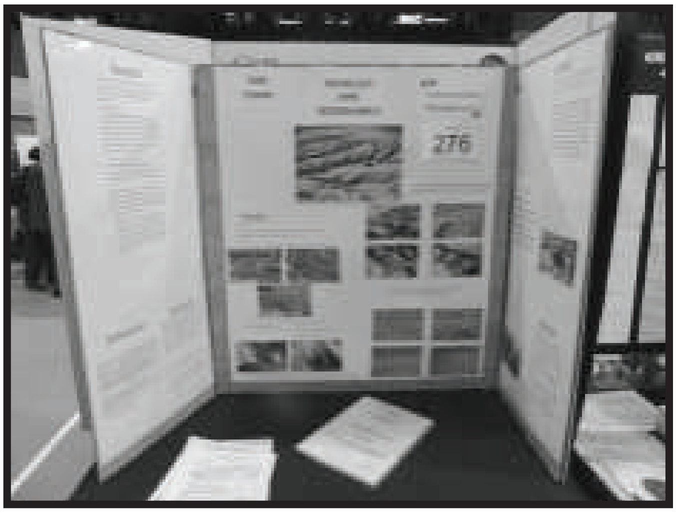
Mrs Rhoda McMaster handing the GSSA trophy to Suné Mentz

Eskom EXPO for Young Scientists Bloemfontein

Dr BB Janecke & Prof HA Snyman
University of the Free State
snymanha@ufs.ac.za, janeckbb@ufs.ac.za

The Eskom Expo for Young Scientists is an annual science fair at the Callie Human Centre of the University of the Free State. This year it took place from 15 – 17 August 2013 and also celebrated its 30th year of existence in Bloemfontein! Learners from schools all over the region exhibited their scientific investigations and mini research projects at the Expo. The learners could discuss their work with judges, other learners and the public. There were 25 different categories that learners could enter into, like Agricultural Sciences, Environmental Sciences, Plant Sciences, Physics, and Chemistry – to name but a few.

Projects with an ecological theme that dealt with a grassland science issue were judged by Dr Beanélri Janecke and prof Hennie Snyman on behalf of the GSSA. The GSSA Award for the Best Ecological Project was awarded to Louis Frewen, a grade 11 learner from Middelburg High School in theEastern Cape. The title of his project was: Bailing out bare patches. The aim was to reclaim bare patches by using bales of grass, which would otherwise have been burnt, in order to establish plant growth and stop erosion. Grass (mostly *Eragrostisplana, Bromuscatharticus, Hordeummurinum*) that sprouted in the lucerne land on their Karoo farm was cut and baled after flooding conditions made the lucerne land unusable. Erosion dongas were then covered with these bales. It resulted in seed coming from the bales germinating and the established grass plants prevented further soil erosion. Bales of other more palatable grass species were also used, but were devoured by cattle and thus became less effective. The project ran for just over two years. Insightful photographs indicated the results before the bales were used, where the bales were put and after the grass plants had established.



Louis Frewen's science project entitled: *"Bailing out bare patches"*

Eskom EXPO for Young Scientists Mahikeng

Anuschka Barac
North West Department Economic Development, Environment, Conservation and Tourism
abarac@nwpg.gov.za

NAME: Ms.KamogeloMafete
SCHOOL: Sol Plaatje Secondary School, Mahikeng
GRADE: 8
CONTACT no: 072 642 1201
PROJECT NAME: Desertification
POSTAL ADDRESS: 1273 Ramushutawanastreet, Montshioa, 2735, Mmabatho (NW Province)

The scholar had a very clear understanding concerning desertification and she showed a remarkable interest in environmental/ ecological matters, especially the ones in and around the community that she lives in. Apparently the students were initially (at school-level) offered the opportunity to choose between a number of different subjects/ themes to do their projects on.

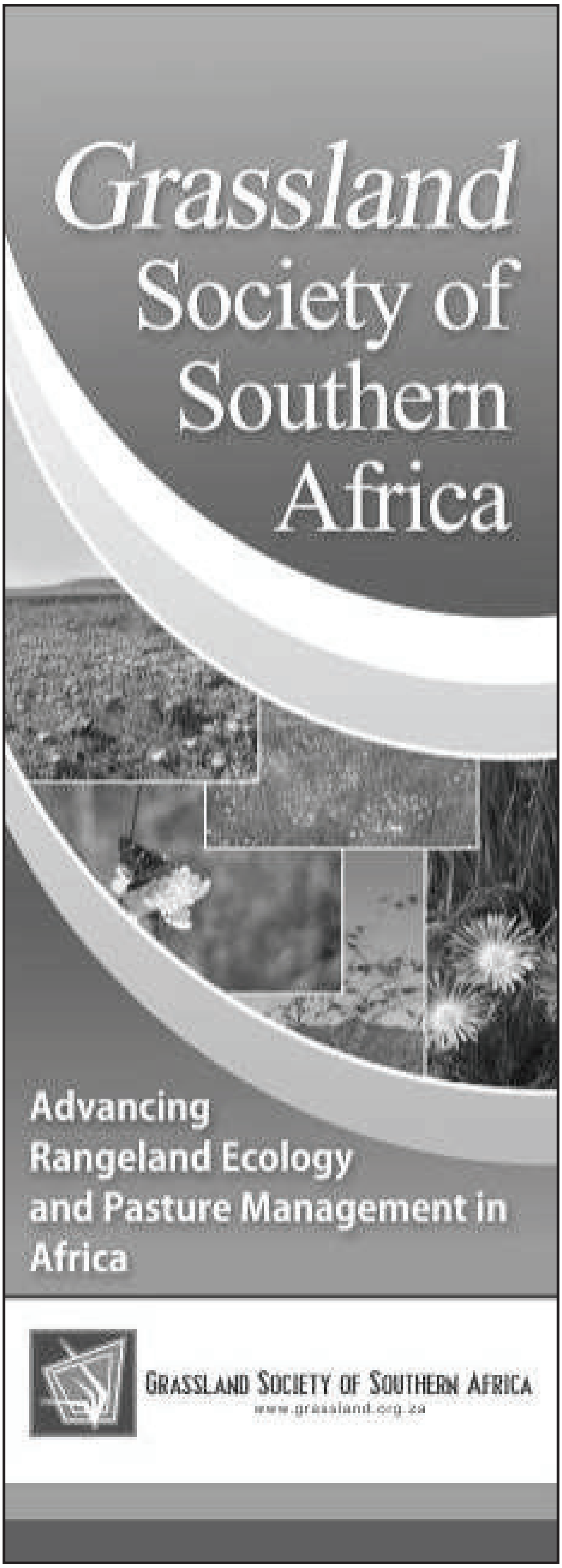
She was however not interested in also doing a project on electricity / energy sources etc related to environmental aspects, as were the rest of the pupils of her age-group. Instead she decided to do some research on the internet in order to determine a matter / problem considered to be of great concern in the ecological field of science.

Her search brought her to the decision to carry out a detailed desktop-study on the concept of desertification as seen from an international point of view, as well as from an African, a southern African (regional) and South African and more to the point a local (district or municipal) point of view (in and around her hometown of Mahikeng).

The scholar has studied the causes of desertification as well as proposed solutions for controlling or restoring desertified rangelands in and around her community. She clearly distinguished the layout of her study between causes, problems experienced, conclusions and made notice of several sources that served as references for this study. I however felt that she could have tried to obtain more scientifically based references to be used in her project as well, together with her more general references regarding this matter. On the other hand, I suppose it might not have been easy for a Grade 8 pupil to have access to such scientific publications either via the school library or the internet.

To gain access to scientific journals one usually has to be a registered student with a tertiary educational institution and thus would need passwords to access such publications and official requests would have to be made through inter-library requisitions and order-processes to obtain some of these publications.

Thus in hindsight I suppose that the references she provided regarding research done on this topic, is sufficient for a project at this level (Grade.8) As mentioned, she does have a good understanding of the matter at hand and seemed to be very excited and positive about the choice of project that she has made. The pupil mentioned that after finishing school she would like to focus her studies on an environmental (more ecological it seems to me) career. So watch out GSSA members!!! We might be seeing more of Kamogelo Mafete in future! May she strive to also become a grassland scientist like all of us as GSSA members!!



33rd Eskom Expo for Young Scientists International Science Fair: GSSA Award for Best Ecological Project

Kedibone Chueu & Hulisani Muswibi
Directorate: Animal Production, Department of Agriculture, Forestry & Fisheries. Pretoria.
KediboneC@daff.gov.za

The 33rd Eskom Expo for Young Scientists International Science Fair (Eskom Expo ISF), formerly known as Eskom Expo for Young Scientists National Finals, was held from the 26 to 28 September 2013 at the Birchwood Hotel and Conference Centre in Boksburg, Gauteng Province. Eskom Expo ISF, which is hosted annually by Eskom in partnership with the Department of Science and Technology, currently represents the largest school-level science event that provides a platform for primary and high school learners to showcase projects within the fields of science, technology, engineering, maths and innovation (STEMI).These projects are judged/ assessed according to internationally accepted ethics and standards.

Once again, the GSSA Award for Best Ecological Project was one of the many organisation-specific awards that formed part of the special awards category at the expo. The GSSA was represented by two judges who adjudicated for this award according to the following criteria:

- The project must deal with a grass land science issue (rangelands/ pastures, rehabilitation, alien and invasive species, game surveys, animal production, etc.)
- The students must exhibit a clear understanding of the problem
- The project must have a sound scientific approach
- Presentation must be good

After viewing various projects that satisfied the above mentioned criteria and listening to learners as they speak enthusiastically about these projects, the judges selected Theo Pretorius and Shannen de Coning as winners of the GSSA Award. These two learners will each receive a prize that consits of a GSSA certificate and medal which will be send to their respective schools before the end of the year.

1. Theo Pretorius: a Grade 7 learner from Menlopark Laerskool in Pretoria East, Gauteng Province
Project Tittle: Thaba Moriri: Game Grazing Patterns
Project Summary: Mr Pretorius' project was aimed at assessing and identifying the various human activities at Thaba Moriri Game Farm in order to identify which activity had the largest influence on grazing patterns of animals on since the establishment of 30 houses on the farm in 2005. Following a methodology that involved processing of interviews and questionnaires from the original landowner (white game farmer) and current occupants, critical factors of change were identified and the largest contributing factors were made.

2. Shannen de Coning: a Grade 10 learner from Stirling High School in Stutterheim, Eastern Cape Province
Project Tittle: Biological Nitrogen-Fixing with Trifolium, Key to nutrious forage and soil fertility
Project Summary: Following the success of a previous project that Ms. de Coning conducted in order to demostrate that establishing grasses and legumes together on a sourveld produces good forage without the need of fertilizers or ploughing in Stutterheim, she was motivated by these results to udertake another project in order to investigate if legumes (*Trifolium* spp) provide nutritious forage as well as improve soil fertility, and to compare if inoculated legumes which are not grazed by cattle perform better that non-inoculated legumes which were is grazed and also compare the results with the natural sourveld. Following a methodology that involved nutritional analysis of forage samples, soil testing and coast analysis, Ms. de Coning concluded that both the inoculated and non-inoculated legumes trials performed better than the natural sourveld. However, the non-inoculated Trifolium performed slightly better and could be regarded as a better option due to the fact that the manure from the grazing cattle is important for improving soil fertility.


Expo for Young Scientists
Northern Gauteng - 2013


Expo for Young Scientists
Northern Gauteng - 2013

Two Young Scientists Invited to the International Grassland Congress in Sydney

Annelene Swanepoel
Western Cape Department of Agriculture
annelenes@elsenburg.com

Pieter Swanepoel and Janke van der Colf, scientists with the Directorate of Plant Sciences at the Western Cape Department of Agriculture, were both invited to the International Grassland Congress in Sydney, Australia, in September 2013 to deliver paper presentations.

Janke started working at the Outeniqua Research Farm near George in 2007 and Pieter followed in 2009. They worked as MSc students under mentorship of Dr. Philip Botha, Specialist Scientist: Pasture Systems, with financial support from the Western Cape Agricultural Research Trust. Pieter's MSc study focussed on the impact of soil organic matter on *Rhizobium* bacterial populations in soil and nitrogen fixation by white clover. Janke passed her MSc study on the production potential of kikuyu over-sown with ryegrass, *cum laude*. At the Grassland Society of Southern Africa (GSSA) Congress in 2009, Janke received the second place for the young scientist award in Johannesburg

Pieter and Janke were appointed by the Department in 2011 as Candidate Scientists, and immediately started further research towards their PhD studies. For his PhD research proposal on soil quality of pastures in the Southern Cape, Pieter received the award for the best research proposal at the 46th GSSA Congress.

The first data from this project was presented as a paper at the 47th GSSA Congress in 2012, for which he also received the award for best paper by a young scientist. At the same congress, Janke received the the second place for the Norman Rethman award for planted pastures. At the 48th congress in Modimolle, Janke van der Colf received two awards, one for the best poster presentation and the other was the Norman Rethman Planted Pastures Award.

