African Journal of Range & Forage Science Special Issue

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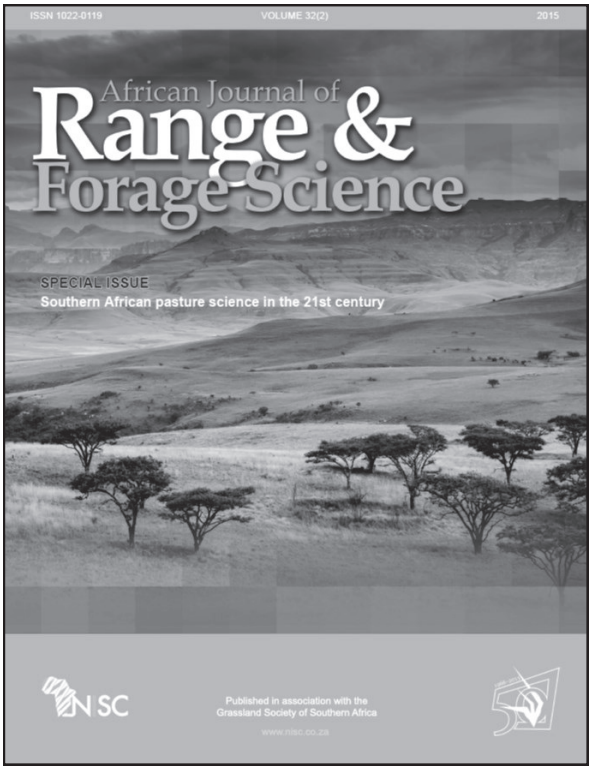
With the estimation of the world's population reaching nine billion people by 2015 challenges for agriculture have come to the fore with more food needing to be produced from smaller areas in ways that promote sustainability, both socially and environmentally. With the decline of areas available to produce agricultural products due to degradation, increased population pressures and urbanization, agriculturalists note these problems to threaten cultivated pastures or improved rangelands in Southern Africa, which contribute significantly to food security in this region.

The aim of this special issue, titled, Southern African Pasture Science in the 21st Century is to introduce past and current research on pastures in Southern Africa, to highlight the research priorities in pasture science and to provide an agenda for future research in this discipline. Approximately 151 million hectares of the Southern Africa's agricultural area is covered by permanent meadows and pastures. Although the majority of this area is natural grasslands and not managed to arrest successional processes, certain areas with lower agricultural potential have been intensified to improve pasture production for grazing animals, or to harvest forage. Research and development of technologies that either increase, sustain, or avoid losses of productivity is imperative to increase the efficiency of production from pastures and, at the same time, ensure environmental sustainability. Research on cultivated pastures is scarce or outdated despite the need to improve production from these areas.

The lead review paper of this special issue highlights the historical changes in research priorities relating to cultivated pastures from the early 1900's and addresses key future research priorities in southern African pastures (Truter et al. 2015). This paper titled, 'Southern African Pasture and Forage Science entering

the 21st Century: Past to Present' is freely available until the end of July along with another review paper entitled 'Managing cultivated pastures for improving soil quality in South Africa: Challenges and opportunities,' Read more of Doctor Swanepoel's Editorial of this special issue, on which this news article is based, here.

The special issue was officially launched at the 50th Congress of the GSSA, hosted at the Royal Agricultural Showgrounds, Pietermaritzburg from 19 to 23 July 2015. The research presented in this special issue will contribute towards a better understanding of potential to improve the productivity and efficiency of cultivated pastures in southern Africa.



Southern African pasture and forage science entering the 21st century: past to present

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South African Pasture and Forage Science has seen many changes over the years with regards to research priorities. The history of this science has created a steady foundation for the further growth and development of this discipline in the 21st Century. To make advances in this science; it is recommended that scientists revisit the past, as this will provide valuable insight and perspective. With over a 180 publications cited, this review has emphasised the important findings of such research, the thoughts of the past which can possibly minimise the risk of imitation, duplication and complication of future research. The majority of publications referred to in this review are from the Proceedings of the Annual Congresses of the Grassland Society of Southern Africa, Journal of the Grassland Society and African Journal of Range and Forage Science for the period 1965-2014. In the past 50 years, a wealth of knowledge has been generated on the function and value of our indigenous grass ". and legume species, especially in our diverse environmental conditions. This review paper has identified eighteen important research and development needs, of which pasture and forage breeding, pasture nutrition, water use and requirements, integrated animal production systems, the value of sub-tropical and tropical forage legumes and drought tolerant forage species are discussed in more detail. The latter research and development needs are interrelated to one another and are regarded as key principles for the further development of pasture and forage science, in changing environmental conditions in Southern Africa. It is conclusive to say that the 21st Century will embrace many new avenues in the development of Pasture and Forage Science in Southern Africa. This is all possible if we remember the words of Confucius, that once said, "There are three methods we learn wisdom; firstly by reflection which is the noblest; secondly by imitation which is the easiest; and thirdly by experience which is the bitterest