Both Pieter and Janke were invited to the International Grassland Congress in Sydney, Australia in September 2013 based on the importance of their research. This invitation to the two young scientists shows that both the importance and relevance of the pasture research programme at Outeniqua Research Farm is recognized by an international scientific society.

Melissa Whitecross Awarded the GSSA Award for Outstanding Academic Achievement in Range and Forage Science

Melissa Whitecross
University of the Witwatersrand
mwhitecross@gmail.com

I am currently a Masters student at the University of the Witwatersrand, Johannesburg (WITS). In May 2013 I was honoured to receive an award from the GSSA for Outstanding Academic Achievement in Range and Forage Science.

The award was given to me for my published work on the impacts of a freeze event in the Venetia-Limpopo Nature Reserve, Limpopo Province, South Africa. Frost has been suggested as a driver of savanna systems in southern Africa. However, little work has been extensively researched in this field. We investigated how a severe freeze event in the winter of 2010 damaged a stand of *Colophospermum mopane* (Mopane tree) and how the damaged trees recovered over the following growing season. This work forms part of a broader study looking into the limiting factors of *C. mopane*'s southern distribution boundary. This study formed part of my Honours degree at WITS and I am currently co-supervising further work on frost events and *C. mopane* in Limpopo Province. My Masters research has taken a slightly different course and is focused mainly on plant physiology and phenology in savannas.

I am investigating what benefits early-leafing savanna trees can gain over their facultative-leafing competitors. Early-leafers are species which flush out their leaves ahead of the start of seasonal rainfall, whilst facultative-leafers will only flush once the rains have begun. We are comparing nitrogen usage, photosynthesis and herbivory rates between these two life history strategies to determine whether the riskier early-leafing strategy has clear benefits over the other. This work is still in its early stages but we hope to publish what we find in the near future.

Plugged and Pumping!

Sue Janse van Rensburg
SAEON Grasslands-Forests-Wetlands Node
sue@saeon.ac.za

One of the biggest challenges facing climate change scientists today is the ability to downscale global circulation models to regional scales. The "envelope of uncertainty" in model products is just too great to meaningfully inform decision makers for local scenario planning. The need for in situ data - particularly in underrepresented areas - used to develop, train and test models has been highlighted as a critical need to reduce these levels of uncertainty in downscaling1.

Understanding global change impacts on South Africa's critical water resources is a unifying theme among SAEON nodes. The value of building on historic experimental catchment stream-flow and weather data for current global change challenges, such as those outlined above, has been highlighted in several SAEON eNews articles.

Following the successful refurbishment of a number of the Jonkershoek experimental catchments by SAEON's Fynbos Node, the SAEON upper catchment stream-flow and weather monitoring programme was extended to Cathedral Peak (in the uKhahlamba Drakensberg Park World Heritage Site) by the SAEON Grasslands Forests Wetlands (GFW) Node.

Looking backwards to help us move forwards

By May 2012, landslides blocking the Mike's Pass access route had been cleared, the four focus weirs had been cleaned and the process towards resurrecting the historic instrument array had been initiated.

SAEON GFW Node staff members and lecturers, Dr Michele Warburton and Mark Horan from the University of KwaZulu-Natal (UKZN), decided it would be worthwhile to hold a "tacit knowledge transfer meeting", bringing together those who had worked in the catchments over the last few decades with those more naive to the responsibilities that lay ahead in continuing the legacy. The idea was to tap into unwritten lessons, the history and the anecdotal stories that are the stuff of legends.

Drawing on the summed experience of those who attended, we also took the opportunity to consider how to make the most of the long-term monitoring programme that had been initiated all those years ago in the 1930s. The meeting provided a clear context and direction for the programme, but also acted as a strong catalyst for stakeholder interest. Subsequent support and value-adding research collaborations were the net positive result.

Deploying the instruments

Armed with a plan of action, August 2012 saw the historic Mike's Pass weather station site resurrected with a new automatic weather station (AWS). This station collects detailed data on various meteorological parameters. It is one of very few stations at this "mid" altitude (1890m) in what constitutes the most important water catchment in the country.

An additional weather station has been placed at the base of Mike's Pass (1364m). Funding for a third full AWS for a high-altitude site (approx. 3000m) has been secured, with deployment planned for September 2013. High-altitude precipitation dynamics in the Drakensberg catchments, like in Jonkershoek are poorly understood. Even less understood are the potential impacts of climate change on this high-altitude dynamic and the consequential hydrological responses that may ensue. A milestone in May 2013 was the completion of the weir refurbishments and the installation of pressure level transducers controlled by data loggers that monitor stream flow in the four weirs selected for continued monitoring. The loggers have had their first check and are working well.

Next on the cards is the installation of 15 rain gauges that replicate the historic array of gauges that complement the stream-flow data, an additional three-wind stations and a series of soil moisture and temperature probes across the catchments.

Students as beneficiaries

The weather data being generated from Mike's Pass is already being used by University of KwaZulu Natal hydrology honours students for "real time" hydrology monitoring training. This is the second year of honours students benefiting from the Cathedral Peak living laboratory. To bring the data alive, the 2013 class was recently taken into the catchments for hands-on training and was tasked to "GPS" the catchment boundaries and previous rain gauge sites.

The resurrection of the weather station and the stream-flow monitoring are also stimulating postgraduate interest and already enabling several projects. Luke Bodmann from UKZN, supervised by Dr Warburton, Prof. Trevor Hill and Dr Jemma Finch recently registered his Masters project with SAEON. The project is titled "Detection and Attribution of Change of Afromontane Archipelago: Cathedral Peak, South Africa". Luke will be using historic and current stream flow, weather and fire data, combined with sedimentary records (fossil pollen-vegetation, micro-fossil charcoal-fire) to detect global change patterns. This is an interdisciplinary project bringing the palaeo, hydrological and meteorological sciences together by comparing long-term palaeo environmental data with short-term instrumental datasets.

As the subject of her Honours research last year, Ntombi Ngoloyi was able to reconstruct a recent fire history by analysing sediments accumulated within catchment sediment traps before they were cleaned.

Tristan Duthie, working with Prof. Trevor Hill, has also registered her MSc project with SAEON. The project focuses on "modern pollen dispersal and deposition rates of vegetation communities of the Cathedral Peak area, KwaZulu-Natal Drakensberg". Feroza Morrise, supervised by Dr Warburton, Dr Hartley Bulcock and Alistair Clulow, has also just started her MSc and is tackling the central question of regional rainfall patterns in the Drakensberg.

Value of collaborations

The SAEON GFW Node has secured significant resources through the National Research Foundation's Strategic Research Infrastructure Grant (SRIG) to replicate the historic instrument array with modern sensors as well as add additional, much needed, sophisticated observation instruments to address critical data needs for global change science.

The strength of a programme like this depends, in many respects, on the level to which stakeholders and scientists engage with the programme to make the best use of the data platform provided by SAEON, as well as to what level they co-support and add value to the platform.

UKZN has signed a participation agreement with SAEON to facilitate collaborations within the Cathedral Peak catchments. In particular, the GFW Node has developed close ties with the Centre for Water Resources Research (CWRR), School of Agricultural, Earth and Environmental Sciences who have historic links to the catchments.

Following from this, a joint proposal between UKZN, SAEON and Ezemvelo KZN Wildlife (EKZNW), spearheaded by the UKZN team, was submitted to the Water Research Commission. The successful application - entitled "Establishment of a more robust observation network to improve understanding of global change in the sensitive and critical water supply area of the Drakensberg" - is enabling a valuable scientific injection into the programme, additional research-related equipment as well as much needed support for students. It symbolises a strong unison between SAEON and UKZN in striving to attain the full monitoring and research potential that these catchments have to offer.

Collective efforts mean these catchments will provide significant monitoring and research data to enable sophisticated research analysis and modelling pertinent to addressing global change questions. None of this would be possible without the continued support from land custodians EKZNW. They provide support both from a strategic level as well as operational ground-based support. On that note we are pleased to announce that SAEON has just renewed its hosting agreement with EKZNW.

A platform for integrated, multi-disciplinary global change science

An important output from the Tacit Knowledge Transfer workshop was the realisation of the wealth of data from catchment 6 collected by Colin and Terry Everson on water and energy balance (see WRC report no 493/1/98).

Some source of uncertainty in climate models is the lack of detailed water-carbon-energy balance data from different systems. Subcomponents of these include precipitation, evapotranspiration, subsurface flow, stream flow, ground water and radiation balance and primary production.

As we walked down the hill contemplating if there had been an expansion of C_3 *Festuca* grass in the area, Prof. Colin Everson turned to me and said, "You know what would be ideal? A full eddy covariance system in catchment 6!" Of course yes. Thanks again to the SRIG NRF grant which has procured an extended eddy covariance system, which is an instrument that measures a number of these key variables, including gross primary production. It is currently being deployed under Colin's close supervision.

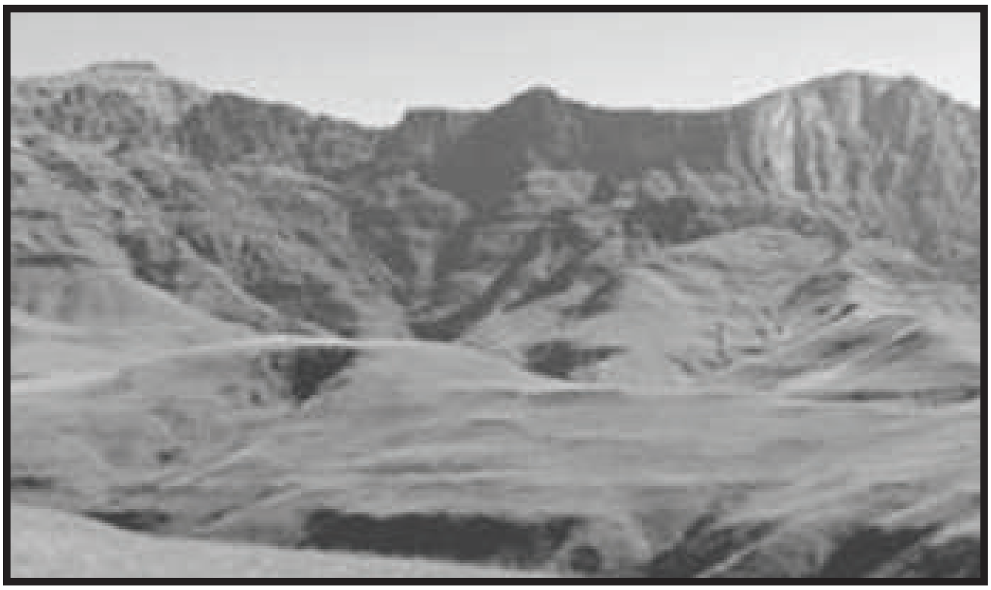
SAEON is fortunate to have Prof. Everson as a current collaborator. Tantalised by the revitalisation of the catchments and the promise they hold, he has returned to his old stomping ground of 18 years, to build on the work he initiated in the 1970s when running catchment monitoring programmes. The only difference now is that the "toys" he likes to measure things with are a little more sophisticated, with a bigger range of what can be measured, and come at slightly more extravagant price tags.

While SAEON is providing the long-term monitoring array including the eddy covariance system, Colin and his team from Commercial Waste Reduction and Recycling and the University of Pretoria are expanding on this with some exciting new research-related equipment fairly novel to South Africa, but more about that in the next update on Cathedral Peak.

Interdisciplinary integration of data and model inputs and outputs looking at land management, vegetation response and soil, water and energy dynamics has also emerged as a possible means to improve downscaling. A major challenge is that not all disciplines are often studied to the appropriate scale at the same site to enable this. The work SAEON is planning and implementing in the Cathedral Peak research catchments is designed to address exactly this challenge.

In addition to the projects already mentioned, we are also initiating soil and carbon work through various linked collaborations, as well as the resampling of historic vegetation plots with Dr Terry Everson to assess long-term vegetation response. The node's ultimate aim is to provide the means, through data provision, for experts to integrate data across disciplines, reduce the envelope of uncertainty in regional predictions and enable more confident, informed decisions for society toward climate adaptation and mitigation.

Interested potential collaborators are welcome to contact Sue van Rensburg for further information. 1 Proceedings of SANCIAHS 2012, and DST-NRF Global Change Conference 2012



The SAEON stream-flow and weather monitoring programme has been extended to Cathedral Peak in the uKhahlamba Drakensberg Park World Heritage Site, the most important water catchment in the country. (Picture: Alex Briggs)

Experts from UKZN, Alistair Clulow and Cobus Botha, assist Sue van Rensburg of SAEON's Grasslands Forests Wetlands Node and Abri de Buys, who joined the team from SAEON's Fynbos Node to "set up" the new automatic weather stations, transferring skills and techniques in the process. (Picture: Sue van Rensburg)

DST-NRF Intern Monique Nunes has her first taste of field work in the Drakensberg, working with GFW Field Technician Matthew Becker to prepare the weirs. (Photo: Alex Briggs)

A very happy team after all four weirs were full and logging data. (Picture: Sue van Rensburg)

Prof. Roland Schulze (right) and Prof. Colin Everson contemplate opportunities moving forward. (Picture: Dr Michele Warburton)

The scientists who shared experiences and knowledge at the tacit knowledge transfer meeting. From left: Ian Rushworth, Prof. Roland Schulze, Prof. Graham Jewitt, Dr Michele Warburton, Prof. Tim O'Connor, Dr Ed Granger, Dr Terry Everson and Prof. Colin Everson.

Developing Sustainability Indicators for two Western Cape Biosphere Reserves

Colin Tucker

Declines in natural capital, such as the degradation of ecosystems and loss of species, are the result of threats created by anthropogenic activities.

The concept of sustainable development encompasses the economic and social growth of societies, with limited impacts on the natural environment. Sustainable development initiatives are being implemented in an attempt to mitigate the decline in natural capital.

Biosphere reserves, which are designated by the United Nations Educational, Scientific and Cultural Organisation's (UNESCO) Man and the Biosphere Programme, aim to be landscape-scale examples of sustainable development.

UNESCO requires biosphere reserves to submit a periodic review every ten years to ensure they are meeting their goals. This requires that they monitor and evaluate their progress towards their sustainable development goals. Sustainability indicators are tools used to assess progress towards ecological, social and economic goals, and can thus be useful tools for biosphere reserves to ensure they are achieving their goals.

Action Research

This research project applied an action research approach. The research objectives were achieved through collaboration with biosphere reserve stakeholders. The first objective was to develop sustainability indicator sets for the Kogelberg and Cape West Coast biosphere reserves, both located in the Cape Floristic Region in the Western Cape. The second objective was to formulate a national protocol for the development of sustainability indicators for South African biosphere reserves.

The first stages of this research involved investigating monitoring and evaluation in biosphere reserves through a systematic review of the peer-reviewed and grey literature, interviews with management representatives of South African biosphere reserves and a web-based questionnaire survey of the World Network of Biosphere Reserves. Sustainability indicators for each biosphere reserve were developed through a collaborative process involving workshops with local stakeholders and focus groups with specialists.

The global review of the peer-reviewed and grey literature revealed that monitoring and evaluation studies in biosphere reserves are mostly conducted in the developing world by authors from the developed world, and many of the studies and indicators that were developed focused on ecological dimensions. These results show that biosphere reserves need to enhance their local capacity for the development and implementation of improved monitoring and evaluation methods and frameworks.

The outcomes of the interviews with representatives of the management of South African biosphere reserves and a survey of the World Network of Biosphere Reserves found that many biosphere reserves identified in this survey are reportedly implementing monitoring and evaluation, but few have developed sustainability indicators. It was found that there are many similar challenges with regards to monitoring and evaluation in biosphere reserves, most notably the lack of capacity and funding.

Collaboration

The collaborative process used to develop sustainability indicators for the Kogelberg and Cape West Coast biosphere reserves proved to be useful and produced the desired outcomes. The local stakeholder workshops produced large sustainability indicator sets, with many indicators that were not measurable, but most were relevant to the biosphere reserves. The specialist focus groups produced more focused and feasible indicator sets.

The local stakeholder and specialist indicator sets were integrated to produce a final set for each biosphere reserve that was relevant to the social-ecological systems of the biosphere reserves, with indicators that could feasibly be implemented.

The lists below contain the goals identified for each biosphere reserve and an example of an indicator from the final set under each goal.

Cape West Coast Biosphere Reserve
Goal 1: Conservation
Indicator: Hectares of alien invasive vegetation

Goal 2: Sustainable development and planning
Indicator: Number of development applications commented on by biosphere reserve committee members

Goal 3: Stakeholder support
Indicator: Increase in the number of hits on the biosphere reserve website

Goal 4: Research and monitoring
Indicator: Increase in number of research publications conducted in the biosphere reserve

Goal 5: Education/capacity
Indicator: A sufficient portion of the budget is allocated for environmental education

Goal 6: Operational/institutional governance

Kogelberg Biosphere Reserve

Goal 1: Increased land for conservation
Indicator: Hectares of priority vegetation types under stewardship contracts and agreements

Goal 2: External leverage for generating conservation funds (externally viable)
Indicator: Three years guaranteed funding for the funding of a co-ordinator

Goal 3: Increasing numbers of projects creating jobs
Indicator: Increase or maintenance of skilled staff working for the Kogelberg Biosphere Reserve Company

Goal 4: Increased community awareness
Indicator: Increase in the number of items in the media

Goal 5: Water quantity and quality
Indicator: Quantity of water at key sites is sufficient to meet the ecological and basic human needs reserve

National Protocol

The national protocol was developed through a synthesis of the results and lessons learnt in the previous stages of the research. This national protocol was designed to be flexible enough to be adapted to the local circumstances and needs of individual South African biosphere reserves. This document will be presented to the National Man and the Biosphere Committee as a guide to the development of sustainability indicators in existing and future biosphere reserves.
The action research approach applied in this study delivered a pragmatic set of sustainability indicators that can be implemented by both biosphere reserves. The National Department of Environmental Affairs, and the Kogelberg and Cape West Coast Biosphere Reserve coordinators have encouraged and supported the development of the sustainability indicator sets and the national protocol.

Supporting these with a social learning institution within each biosphere reserve will be required for ensuring their ongoing utility.

Member Profiles

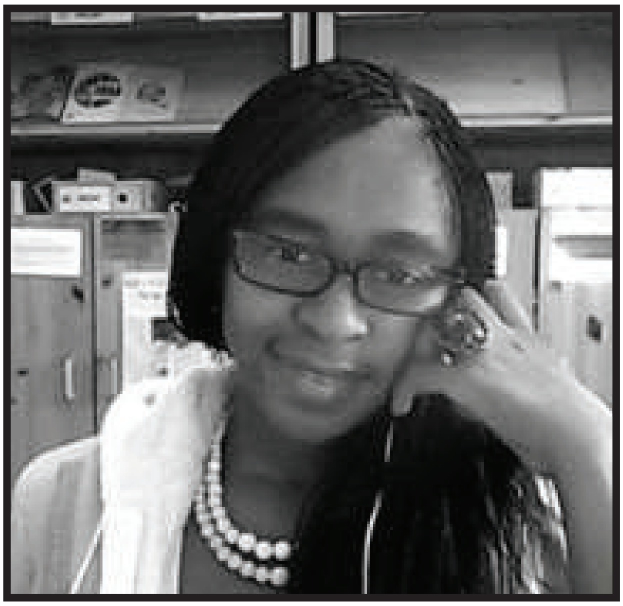
Clement Adjorlolo (PhD) received the undergraduate qualification in Range and Wildlife Management from the College of African Wildlife Management, Tanzania, in 2001, and received the B.S. Honours, MSc. and PhD degree in Physical Geography and Environmental Science from the University of KwaZulu-Natal (UKZN), South Africa, in 2007, 2009 and 2013, respectively. He has over a decade of experience in the fields of ecosystem ecology and biodiversity conservation.

Clement's working experience includes the implementation of the Coastal Wetlands Management Project in Ghana where he conducted wildlife species inventory and vegetation surveys and participated in the Ecosystem Goods and Services Research Programme for the Songor RAMSAR site (01/1996 – 06/2001). From 08/2001 to 12/2006 he worked for the Nature and Development Group of Africa (NDG-Africa) consultancy in Pietermaritzburg, South Africa where he was involved in assessing impacts of infrastructure development projects on biodiversity.

His research focus in recent years has been on the application of remote sensing and Geographic Information Systems (GIS) technology to natural resources assessment. He is currently a Professional Scientist with the KwaZulu-Natal Department of Agriculture and Environmental Affairs (06/2009 - to date), involved in the development of spatial statistical, multispectral and hyperspectral techniques for modelling biophysical and biochemical properties of vegetation and for mapping vegetation associations. His career goal is to build on this platform to make a significant contribution to the management of natural resources at local, regional and global level.

Member Profiles

Linda Luvuno is a Pietermaritzburg local, studying towards her masters in Ecological Science. Her background is in biological and environmental sciences with a specific interest in ecological remote sensing. Linda's research furthers this interest with an investigation of the influence of fire on wetland vegetation structure and composition. This study has two components, an ecological component studying the effects of fire on wetland vegetation and structure and a landscape study using remote sensing to investigate long term changing in the landscape linking it back to the fire history. Linda is 22 months into her 2 year internship with the Mondi Wetlands Programme (WESSA) and she hopes to have her thesis complete by early 2013.



More broadly, Linda enjoys participating in varsity cricket and is very active in her local church. Committed to the Pietermaritzburg community at large, a good portion of her weekend time is spent volunteering at a local children's home. She has a passion for South Africa's people and biodiversity; and enjoys being involved in meaningful projects that will have a positive impact on the future of this country.

.

WESSA

PEOPLE CARING FOR THE EARTH

New and Resigned Members

New Members

- Mr Brighton Shumba , Lima Rural Development Foundation
- Mr Craig Mulqueeny , Ezemvelo KZN Wildlife
- Mrs Emelda Tshishiku-Diyi , Northern Cape Department of Environment & Nature Conservation
- Dr Gloria Kgobe , UNISA
- Ms Kerryn Morrison , Endangered Wildlife Trust
- Dr Martha Lazaridou-Athanasiadou , Kavala Institute of Technology
- Ms Onai Mtengwa , University of Venda
- Mrs Sheila Househam , KwaZulu-Natal Department of Agriculture and Environmental Affairs
- Mr Stephan Steyn , University of the Free State
- Mr Wolfgang Kanz , Afzelia Environmental Consultants

Resigned Members

- Danne Joubert Miss
- Glenn Ramke Ms, Endangered Wildlife Trust
- Lincoln Raitt Prof, University of the Western Cape
- Natasha van de Haar Mrs, Scientific Aquatic Services

Themeda triandra
A Keystone Grass Species

Hennie Snyman[1]*, Lachlan Ingram[2] and Kevin Kirkman[3]
[1]Department of Animal, Wildlife and Grassland Sciences, University of the Free State, [2]Plant Breeding Institute, Faculty of Agriculture and Environment, University of Sydney, [3]Grassland Science, School of Life Sciences, University of KwaZulu-Natal
snymanha@ufs.ac.za
African Journal of Range and Forage Science 2013
1-27 (DOI: 10.2989/10220119.2013.831375)

Themeda triandra is a grass species that dominates grasslands and savannas throughout southern and eastern Africa, Australia, south-east Asia, India and the Middle-East. Within these regions it is found across a broad range of climates, geological substrates and ecosystems. John Acocks, one of the best known botanists and ecologists in South Africa, stated "*Themeda* is by far the most generally important of our grasses".

Inappropriate grazing management, however, can result in a decline of *Themeda*, as it is not well adapted to an uninterrupted, selective grazing regime. A decline in abundance of *Themeda* in grasslands is usually coupled to a decline in grazing value, species richness, cover and ecosystem function. In spite of its significant ecological and economic importance, there has been no attempt to review and synthesise the considerable body of research undertaken on this grass. The aim with this review is to summarise and synthesize work previously undertaken and identify areas where further research is required.

It is likely that the *Themeda* covered in this review is not a single species but rather a species complex, which has over time become exceptionally well adapted to local biotic and abiotic variables under stable conditions. This likely makes it vulnerable to change, and may explain its rapid disappearance under changing conditions, such as selective grazing pressure or lack of fire. Its disproportionate ecological and economic importance, combined with its role as an indicator species provides justification for consideration as a keystone grass species.

We have attempted to both review and fit the published research into the bigger ecological picture which *Themeda triandra* occupies (Figures 1 and 2). Our hope is that, by listing a number of potential areas for research, this study will enable current and future researchers to apply their efforts in obtaining a more comprehensive and complete picture of this important grass species.