Managing cultivated pastures for improving soil quality in South Africa: challenges and opportunities

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Human interference by improving and managing natural systems (such as intensive cultivated pastures) may be beneficial in terms of increased agricultural output from a smaller area. This is ultimately important to increase food supply to be able to sustain global human population growth.

However, management of such intensive systems should be sustainable. Lowered soil quality through time leads to attrition of productive land for agricultural use. This may become a serious problem, especially for intensive cultivated pasture production in South Africa. Soil degradation as a result of mismanagement is a concerning issue. Examples of mismanagement include practising continuous tillage, improper grazing management, injudicious application of fertilisers and poor irrigation management.

It is proposed that soil quality (physical, chemical and biological properties of soil) should be used to monitor sustainability and protect soil in the long run. The aim of this review paper is to provide a synthesis of the challenges and opportunities in soil management of cultivated pastures. The value of measuring soil chemical, physical and biological parameters, rather than merely determining soil fertility status, is stressed.

Moving toward multi-herbivore species (MHS) in cultivated pastures

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Demand for animal products is growing faster than for any other agricultural product. As a result, pressure for greater output from cultivated pastures is expected. Assuming pasture area will decrease with land degradation, conversion to grain crops or urban expansion, the only alternative is to increase productivity per area. Replacing current one- or two-herbivore (usually cattle, sheep or goats) pasture systems with multiple-herbivore species (MHS) may be one approach to meeting demand. This becomes feasible only as cultivated pastures increase in biodiversity and canopy complexity. With diverse plants in our pastures, we can support equally diverse herbivores varying in vegetation preference (browsers vs grazers), metabolic rate, anatomy or habitat niche. Surprisingly little research has evaluated MHS on cultivated pasture so we must depend on rangeland or wildlife experiences for insights. Those natural pastures predict that if we introduce sequential or simultaneous MHS into cultivated pastures, this should result in greater productivity, diversity and resilience of plant as well as animal populations. The challenge is to encourage researchers, consultants and, above all, land managers to consider converting single-plant species pastures designed for a single herbivore toward MHS that require far more intricate science and management. Cultivated pasture scientists and managers in Africa may find it easier than the rest of the world to take this approach because this continent's natural ecosystems provide prime examples of how diverse vegetation populated with MHS increase carrying capacity. It behooves us to apply this experience to our own cultivated pastures as well as to those in the rest of the world.

A critical view on the soil fertility status of minimum-till kikuyu–ryegrass pastures in South Africa

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Cultivated pastures improve animal production systems and contribute, amongst others to food security. Initially, annual pastures were established by conventional tillage methods, but from the 1990s permanent pastures were established on a minimum-tillage regime. Lime and fertiliser guidelines, which were developed for annual pastures established by conventional tillage methods, were followed on minimum tillage systems, despite changes in the soil physical properties and stratification of biological parameters. Fertiliser management strategies and guidelines for minimum-till kikuyu-ryegrass pasture were assessed in a survey throughout the southern Cape region. From this survey, the importance of soil microorganisms to secrete enzymes to make soil nutrients available for plants was clearly observed. When considering mean soil fertility levels, which did not infer any information on specific pastures, all essential plant nutrients were within the requirements of kikuyu-ryegrass pasture, but from an environmental sustainability perspective, phosphorus and zinc levels were too high. The P concentration was 16 to 23 times higher in the 0–100 mm layer of the cultivated pasture than in virgin soil and Zn concentration between 26 and 53 times higher, depending on the district. Such high concentrations could cause deleterious effects on ecosystem health or sustainability of pasture production. This could be as a consequence of irresponsible sales-driven fertiliser advice to farmers, or the continued adherence to lime and fertiliser guidelines that were originally developed for conventionally tilled pasture systems. It is important to follow fertiliser management strategies strictly for a specific tillage systems for specific pasture crops. Chemical quality of soil can only be managed when taking soil samples at least every second year. Liming and fertilisation should also be managed strictly according to the guidelines for the specific crop. Beware of over-fertilisation – it is unnecessary and detrimental for environmental sustainability.