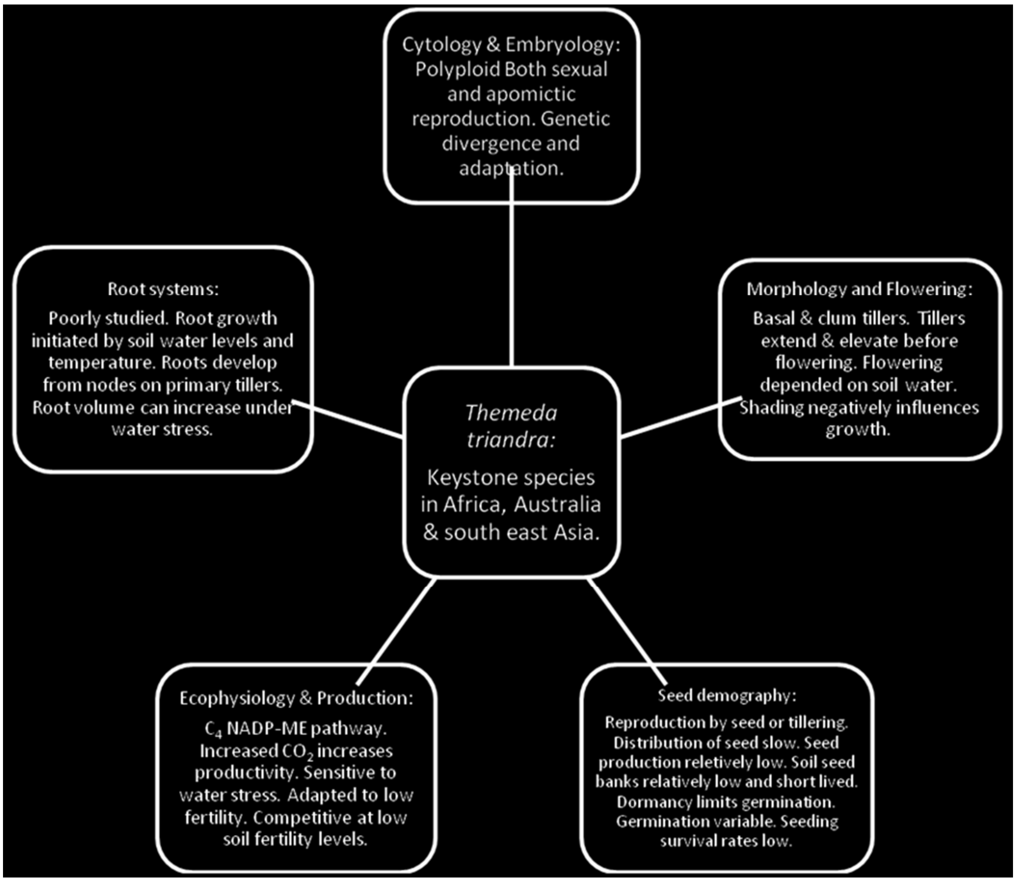


Figure 1 Biotic and abiotic factors affecting the distribution and abundance of *Themeda triandra*

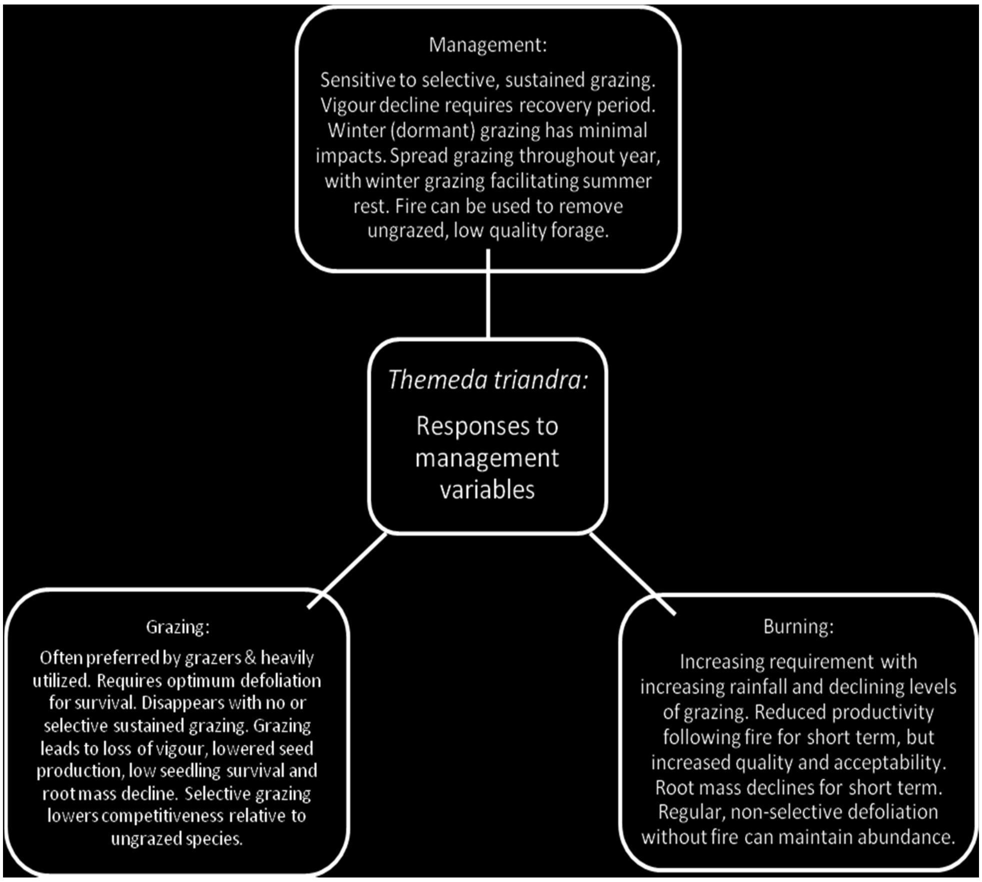


Figure 2 Management of *Themeda triandra* grasslands

In Vitro Organic Matter Disappearance of Kenyan Browse using Rumen Liquid from Goats Ingesting Grass Versus Browse

Caroline C. Wambui, James P. Muir, John Githiori and Barry D. Lambert
Texas A & M AgriLife Research
j-muir@tamu.edu
African Journal of Range and Forage Science 2013
(DOI:10.2989/10220119.2013.813871)

African browse often contains condensed tannins (CT) which may be beneficial to browser health. Benefits include suppression of internal parasites or improved protein absorption; in concentrations over 5%, however, it may interfere with rumen breakdown of forage. Few East African trees and shrubs have been tested for CT so this study measured concentrations in four introduced and seven native tree/shrub species in Kenya known to be consumed by ruminants. Leaf crude protein varied from 14 to 25% while CT ranged from almost none to nearly 12%.

This emphasizes the need to test our browse for CT in case wildlife or goats are being forced to consume too much or not enough. A second aspect of the study looked at the effect of diet on breakdown of CT and crude protein of individual browse species in the rumen. The presence or absence of CT in feed apparently has an effect on rumen function although how this affects production is still not clear. At the very least, the presence of CT in laboratory rumen digestibility trials should be documented when looking at browse with CT.

"Benefits include suppression of internal parasites or improved protein absorption"

Browse [redacted]	ECT	PBCT	FBCT	TCT
Acacia brevispica	**4.1^{ab}**	**1.8^{bc}**	**1.5^{bcd}**	**7.4^{bc}**
Acacia tortilis	**5.8^{a}**	**3.0^{b}**	**3.1^{a}**	**11.9^{a}**
Balanites aegyptiaca	**0.0^{c}**	**0.0^{c}**	**0.1^{e}**	**0.2^{e}**
Berchemia discolor	**0.5^{c}**	**5.1^{a}**	**2.2^{ab}**	**7.8^{bc}**
Grewia bicolor	**6.6^{a}**	**2.9^{b}**	**1.2^{cde}**	**10.7^{ab}**
Gliricidia sepium	**0.0^{c}**	**3.0^{b}**	**1.9^{bc}**	**4.9^{cd}**
Leucaena leucocephala	**1.9^{bc}**	**2.5^{b}**	**2.0^{bc}**	**6.4^{cd}**
Pithecelobium dulce	**1.0^{c}**	**1.5^{bc}**	**0.7^{de}**	**3.2^{de}**
***Prosopis juliflora* leaves**	**0.0^{c}**	**0.2^{c}**	**0.2^{e}**	**0.4^{e}**
***P. juliflora*_pods**	**0.1^{c}**	**0.4^{c}**	**0.2^{e}**	**0.7^{e}**
Terminalia brownii	**1.2^{c}**	**1.3^{bc}**	**0.6^{de}**	**3.2^{de}**
Ziziphus mucronata	**1.0^{c}**	**1.6^{bc}**	**0.7^{de}**	**3.3^{de}**
Effect of species	**0.001**	**0.004**	**0.0009**	**<0.0001**
SEM[1]	**0.89**	**0.64**	**0.35**	**1.1**

Table 1. Extractible (ECT), protein-bound (PBCT), fiber- bound (FBCT) and total (TCT) condensed tannins in leaves collected from browse species in Kenya.

Post-wildfire regeneration of rangeland productivity and functionality – observations across three semi-arid vegetation types in South Africa

Johannes A.D. Breedt[1,2], Niels Dreber[1,3]*, Klaus Kellner[1]
[1]School of Biological Sciences, North-West University, Private Bag X 6001, Potchefstroom 2520, South Africa
[2]present address: African Remediation Technologies, 1024 Saxby Avenue, Eldoraigne X 10157, South Africa
[3]Biodiversity, Evolution & Ecology of Plants, Biocentre Klein Flottbek & Botanical Garden, University of Hamburg, Ohnhorststrasse 18, 22609 Hamburg, Germany
n.dreber@gmx.de
African Journal of Range and Forage Science 2013
(DOI:10.2989/10220119.2013.816367)

Uncontrolled fires can result in significant reductions of the agricultural potential of rangelands and substantial economic losses. Environmental assessments help to better understand fire effects on the natural resources and provide important information that can feed into decision-making at farm scale.

We investigated the short-term impact of a wildfire on the grass layer in different veld types of the North West province, in order to gain insight in the regeneration capacity of affected rangelands. In the growing season following the wildfire, the standing grass biomass was much lower in previously burned sites compared to adjacent unburned sites across veld types.

The loss in rangeland production was also evident by a general decrease of grazing capacity and reduction in potential grazing days. In addition, much litter was burned increasing the proportion of bare soil, which is likely to influence soil stability, nutrient cycling and water infiltration. Nevertheless, the grass sward showed to recover quite well with no fire-related effects on species composition and grazing value, grass density and diversity.

However, it seems advisable that grazing of burned rangelands immediately after the fire event should be carried out in a sustainable way to avoid a further decrease in rangeland condition and stability.

Legume seed and seedling and weed seedling dynamics in annual medic pastures (*Medicago* spp) in wheat-medic systems in the Swartland region of the Western Cape.

I. The influence of medic cultivar, crop rotation and cultivation during the wheat phase

II. The influence of herbicide treatments during the pasture

Johann M van Heerden
ARC-LBD: Animal Production
PO Box 3320, Matieland, 7602 , South Africa.
jmvh@sun.ac.za

Abstract

The productivity of medic (*Medicago* spp) pastures declined on commercial farms. To find a solution, nine cultivars of three medic species were evaluated and compared at two herbicide (Imazamox and Haloxyfop-R-methyl ester) and two cultivation practices (direct seeding and seeding preceded by shallow tine cultivation) and two wheat (W)-pasture (P) rotations (PPWW and PWPW). Seed and seedling numbers were determined in soil samples taken over four seasons. Cultivars varied in their ability to produce seedlings and to maintain seedling and residual seed levels. The ideal seed mixture was found to consist of cultivars and species varying in hard seed content, such as Santiago, Caliph, Serena and Parabinga. A short pasture phase followed by only one wheat season was most beneficial to the maintenance of the medic pastures. Greater control of broad leaved weeds in the pasture phase by the Imazamox treatment compared to the Haloxyfop treatment, resulted in higher medic seedling and seed levels. Tine cultivation compared to direct seeding also promoted the regeneration of both the grass and medic seedlings. This showed that some cultivation is needed during the wheat year, provided this cultivation does not result in deep burial of medic seeds.

Introduction

Annual legumes, such as medics (annual *Medicago* spp), serve as leys for winter cereals in the Swartland region of the Western Cape, as well as pastures with a high potential for wool and mutton production (Van Heerden & Tainton, 1987; 1988). The inclusion of these legume pastures in cropping systems has a positive influence on subsequent cereal crops (MacLeod, MacNish & Thorn, 1993).

One of the reasons is that these legumes are able to fix substantial amounts of nitrogen, which reduces the N-fertilization needed by subsequent cereal crops (Ladd, Oades & Amato, 1981). Grass weeds can also be most effectively controlled in the legume pasture phase of medic-cereal rotations. In the past it was, however, often found that wheat yields tended to be lower after legumes such as lupines (*Lupinus angustifolius* L), lucerne (*Medicago sativa* L.) and medic pastures (Sim, 1958: Wicht, Loubser & Landman, 1978). Grobbelaar (1971) attributed this to the high level of root diseases in winter cereal crops following legume pastures. With the greater availability of chemical herbicides for the control of grass weeds in short rotation medic-cereal systems, this problem was alleviated. Le Roux, Agenbag & Mills (1995) found that, by controlling the grass weeds, which are important competitors and vectors for root diseases, in medic pastures, the number of grass weed plants in the subsequent wheat crop was reduced by 89%. This also resulted in a 51% decrease in take-all incidence in the wheat and a 34% increase in the wheat yield. Similar advantages, due to grass weed control in the previous pasture phase on subsequent winter cereal yields, have been documented in Australia (MacLeod, MacNish & Thorn, 1993; Stephenson, 1993).

The success of the annual legume pasture-crop system hinges on the ability of the pasture legume component to produce large numbers of seeds at the end of each pasture phase. Most of these seeds are hard, resulting in only a very small fraction of the total seed bank in the soil being viable at the start of a particular growing season. The hard seed reserve thus created, would only germinate during subsequent seasons and are able to survive one or more cropping seasons between pasture phases. This medic-cereal cropping system is therefore highly dependant on the accumulation of adequate legume seed reserves in the top soil to enable effective legume seedling numbers to regeneration (Carter, Wolfe & Francis, 1982; Gillespie, 1983; Carter, 1987). The failure of legume pastures in the Australian cereal belt has therefore been found to be mainly attributable to inadequate seed reserves and consequent low seedling regeneration (Carter & Porter, 1993). Carter, *et al* (1982), Gillespie (1983) and Carter (1987) attribute the deterioration of annual legume pastures in Australia to changes in cropping frequency with longer cropping phases and changing crop and pasture management practices which impact on soil seed reserves.

Soil cultivation during the cereal cropping phase in annual legume/cereal rotations also has an influence on the successful regeneration of annual legumes. Local as well as Australian research has clearly shown that shallow cultivation during the cropping phase is needed to ensure that the legume seeds are not buried too deeply (Abd El-Moneim & Cocks, 1986; Carter & Challis, 1987; Cocks, 1992; Carter & Porter, 1993; Kotze, Langenhoven & Agenbag, 1998). As the too deep burial of medic seeds will result in poor medic seedling regeneration of these relatively small seeded legumes during the season following the cereal phase, shallow tine cultivation is usually used when establishing the cereal crops during this phase.

A decline in the productivity and sustainability of the legume component of annual legume pastures was observed on commercial farms in the Western Cape over a number of seasons. This was found to be attributed to a decrease in the number of legume seedlings reestablishing due to a decline in viable seed numbers (van Heerden, in press). This may possibly be attributable to a range of contributing factors. Some of the potential factors include poorly adapted species and cultivars (Reed, Mathison & Crawford, 1989), increase grass and broad leaved weed infestation in both the pasture and cropping phases (Van Heerden, 1990; Stephenson, 1993) and the use of incorrect cultivation and crop rotation systems (Abd El-Moneim & Cocks, 1986; Carter & Challis, 1987; Cocks, 1992; Carter & Porter, 1993; Kotze, Langenhoven & Agenbag, 1998). This research was therefore conducted to study the influence of crop rotation, soil cultivation and herbicide treatments on the seed and seedling dynamics of a number of medic species and cultivars in the Swartland.

Methods

A trial was established during June 1998 on a Glenrosa soil at Langgewens experiment station (33° 17' E and 18° 42' S at 177m above sea level) in the Swartland region. The climate of the trial site during the period 1998 to 2001 is shown in Fig 1.

Mild wet winters were experienced with the active growing season starting in April/May and terminating in September/October, which is characteristic of the area.

The shortest and driest growing season was experienced during 2000, while 1998 and 2001 was wetter and 1999 intermediate. None of the seasons were adversely wet or dry and conditions were highly favourable for maximum pasture seedling regeneration and growth and seed set.

Before establishment, the soil of the trial site was sampled and the P, pH, K, Cu and Zn status determined. No fertilisation was needed. The pastures were sown in 200 mm rows within 9m x 50m plots at a seeding rate of 20 kg.ha^{-1}, using a tractor mounted seeder. Before seeding the seed of each plot was individually inoculated with appropriate commercial inoculant, using standard commercial glue. Nine cultivars of three medic species, ie *Medicago truncatula* Gaertn. (cv's Sephi, Paraggio, Caliph, Mogul, Parabinga and Cyprus), *Medicago sphaerocarpos* Bertol. (cv Orion) and *Medicago polymorpha* M. (cv's Santiago and Serena) were randomly allocated to plots arranged in eight blocks.

The eight blocks were fenced off into four paddocks containing two blocks each. All the paddocks were continuously grazed during 1998. During July 1998 the first herbicide treatments were applied and one block in each of the four paddocks were sprayed with imazamox @ 48 g ai.ha^{-1}(I), which controls grass and broad leaved weeds, while the remaining blocks were sprayed with haloxyfop-R-methyl ester @ 108g ai.ha^{-1} (H), which controls mainly grass weeds. During 1999 two paddocks were allowed to regenerate and again grazed, while the

Species	Cultivars	Number of legume seedlings (N°.m^{-2})	Number of legume seeds (N°.m^{-2})	Viable legume seeds (%)
M truncatula	Caliph	198 ^{cd}	2760 ^{ab}	8 ^{e}
	Cyprus	374 ^{a}	1518 ^{c}	27 ^{c}
	Mogul	296 ^{ab}	912 de	27 c
	Parabinga	245 ^{bc}	2203 ^{b}	14 ^{de}
	Paraggio	348 ^{a}	1419 ^{cd}	36 ^{b}
	Sephi	301 ^{ab}	924 ^{cde}	38 ^{b}
M polymorpha	Santiago	308 ^{ab}	3153 ^{a}	13 ^{de}
	Serena	313 ^{ab}	2322 ^{b}	18 ^{d}
M sphaerocarpus	Orion	119 ^{d}	493 ^{e}	54 ^{a}

Table 1. The average medic seedling and seed numbers and the % viability of these seeds of nine medic cultivars during three consecutive seasons (2000, 2001 and 2002) at Langgewens experiment station (data followed by the same letter within a particular column do not differ significantly ($P<0.05$)).

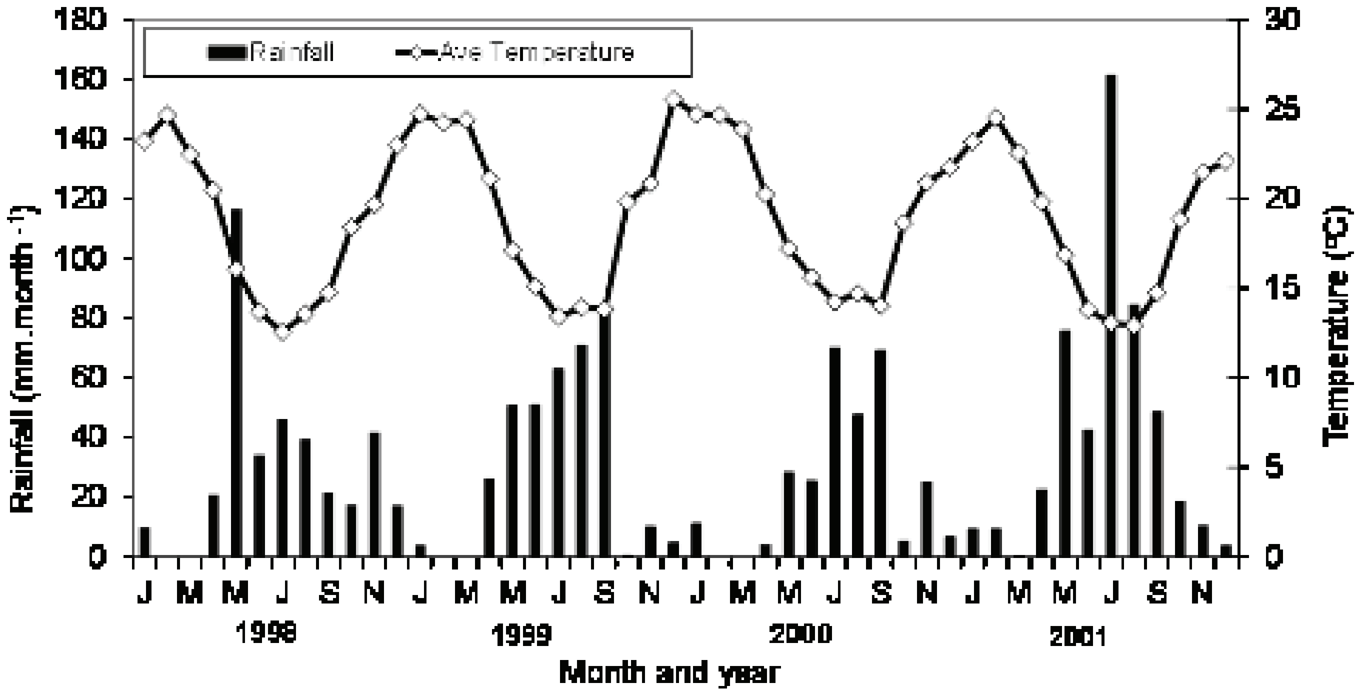


Figure 1. Total monthly rainfall and average temperature at Langgewens experiment station in the Swartland, during the trial period (1998 to 2001)

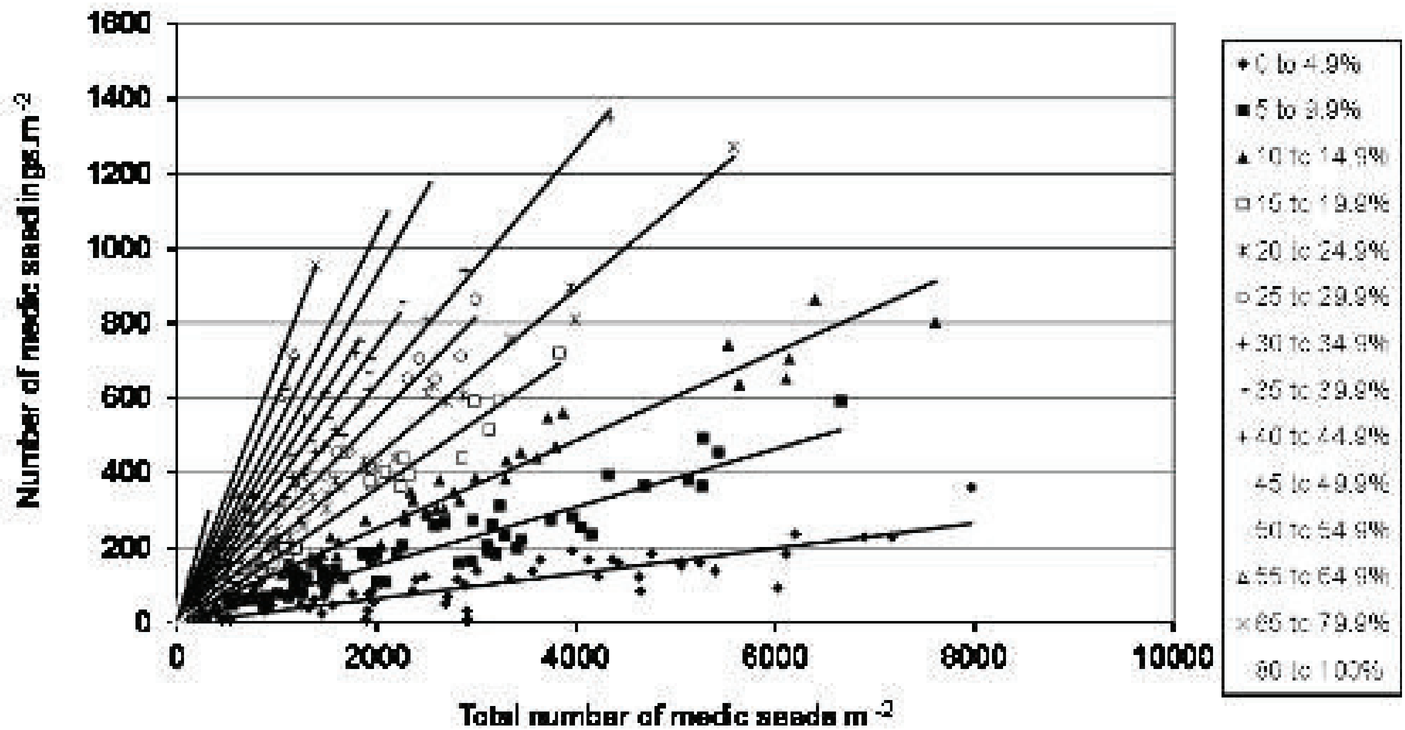


Figure 2. Relationship between number of medic seedlings and total medic seed number at various levels of viable (%) seed contents over all species and cultivars at Langgewens experiment station in the Swartland

Sampling date	Crop rotation treatment	Phase of each system	Broad leaved weed seedlings (N°.m^{-2})	Grass weed seedlings (N°.m^{-2})	Medic seedlings (N°.m^{-2})	Total Medic seeds (N°.m^{-2})	Viable Medic seeds (%)
2000	PPWW	PP	260 ^{a}	286 ^{c}	340 ^{a}	2659 ^{a}	13 ^{c}
	PWPW	PW	179 ^{ab}	239 ^{cd}	264 ^{b}	1504 ^{bc}	18 ^{b}
2001	PPWW	PPW	166 ^{c}	471 ^{ab}	228 ^{b}	1744 ^{b}	13 ^{c}
	PWPW	PWP	231 ^{ab}	174 ^{d}	153 ^{c}	1663 ^{b}	9 ^{c}
2002	PPWW	PPWW	36 ^{d}	556 ^{a}	262 ^{b}	1112 ^{c}	24 ^{a}
	PWPW	PWPW	81 ^{d}	419 ^{b}	341 ^{a}	1786 ^{b}	19 ^{b}

Table 2. The influence of two crop rotation treatments on medic and weed seedling and medic seed numbers and the % viability of medic seeds on three sampling dates at Langgewens experiment station (data followed by the same letter within a particular column do not differ significantly ($P<0.05$)).

other two paddocks were planted to wheat. No herbicides were applied to the paddocks in the pasture phase in 1999. During 2000 the two paddocks, which were grazed during 1999, were planted to wheat, while the other two paddocks were grazed and one block of each were sprayed for a second time with imazamox and haloxyfop respectively, using the same application rates. During 2001 the whole trial was planted to wheat. Due to the potential buildup of grass weeds, it was not practical to include a control treatment in which no weeds were controlled during the pasture phase. As a grass herbicide treatment in the pasture phase, such as haloxyfop, is one of the standard practices used by farmers and thus served as control treatment.