The seasonal dry matter production, botanical composition and forage quality of kikuyu over-sown with annual or perennial ryegrass

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Kikuyu (*Pennisetum clandestinum*) is a well-adapted, persistent pasture base that can support high stocking rates due to high pasture growth rates during summer and autumn. However, low winter and spring growth rates and low forage quality restrict milk production per cow. As result, kikuyu is strategically over-sown with ryegrass (*Lolium* spp.) to improve seasonal dry matter (DM) production and nutritive value. The aim of this study was to determine the yield and nutritional value of irrigated kikuyu over-sown with perennial (*L. perenne*), Italian (*L. multiflorum* var. *italicum*) or Westerwolds (*L. multiflorum* var. *westerwoldicum*) ryegrass. The three pasture systems reached optimum growth during different months and seasons. Winter growth rates were low compared to other seasons. Peak growth rates occurred during spring for the Italian ryegrass-kikuyu pasture, summer for the Westerwolds ryegrass-kikuyu pasture and late spring and early summer for perennial ryegrass-kikuyu pasture. The lower growth rate of the Westerwolds ryegrass during spring, compared to the Italian ryegrass, resulted in a higher kikuyu component during spring, summer and autumn. The high growth rate of Italian ryegrass during spring impacted negatively on the summer DM production due to the delayed commencement of kikuyu growth during spring and resultant lower kikuyu density in summer. The three pasture systems had similar total annual DM production during year 1, but total annual DM production was higher for perennial ryegrass-kikuyu pasture during year 2.

This was attributed to the ability of the perennial ryegrass-kikuyu treatment to maintain DM production during periods when other treatments underwent a decrease in production, namely spring for Westerwolds ryegrass-kikuyu and summer for Italian ryegrass-kikuyu. As kikuyu density increased in kikuyu-ryegrass pastures from winter to summer, the DM and NDF content increased, while the ME content decreased. As a pasture for high producing dairy cows, all pastures were deficient in Ca during all seasons and in P during summer and autumn.

Grazing capacity, milk production and milk composition of kikuyu over-sown with annual or perennial ryegrass

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Kikuyu (*Pennisetum clandestinum*) is a highly productive pasture species that supports high stocking rates and milk production per ha, but production per cow is low due to low nutritive value. The aim of this study was to determine the grazing capacity, milk production and milk composition of dairy cows grazing irrigated kikuyu over-sown with Italian (*Lolium multiflorum* var. *italicum*), Westerwolds (*L. multiflorum* var. *westerwoldicum*) or perennial ryegrass (*L. perenne*) during autumn.

The grazing capacity of the kikuyu-ryegrass systems was lower during winter and autumn than during spring and summer, with the seasonal grazing capacity of the perennial ryegrass treatment more evenly distributed than that of the Italian and Westerwolds ryegrass treatments. The perennial ryegrass treatment had a lower butterfat and milk production per lactation than the Italian and Westerwolds ryegrass treatments, but had the highest milk solids and fat corrected milk production per ha. The latter was a result of the higher annual grazing capacity achieved by the perennial ryegrass treatment.

It was concluded that because kikuyu over-sown with perennial ryegrass supported a higher number of animals and had a more evenly distributed fodder-flow, it achieved higher animal production per ha than kikuyu over-sown with annual ryegrass varieties.

Production potential of Italian and westerwolds ryegrass established at different planting dates

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Fodder flow planning is essential for dairy pasture systems, because the successful implementation thereof allows fodder to be available throughout the year. Italian and Westerwolds ryegrass (*Lolium multiflorum* var. *italicum* and *westerwoldicum*, respectively) are temperate annuals often planted in the southern Cape region of South Africa. The monthly production potential of these grasses can be manipulated by planting date. The aim of this study was to determine the pasture production potential of Italian and Westerwolds ryegrasses planted at different planting dates in the southern Cape. Planting date influenced the production potential of both Italian and Westerwolds ryegrasses. Italian ryegrass planted between December and June, is more productive than Westerwolds ryegrasses planted during the same period. If the requirement of a fodder flow programme is to provide fodder from May until November, which includes the critical winter months (June, July and August), Italian ryegrass is a better option than Westerwolds ryegrass and should be planted during February or March. If the aim is to have high production in spring and early summer (September to December), Italian ryegrass should be planted during May or June. Regardless of the variety, annual ryegrass should not be planted later than June. This will result in short productive periods (three to four months) and the annual production will be low. When ryegrass is established in pure swards, Italian ryegrass is a better option than Westerwolds ryegrass based on growth rate and annual production. The results highlight the importance of developing pasture management guidelines for specific regions based on research and clear set criteria.