During 2000 the two paddocks, which were grazed during 1999, were planted to wheat, while the other two paddocks were grazed and one block of each were sprayed for a second time with imazamox and haloxyfop respectively, using the same application rates. During 2001 the whole trial was planted to wheat. Due to the potential buildup of grass weeds, it was not practical to include a control treatment in which no weeds were controlled during the pasture phase. As a grass herbicide treatment in the pasture phase, such as haloxyfop, is one of the standard practices used by farmers and thus served as control treatment.

2000 data: PPWW rotation system:1998 P, 1999 P (or PP) PWPW rotation system:1998 P, 1999 W (or PW)

2001 data: PPWW rotation system:1998 P, 1999 P, 2000 W (or PPW) PWPW rotation system:1998 P, 1999 W, 2000 P (or PWP)

2002 data: PPWW rotation system:1998 P, 1999 P, 2000 W, 2001 W (or PPWW) PWPW rotation system:1998 P, 1999 W, 2000 P, 2001 W (or PWPW)

During the 1999 and 2000 cropping phases the blocks were split into two sub blocks, which were each subjected to a different cultivation practice, a direct seeding (N) and a seeding preceded by the industry standard shallow tine cultivation (T) treatment respectively. During the wheat phases, standard herbicide treatments for broad leaved weed (bromoxynil @ 400 g $ai.ha^{-1}$, MCPA @ 200 g $ai.ha^{-1}$ and chlorsulfuron @ 6 g $ai.ha^{-1}$) and grass weed control (dichlofop-methyl @ 378 g $ai.ha^{-1}$) in wheat, were applied. Before sowing the wheat, each paddock was also sprayed with glyphosate, using standard application levels, to kill all the weeds and medics which had regenerated.

Two $0.066m^{-2}$ soil samples were taken to a depth of 50mm within each plot in April during 2000, 2001 and 2002. The soil samples were wetted immediately after sampling and weed and medic seedlings allowed to germinate under a shade cloth. All medic and weed seedlings were identified. The number of medic seedlings was taken as a measure of the number of viable medic seeds.

The soil samples were subsequently rinsed on a fine sieve, to remove excess soil, and dried. After drying, the medic seeds and pods were manually separated from the remaining stone and sand fractions and the seeds extracted from the pods and manually counted as a measure of the number of hard or non-germinating medic seeds. These data were subjected to a standard analysis of variance with cultivar, cultivation, herbicide and crop rotation system as main factors and seasons as subplots.

Results and Discussion

Species and Cultivars

There was no significant interaction between cultivar and the other three treatments (cultivation, crop rotation and herbicide) for the parameters, number of legume seedlings, number of legume seeds and the percentage viable legume seeds. There was also no significant interaction between cultivar and season for these parameters. The average number of legume seedlings which regenerated, the average total number of seeds (number of hard seed plus seedlings) and the percentage of the total seeds which germinated over the whole trial period, are shown in Table 1.

Cyprus (374 seedlings.m^{-2}) and Paraggio (348 seedlings.m^{-2}) had the highest average number of seedlings over the whole trial period, but not significantly higher than Sephi (301 seedlings.m^{-2}), Santiago (308 seedlings.m^{-2}), Serena (313 seedlings.m^{-2}) and Mogul (296 seedlings.m^{-2}). Orion had the lowest seedling numbers (119 seedlings.m^{-2}), but not significantly lower than Caliph (198 seedlings.m^{-2}). Parabinga had intermediate seedling numbers (245 seedlings.m^{-2}), which was not significantly higher than that of Caliph and lower than that of Mogul, Sephi, Santiago and Serena.

Santiago had the highest total number of seeds (3153 seeds.m^{-2}), but with that of Caliph (2760 seeds.m^{-2}) not significantly lower. Parabinga (2203 seeds.m^{-2}) and Serena (2322 seeds.m^{-2}) had lower numbers of seeds, but still significantly higher levels than the remainder of the cultivars and not significantly lower than Caliph. Orion had the lowest hard seed levels (493 seeds.m^{-2}), but not significantly lower than Mogul (912 seeds.m^{-2}) and Sephi (924 seeds.m^{-2}). Cyprus (1518 seeds.m^{-2}) and Paraggio (1419 seeds.m^{-2}) maintained intermediate levels of seed, which was not significantly higher than Sephi.

Orion had significantly the highest (54%) soft or viable seed content. Sephi (38%) and Paraggio (36%) also tended to be soft seeded with significantly higher levels of soft seed than the remainder of the cultivars. Serena (18%), Parabinga (14%), Santiago (13%) and Caliph (8%) were significantly more hard seeded than the two intermediate cultivars Cyprus (27%) and Mogul (27%).

The number of viable seedlings which establish each season has a major influence on the yield of annual legume pastures in a particular season (Carter, Wolfe & Francis, 1982; Gillespie, 1983; Carter, 1987). The two cultivars Cyprus and .

Paraggio would therefore be the best cultivars to use in the area where the trial was conducted .

The important influence of the % viable medic seed on the relationship between total medic seed and viable seed establishing is shown in Figure 2.

Do compile Figure 2 all the data was pooled over species, cultivars, treatments and seasons and grouped into 14 classes of medic seed viability (0 to 4.9% to 80 to 100%). The figure clearly indicates that the higher the viability, the less seed is needed to produce high numbers of medic seedlings, while the converse is also true. The danger of too many viable seeds, however, lies in the higher susceptibility of the pastures to out of season summer rains. Viable seed numbers are, therefore, not the only factor to consider as the number of hard seeds is also very important and determines whether a cultivar is persistent even when very little or no seed is set due to adverse conditions during a growing season. Cultivars such as Santiago and Serena and possibly Parabinga, with higher hard seed levels, should therefore also be included in mixtures with softer seeded cultivars such as Paraggio.

Crop Rotation

The influence of the two crop rotation systems (PPWW and PWPW) on the weed and medic seedling and medic seed dynamics over the trial period is shown in Table 2. The 2000 data is the result of two years of pasture (PP) in the PPWW treatment and one year of pasture and one year of wheat (PW) in the PWPW treatment. The 2001 data reflects the effect of two years of pasture and one wheat season (PPW and PWP) on both the PPWW and PWPW treatments. The 2002 data is the result of the full range of treatments, two pasture seasons and two wheat seasons (PPWW and PWPW).

The broad leaved weed seedlings declined significantly on the PPWW treatment from 2000 to 2002 (260 to 36 seedlings.m^{-2}). Between 2001 and 2002 the seedling numbers also declined (231 to 81 seedlings.m^{-2}) significantly on the PWPW system. During 2001 the broad leaved weed seedlings were significantly higher on the PWPW (231 seedlings.m^{-2}) than the PPWW (166 seedlings.m^{-2}) treatment, while no significant effect of rotation system was visible in 2000 and 2002. The results were probably influenced by the fact that broad leaved weeds were effectively controlled during the wheat phases and therefore tended to be lower after the wheat (W) phases than after pastures (P). This seems to indicate that the broad leaved weeds should not be a problem when controlled in the wheat phase.

The grass weed seedlings increased significantly between 2000 and 2002 on the PPWW treatment (286 to 556 seedlings.m^{-2}), but not significantly between 2001 and 2002. Between 2000 and 2001 the number of grass seedlings did not change significantly ($P \leq 0.05$) on the PWPW treatment, but in 2002 (419 seedlings.m^{-2}) the number of grass seedlings, were significantly higher. During 2001 (471 vs 174 seedlings.m^{-2}) and 2002 (556 vs 419 seedlings.m^{-2})

Herbicide treatment	Broad leave weed seedlings (N°.m^{-2})	Grass weed seedlings (N°.m^{-2})	Medic seedlings (N°.m^{-2})	Total Medic seeds (N°.m^{-2})
I	130 ^{b}	417 ^{a}	307 ^{a}	1923 ^{ab}
H	190 ^{a}	359 ^{a}	240 ^{ab}	1587 ^{bc}
2 x I	85 ^{b}	387 ^{a}	289 ^{ab}	2028 ^{a}
2 x H	227 ^{a}	205 ^{b}	204 ^{c}	1421 ^{c}

Table 3. The influence of two herbicide treatments on medic and weed seedling and medic seed numbers at Langgewens experiment station (data followed by the same letter within a particular column do not differ significantly (P<0.05)).

Sampling date	Cultivation treatment	Broad leaved weed seedlings (N°.m^{-2})	Grass weed seedlings (N°.m^{-2})	Medic seedlings (N°.m^{-2})
2000	N	224 ^{a}	151 ^{c}	217 ^{bc}
	T	135 ^{b}	328 ^{b}	311 ^{a}
2001	N	119 ^{b}	418 ^{b}	152 ^{c}
	T	206 ^{a}	550 ^{a}	272 ^{ab}

Table 4. The influence of two cultivation treatments on medic and weed seedling numbers during two sampling dates at Langgewens experiment station (data followed by the same letter within a particular column do not differ significantly (P<0.05)).

the number of grass weed seedlings were significantly higher on the PPWW than the PWPW treatment. Grass weeds seem to be a much greater problem than broad leaved weeds. The number of grass weed seedlings also tended to be higher after the wheat (W) than the pasture (P) phases in both systems, due to the more effective control of grasses in the pasture phases. The increase in grass weed seedlings on the PPWW treatment may also be due to the fact that grass weeds were only controlled once in the first pasture phase of the PPWW system, while weed control was applied twice on the pastures of the PWPW system.

On the PPWW treatment the number of medic seedlings were significantly highest in 2000 (340 seedlings.m^{-2}) and on the PWPW (341 seedlings.m^{-2}) treatment during 2002. The number of medic seedlings were significantly higher on the PPWW than the PWPW treatment during 2000 (340 vs 264 seedlings.m^{-2}) and 2001 (228 vs 153 seedlings.m^{-2}). During 2002, however, the number of medic seedlings were significantly higher on the PWPW (262 seedlings.m^{-2}) than the PPWW (341seedlings.m^{-2}) treatment. There was no indication that any one of the two systems promoted or depressed the number of medic seedlings and seedling number was perhaps mainly influenced by the stage or phase of a particular system at the time of sampling.

The total number of medic seeds (number of hard medic seeds plus number of medic seedlings) declined significantly on the PPWW treatment from the 2000 (2659 seeds.m^{-2}) to 2001 (1744 seeds.m^{-2}) and from 2001 to 2002 (1112 seeds.m^{-2}). On the PWPW treatment there was no significant change in the total number of medic seeds over seasons. This resulted in the number of seeds being significantly higher on the PPWW (2659 seeds.m^{-2}) than the PWPW treatment (1504 seeds.m^{-2}) in 2000, but significantly higher on the PWPW (1786 seeds.m^{-2}) than the PPWW treatment (1112 seeds.m^{-2}) in 2002. The short rotation system (PWPW), with only one cropping phase between the pasture phases, seem to result in higher seed reserve levels than the longer rotation (PPWW), which has two consecutive seasons of cropping. In the case of this parameter the fact that weeds were only controlled in one pasture season on the PPWW, while herbicides were applied in two seasons on the PWPW system, may also have resulted in higher seed production on the latter system.

During 2000 the percentage viable medic seeds were significantly higher on the PWPW (18%) than the PPWW (13%) system. During 2002, however, the percentage was significantly higher on the PPWW (24%) than the PWPW (19%) system. These differences were largely due to the fact that more new seed, but with lower levels of percentage viability, was produced in the pasture (P) phases. The wheat (W) phases, however, resulted in a decrease in seed numbers with higher levels of percentage viable seeds. Although none of the two systems had any advantage as far as the production of viable medic seedlings, the short rotation (PWPW) system (with one pasture and one wheat phase) seemed to promote high medic seed reserve levels.

The fact that the trial had completed only one cycle, however made a definite conclusion as far as the advantages of a particular system difficult.

Herbicide Application

The influence of the two herbicide treatments, imazamox (I) and haloxyfop (H) on the number of weed and medic seedlings and the medic seed reserves are shown in Table 3.

As the two herbicide treatments I and H were only applied once (in 1998) in the pasture phase of the PPWW system, but twice (in 1998 and 2001) in the PWPW system, the effect of frequency of application also had to considered in the interpretation of the data. In Table 3 the data was therefore grouped into two sets, representing one application (I and H) or two applications (2xI and 2xH), respectively. The I and 2xI treatments resulted in significantly lower levels of broad leaved seedlings (130 and 85 seedlings.m^{-2}) than on the H and 2xH treatments (190 and 227 seedlings.m^{-2}). This was to be expected, as I is a broad spectrum herbicide, which controls broad leaved and grass weeds. In the case of the grass seedlings, there was no difference between the two herbicides after one application. After two applications the number of grass seedlings were significantly lower on the 2xH treatment (205 seedlings.m^{-2}) than the 2xI treatment (387 seedlings.m^{-2}). It was therefore clear that the I treatment was most effective in controlling broad leaved weeds, while H was more effective in controlling grass weed numbers.

After only one application there was no significant difference in the number of medic seedlings regenerating on the two herbicide treatments, but after two applications the number of medic seedlings were significantly higher on the 2xI (289 seedlings.m^{-2}) than the 2xH (204 seedlings.m^{-2}) treatment. This was clearly the result of the relative influences of the two herbicide treatments on the medic seed reserves. Although there was no difference between the effects of the two herbicide (I and H) treatments after one application, medic seed reserves were significantly higher on the 2xI (2028 seeds.m^{-2}) than the 2xH (1421 seeds.m^{-2}) treatment after two applications. The greater control of the broad leaved weeds on the I and 2xI treatments compared to the H and 2xH treatments therefore may have been the deciding factor. This contrasts with the finding of van Heerden (1990) who found that the removal of grass weeds in medic pastures promoted medic pod production. This latter trial, however, had a much longer pasture phase and there was no cropping break in this period, while one treatment was also a control in which weeds were not sprayed. This may have resulted in a much greater buildup of grass weeds on the treatment where no weed control was applied in the previous trial than in any of the two treatments of the present trial.

Cultivation

The influence of the two cultivation treatments on weed and medic seedling and medic seed numbers is shown in Table 4.

In 2000 the broad leaved weed seedling were significantly higher on the N (224 seedlings.m^{-2}) than the T (135 seedlings.m^{-2}) treatment, but in 2001 significantly higher on the T (206 seedlings.m^{-2}) than the N (119 seedlings.m^{-2}) treatment. There was also a significant decline in broad weed seedling numbers from 2000 (224 seedlings.m^{-2}) to 2001 (119 seedlings.m^{-2}) on the N treatment, but a significant increase (from 135 to 206 seedlings.m^{-2}) on the T treatment over the same period.

The direct seeding treatment (N) therefore tended to depress broad leaved weeds, while the tine cultivation (T) seemed to promote this component. In contrast, grass weed seedling numbers were significantly higher on the T (328 and 550 seedlings.m^{-2}) than the N (151 and 418 seedlings.m^{-2}) treatment in both the 2000 and 2001 seasons. The medic seedling numbers were also significantly higher on the tine (T) (311 and 272 seedlings.m^{-2}) than the direct seeding (N) (217 and 152 seedlings.m^{-2}) treatment in both seasons. The more vigorous tine (T) cultivation, therefore, seemed to promote the regeneration of both the grass and medic seedlings. The results seem to indicate that more vigorous cultivation is needed during the wheat year to ensure successful medic regeneration, provided this cultivation does not result in the to deep burial of medic seeds (Abd El-Moneim & Cocks, 1986; Carter & Challis, 1987; Cocks, 1992; Carter & Porter, 1993; Kotze, Langenhoven & Agenbag, 1998).

Conclusions

The medic cultivars varied in their ability to produce adequate numbers of seedlings and to maintain high levels of residual seed. The ideal annual legume pasture should consist of a mixture of cultivars and species varying in hard seed content. The cultivars Santiago, Caliph, Serena and Parabinga seemed best suited to the area. Crop rotation also influenced the residual seed and the seedling numbers. The two consecutive pasture phases in the PPWW system resulted in a greater buildup of medic seeds in the pasture phases, but the following two wheat phases depleted the medic seed reserves again. A short pasture phase followed by only one wheat season (PWPW) is thus more beneficial to the maintenance of adequate medic seed reserves and ultimately result in higher numbers of medic seedlings. In spite of the fact that grass control is more difficult than broad leaved weed control in the cropping phase, the greater control of the broad leaved weeds in the pasture phase by the I treatment compared to the H treatment, resulted in higher medic seedling and seed levels on the I treatment. As far as the cultivation treatments, seeding preceded by a tine cultivation (T), promoted the regeneration of both the grass and medic seedlings compared to direct seeding (N). This showed that cultivation is needed during the wheat year to ensure successful medic regeneration, provided this does not result in a too deep burial of medic seeds.

References

Abd El-Moneim, A.M. & Cocks, P.S., 1986. Adaptation of *Medicago rigidula* to a cereal-pasture rotation in northwest Syria. *J. Agric. Sci., Camb.*, 107, 179 – 186.

Carter, E.D., 1987. Establishment and natural regeneration of annual pastures. In Temperate pastures. Eds: J.L. Wheeler, *et al.* 35 - 51. *Aust. Wool Corp. Tech. Public.*, AWC, CSIRO, Melbourne.

Carter, E.D. & Challis, S., 1987. Effect of depth of sowing medic seeds on emergence of seedlings. *Proc. 4th Aust. Agron. Conf.*, Melbourne, 192.

Carter, E.D. & Porter, R.G., 1993. Predicting the emergence of annual pasture legumes in cereal-livestock framing systems of South Australia. *Proc. XVII Internat. Grassl. Congr.*, 2193 – 2194

Carter, E.D., Wolfe, E.C. & Francis, C.M., 1982. Problems of maintaining pastures in cereal-livestock areas of southern Australia. *Proc. Aust. Agron. Conf.*, Wagga Wagga NSW, 68 - 82.

Cocks, P.S., 1992. Changes in the size and composition of the seed bank of medic pastures grown in rotation with wheat in North Syria. *Aust. J. Agric. Res.*, 43, 1571 – 1581.

Gillespie, D.J., 1983. Pasture deterioration - causes and cures. *J. Agric. West. Aust.*, 1, 3 - 8.

Grobbbelaar, W.S., 1971. Lupins in the winter rainfall region. *Farm. S. A.*, Sept, 59 – 63.

Ladd, J.N., Oades, J.M. & Amato, M., 1981. Distribution and recovery of nitrogen from legume residues decomposing in soils sown to wheat in the field. *Soil. Biol. Biochem.*, 13, 251 - 256.

Le Roux, D.J., Agenbag, G.A. & Mills, L.J., 1995. Grasbeheer in peulgewasweidings: invloed op die opbrengspotensiaal van opvolgende koringaanplanting. *Appl. Pl. Sci.*, 9, 39 - 42.

Macleod, W.J., MacNish, G.C. and Thorn, C.W., 1993. Manipulation of ley pastures with herbicides to control take-all. *Aust. J. Agric. Sci.*, 44, 1235 - 1244.

Reed, K.F.M., Mathison, M.J. & Crawford, E.J., 1989. The adaptation, regeneration and persistence of annual legumes in temperate pasture. In: Persistence of forage legumes. Eds: G.C. Marten, A.G. Matches, R.F. Barnes, R.W. Brougham, R.J. Clements & G.W. Sheath. *Amer. Soc. Agron.*, USA.

Sim, J.T.R., 1958. Agronomy investigations in the Winter Rainfall Region, 1892 – 1953. *Sci. Bull.*, 373, Dep. Agric.

Stephenson, D.W., 1993. Barley grass control with herbicides in subterranean clover pasture. 2 Effect on pasture and wheat in the year following spraying. *Aust. J. Exp. Agric.*, 33, 743 - 749.

van Heerden, J.M. & Tainton, N.M., 1987. Potential of medic and lucerne pastures in the Rûens area of the southern Cape. *J. Grassl. Soc. Sth. Afr.*, 4, 95 - 99.

van Heerden, J.M. & Tainton, N.M., 1988. Influence of grazing management on the production of an irrigated grass/legume pasture in the Rûens area of the Southern Cape. *J. Grassl. Soc. sth. Afr.*, 5, 130 - 137.

Van Heerden, J.M., 1990. The influence of the application of grass herbicides on the production of dryland medic and lucerne pastures in the Rûens area of the Southern Cape. *J. Grassl. Soc. sth. Afr.*, 7, 152 - 156.

van Heerden, J.M., (in press). Legume and weed seedling regeneration in annual legume pastures on 30 commercial farms in the agro-pastoral region of the Western Cape. *S.Afr. J. Plant & Soil.*

Van Jaarsveld, A.B., 1983. Lupin diseases in South Africa with special reference to powdery mildew. Ph.D. (Agric) thesis, University of Stellenbosch.

Wicht J.E., Loubser J.W. & Landman, M., 1978. The Swartland utilization and management trial. Crop. Prod., 7 , 41-49

The Production Potential of Italian and Westerwolds Ryegrasses Planted at Different Planting Dates

Philip Botha, Lethukuthula Zulu
Western Cape Department of Agriculture, Outeniqua Research Farm
philipb@elsenburg.com, lethuz@elsenburg.com

The seasonal variation in growth and nutritional value of perennial pastures restrict animal production. The fodder flow program for dairy and beef cattle production units in the coastal region of the Southern Cape of South Africa consist mainly of combinations of perennial pastures such as lucerne (*Medicago sativa*), Kikuyu (*Pennisetum clandestinum*), perennial ryegrass (*Lolium multiflorum*) and clover species (*Trifolium repens* en *T. pratense*).

The growth rates of these crops differ during spring, summer and autumn, but reach a mutual low during winter (Van Heerden *et al.* 1989). In an effort to overcome the problem of pasture shortages during winter, seasonal variation in growth and pasture quality, farmers in the Southern cape plant annual ryegrass (*Lolium multiflorum spp.*) in pure stands, in mixtures with other annual grasses or as crops over-sown into perennial pastures. Data regarding the production potential of annual ryegrass planted at different planting dates is inadequate to assist in accurate fodder flow planning. The aim of this study was to determine the pasture production potential of Italian and Westerwolds ryegrasses planted at different

Procedures

The study was carried out between 2009 and 2011 on the Outeniqua Research Farm near George (altitude 201 m, 33° 58' 38" S and 22° 25' 16" E, rainfall 729 mm year^{-1}) in the Western Cape of South Africa. The area has a temperate climate, with mean minimum and maximum air temperatures varying between 7 ^{0}C -15 ^{0}C and 18 ^{0}C - 25 ^{0}C, respectively. The study was a small-plot trial carried out on an Estcourt soil type (Soil Classification Workgroup 1991) under irrigation. The grasses were sown in 150 mm rows at a seeding rate of 20 kg ha^{-1} for the diploid and 25 kg ha^{-1} for the tetraploid cultivars. Plot size for each cultivar was 10.5 m^2. Irrigation was applied by means of a permanent overhead sprinkler system in one or two applications per week, at rates of 10-15 mm, based on tensiometer readings. Irrigation commenced at a tensiometer reading of -25 kPa and was terminated at a reading of -10 kPa. Annual ryegrass (*L. multiflorum*) varieties nl. Italicum (Italian ryegrass) and Westerwoldicum (Westerwolds ryegrass) were evaluated. The data of four Italian and four Westerwolds ryegrass cultivars planted in separate plots were pooled and the production rate and total production calculated. The varieties, ploid and cultivars combined and used as treatments, are given in Table 1. Prior to planting, fertiliser was applied according to the soil analysis to raise soil phosphorous (P) level to 35 mg kg^{-1} (citric acid), potassium (K) level to 80 mg kg^{-1} and pH (KCl) to 5.5. Nitrogen (N) was applied to the grass and grass-legume pastures at a rate of 50 kg N ha^{-1} month^{-1}.

All the treatments were planted on 24 consecutive months from May 2009 until April 2011 in a well prepared seedbed. The dry matter (DM) production was estimated by cutting the treatments by means of a sickle bar mover set to a height of 50 mm at an interval of 28-35 days, when the ryegrasses had reached the three leave stage or when overshadowing of the growing points of grasses had started to occur (Fulkerson & Donaghy 2001). Samples were dried at 60°C for 72 hours to a constant mass and weighed to determine DM content (%) and dry matter (DM) production.

The trial was a randomised complete block design with 184 treatment combinations randomly replicated in two blocks. The treatment design was a factorial with two factors nl. planting dates and cultivars. An appropriate analysis of variance (ANOVA) was performed, using SAS/STAT software, Version 9.2 (SAS, 2008). The Shapiro-Wilk test (Shapiro & Wilk 1965) was performed to test normality of residuals and Student's t-LSD (least significant difference) (Ott 1993) was calculated at a 5% significance level to compare treatment means.

The two treatments evaluated during the trial according to annual ryegrass variety, ploidy and cultivar combinations are given in Table 1.

Results and discussion

Table 2 shows the monthly growth rate (kg DM ha^{-1} day^{-1}) and total dry matter production (ton DM ha^{-1}) of Italian ryegrass planted at different planting dates.

Italian ryegrass was harvested up to ten times if planted during January, February or March with a total DM production (Table 4) of 9.7, 10.1 and 9.9 ton DM ha^{-1} respectively. The total harvests decreased monthly from 7 to 3 harvests if planted from April until September. The total DM production (Table 4) decreased during the same period from 8.7 to 5.5 ton DM ha^{-1}. The December planting date was also harvested ten times but the monthly growth rate from June until September and the total DM production (8.5 to DM ha^{-1}) were lower ($P<0.05$) than the January, February and March planting dates for this critical winter period.

If the aim in a fodder flow program is to provide feed from May until November, which include the critical winter months (June, July and August), it is better to plant Italian ryegrass during January, February or March. The production will be spread over nine to ten harvests with growth rates from 13 and 53 kg DM ha^{-1} day^{-1} and a total production of 9.7 and 10.1 ton DM ha^{-1}.

Treatment	Variety	Ploidy	Cultivar
1	Italian	Diploid	Agriton
	Italian	Diploid	Enhancer
	Italian	Tetraploid	Jeanne
	Italian	Tetraploid	Parfait
2	Westerwolds	Diploid	Agri-Hilton
	Westerwolds	Tetraploid	Archie
	Westerwolds	Tetraploid	Energa
	Westerwolds	Tetraploid	Jivet

Table 1 The two treatments evaluated during the trial according to annual ryegrass (*L. multiflorum*) variety, ploidy and cultivar combinations.

Plant date	Monthly growth rate (kg DM ha-1 day)															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Dec	5^{G}	21^{yz-AB}	31^{qrstuv}	31^{qrstuv}	38^{m-nop}	24^{wxyz}	20^{zBA}	16^{BCDE}	45^{ijkl}	52^{fgh}						
Jan			14^{CDE}	21^{yz-AB}	38^{m-nop}	30^{rstuvw}	25^{wxyz}	31^{qrstuv}	50^{fghij}	46^{hijkl}	33^{qprst}	23^{xyzA}				
Feb				17^{ABCD}	43^{klm}	36^{opqr}	27^{uvwxy}	32^{pqrstu}	47^{ghijk}	49^{fghijk}	37^{nopq}	19^{ABC}	21^{yz-AB}			
Mar				13^{CDE}	37^{opq}	35^{opqrs}	33^{qprst}	48^{ghijk}	53^{fg}	47^{ghijk}	25^{wxyz}	33^{qprst}				
Apr						12^{DE}	38^{m-nop}	66^{d}	55^{ef}	46^{hijkl}	26^{vwxyz}	30^{rstuvw}				
May							11^{EF}	64^{d}	74^{c}	62^{d}	45^{ijkl}	37^{nopq}				
Jun								5^{GF}	76^{c}	86^{b}	63^{d}	43^{klmn}				
July									23^{xyzA}	92^{a}	75^{c}	51^{fghi}				
Aug										32^{pqrstu}	75^{c}	60^{de}	25^{wxyz}			
Sep											41^{lmno}	77^{c}	45^{jkl}			
Oct												27^{tu-vwx}	61^{d}	34^{qprs}	11^{EF}	29^{stuvwx}
Nov													29^{stuvw}	54^{ef}	10^{EFG}	26^{vwxyz}

Table 2: The monthly growth rate (kg DM $ha^{-1}day^{-1}$) of Italian ryegrass planted at different planting dates.

If the aim is to produce optimum spring and early summer (August to December) fodder, Italian ryegrass should be planted during April, May or June. The ryegrass will be productive for 5 to 7 months and the total DM production can vary between 8 and 9 ton DM ha^{-1}. However, Italian ryegrass planted from July until November will result in short periods (2-3 months) of high production (up to 92 kg DM ha^{-1} day^{-1}) but the total DM production over the growth period will be low and can vary between 3.9 and 7.7 ton DM ha^{-1}.

Table 3 shows the monthly growth rate (kg DM ha^{-1} day-1) of Westerwolds ryegrass planted at different planting dates.

The Westerwolds ryegrass was harvested nine times if planted during January and eight times if planted during February or March with a total DM production of 7.0, 8.3 and 7.8 ton DM ha-1, respectively. The amount of harvests decreased monthly from 6 to 3 harvests if planted from April until September. The total DM production (Table 4) varied between 7.0 and 8.3 ton DM ha-1 when planted during January and February respectively but could be as low as 3.7 and 4.1 ton DM ha^{-1} if planted during October or November.

The December planting date produced 10 harvests but although the March, April and May growth rates were similar ($P>0.05$), they were higher ($P<0.05$) than the June, July and August planting dates. The total DM production (Table 4) of the December planting date (7.6 ton DM ha-1) was also higher ($P<0.05$) than the total DM production (ton DM ha-1) of the April, September, October and November planting dates but similar ($P>0.05$) to that of the other planting dates. If planted during December it can be expected that Westerwold ryegrass, as a pasture, will not be productive from November onwards. This will have an adverse effect on the fodder flow program since this data also shows that the September until November planting dates are the worst period to establish Italian or Westerwolds ryegrass and feed shortages can be expected.

If the aim is to plant Westerwolds ryegrass as fodder from May until November, which include the winter months (June, July and August), it is better to plant Westerwolds ryegrass during January, February or March. The production will be spread over 8-9 harvests, varied between 15 and 46 kg DM ha^{-1} day-1 and a total DM production (Table 4) of between 7.0 and 8.3 ton DM ha^{-1}. If the aim is to produce optimum spring (September until November) and early summer (December) fodder from Westerwolds ryegrass, it is better to plant during May and June for spring and July or August for early summer production. The ryegrass will be productive between 3 and 6 months and the total DM production (Table 4) will vary between 3.7 and 7.6 ton DM ha^{-1}. Westerwolds ryegrass planted from August until November will only be productive for short periods (mostly 2 – 4 months) producing up to 68 kg DM ha^{-1} day-1 but the total production will be low and can vary between 3.7 and 6 ton DM ha^{-1}. Table 4 compares the total DM production (ton DM ha^{-1}) of Italian and Westerwolds ryegrass planted at different planting dates.

Plant date	Monthly growth rate (kg DM ha^{-1} day)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Dec	7^{H}	21^{ABCDE}	32^{qrstuv}	$29^{stu-vwxyz}$	$32^{qrstuvw}$	20^{ABCDE}	16^{DEFG}	12^{GH}	44^{hij}	$35^{m-nopqrs}$					
Jan			15^{FG}	19^{BCDEFG}	32^{pqrstu}	$25^{vwxyzAB}$	21^{ABCDE}	25^{xyzAB}	$41^{hijklmn}$	$25^{wxyz-AB}$	16^{DEFG}				
Feb				25^{xyz-AB}	43^{hijkl}	$31^{qrstu-vwx}$	26^{vwxyzA}	$29^{stu-vwxyz}$	46^{hi}	$30^{qrstu-vwxy}$	24^{yzAB}				
Mar				17^{CDEFG}	41^{hijklm}	34^{opqrs}	$31^{qrstu-vwx}$	$36^{lm-nopqr}$	$40^{ijklmno}$	32^{pqrstu}	19^{BCDEFG}				
Apr						15^{FG}	42^{hijklm}	58^{def}	$39^{klm-nop}$	$29^{rstu-vwxyz}$	21^{ABCD}				
May							13^{GH}	64^{cde}	58^{ef}	44^{hijk}	$37^{klmnopq}$	8^{zABC}			
Jun								5^{l}	82^{ab}	76^{b}	42^{hijklm}	24^{xyzAB}			
July									22^{ABCD}	86^{a}	$59d^{ef}$	53^{fg}			
Aug										33^{pqrst}	68^{c}	47^{gh}	$26^{uvwxyzAB}$		
Sep											35^{nopqrs}	66^{c}	$29^{stuvwxyz}$		
Oct												25^{xyzAB}	54^{fg}	$26^{tu-vwxyzA}$	7^{HI}
Nov													43^{hijkl}	65^{cd}	7^{HI}

Table 3 The monthly growth rate (kg DM ha^{-1}day^{-1}) of Westerwolds

Ryegrass variety	Planting date and total DM production (ton DM ha^{-1})											
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Italian	8.5^{cde}	9.7^{ab}	10.1^{a}	9.9^{a}	8.7^{cd}	9.0^{bc}	8.2^{defg}	7.7^{fgh}	6.6^{ij}	5.5^{jk}	5.2^{lm}	3.9^{n}
Wester-wolds	7.6^{fgh}	7.0^{hi}	8.3^{def}	7.8^{efg}	6.7^{ij}	7.6^{gh}	7.0^{hi}	7.0^{hi}	6.0^{jk}	4.5^{mn}	3.7^{n}	4.1^{n}

Table 4 The total DM production (ton ha^{-1}) of Italian and Westerwolds ryegrass planted at different planting dates.

The total DM production (ton DM ha-[1]) of the Italian ryegrass for the December until June planting dates was higher ($P<0.05$) than that of the Westerwolds ryegrass. The total DM production of both the Italian and Westerwolds ryegrasses during the August, September and November planting dates were low and the difference in DM production between the two varieties were less than 1 ton DM ha-[1]. This data shows that Italian ryegrasses are on a total DM production basis, when planted between December and June, more productive than Westerwold ryegrass. The best plantings dates, depending on the requirements within the fodder flow program, are between December and July.

Conclusions

Planting date influenced the production potential of both Italian and Westerwolds ryegrasses. The combined average growth rate over two years of the two varieties shows that Italian ryegrass, planted from December until June, is more productive than Westerwolds ryegrasses.

The variation in growth rate during spring and early summer over years at similar planting dates is an indication that climatic factors and the presence of weeds can influence the production potential of these temperate grasses. This can be a risk for farmers and an important reason for selecting planting dates in such a way to insure that these crops are productive, have the potential to overcome climatic changes and the ability to compete with spring and summer weeds.

If the aim, from a fodder flow perspective, is to provide fodder from May until November, which also includes the critical winter months (June, July and August), Italian ryegrass, is a better option than Westerwolds ryegrass if planted during February or March. If the aim is to produce optimum spring and early summer (September to December) fodder, Italian ryegrass should be planted during May or June.

Italian or Westerwolds ryegrasses should not be planted later than June. This will result in short productive periods (3-4 months) and the total production will be low.

Comments

Planting date has a pronounced effect on the production potential of Italian and Westerwolds ryegrass. Both these species should be planted at specific planting dates to provide feed within a fodder flow programme from May until November. The production potential of Italian or Westerwolds ryegrass planted from September until November is low and will probably not be cost effective under irrigation if fertilised with nitrogen. December as a planting date for Westerwolds ryegrass is risky and could result in fodder shortage during winter, spring and early summer. If not strategically oversown into perennial pasture, Italian ryegrass is a better option than Westerwolds ryegrass based on growth rate and total production.

References

Fulkerson WJ and Donaghy 2001. Plant-soluble carbohydrate reserves and senescence – key criteria for developing an effective grazing management system for ryegrass-based pasture: a review. Austral ian Journal of Experimental A griculture. 41: 261-275.

Soil Classification Workgroup 1991. Soil Classification, a Taxonomic sys tem for South Africa. Memoirs on the Natural Agricultural Resources of South Africa. Nr 15. Department of Agricultural Development, Preto ria.

Ott RL 1993. An Introduction to Statistical methods and data analysis. Belmont, California:Duxbury Press: pp 807-837 (pp 1-1051)

SAS Institute, Inc. 2008. SAS Version 9.2. SAS Institute Inc, SAS Campus Drive, Cary, North Carolina 27513.

Shapiro S S and Wilk M B 1965. An Analysis of Variance Test for Normality (complete samples)., Biometrika, 52, 591-611.

Van Heerden JM, Tainton NM and Botha PR 1989. A comparison of grass and grass/legume pastures under irriga tion in the Outeniqua area of the southern Cape. Tydskrif Weidingsvereniging van Suid Afri ka. 6 (4). p 220-224.