The Production Potential of Kikuyu (*Pennisetum clandestinum*) Over-Sown with Ryegrass (*Lolium* spp.) in a No-Till System

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The production potential of kikuyu (*Pennisetum clandestinum*) over-sown with ryegrass (*Lolium* spp.) in a no-till system

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Abstract. Pastures for milk production in the southern Cape of South Africa are based on no-till systems where kikuyu (*Pennisetum clandestinum*) is over-sown with ryegrass during autumn to improve seasonal pasture production and forage quality. The aim of the study was to quantify the pasture and milk production potential of kikuyu over-sown with Italian ryegrass (*Lolium multiflorum* var. *italicum*), Westerwolds ryegrass (*L. multiflorum* var. *westerwoldicum*) or perennial ryegrass (*L. perenne*). The study was conducted for 2 years on existing kikuyu pastures grazed by Jersey cows. Growth rate, dry matter (DM) production, botanical composition, forage quality, grazing capacity, milk composition and milk production were determined. Whilst each pasture type reached their peak growth rates during different months, the perennial ryegrass treatment maintained DM production during periods when the remaining pastures experienced a decrease in production. As a result, perennial ryegrass pasture maximised annual DM production and annual grazing capacity, and achieved a more constant grazing capacity. The butterfat and milk production per lactation were lowest for the perennial ryegrass treatment, but it recorded the highest milk production per ha. As ambient temperatures increased from winter to summer, the proportion of kikuyu increased for all pastures as did the DM and NDF content, although the ME content decreased. In summary, grazing capacity is the determining factor for milk production per ha on kikuyu-ryegrass based systems.

Keywords: Kikuyu, ryegrass, milk production, dry matter production, forage quality.

Introduction

The perennial tropical grass, kikuyu (*Pennisetum clandestinum*), contributes the greater part of feed in summer and autumn (Botha *et al.* 2008) on predominately pasture based dairy systems in the Southern Cape region of South Africa (Meeske *et al.* 2006). The production of kikuyu is seasonal with high dry matter (DM) yields corresponding to summer and autumn and low DM production during the cool seasons. Although kikuyu can support high stocking rates and milk production per ha (Colman and Kaiser 1974; Reeves 1997), production per cow is typically low because forage quality is low (Marais 2001).

Energy supplementation has been shown to effectively improve milk production of animals grazing kikuyu, but it can be expensive and requires an understanding of animal nutrition to implement successfully (Marais 2001). Alternatively, temperate grass species provide the least expensive forage source to fill the cool season-feed gap and may supplement the decline in forage quality during summer (Fulkerson *et al.* 1993). The strategic incorporation of temperate grasses, such as annual Italian (*L. multiflorum* var. *italicum*) and Westerwolds (*L. multiflorum* var. *westerwoldicum*) ryegrasses and perennial ryegrass (*Lolium perenne*), has been shown to improve the seasonal DM production and quality of kikuyu pasture (Botha 2003). The choice of species to over-sown into kikuyu has been found to influence the production of kikuyu during spring and summer (Elmore *et al.* 1997; Harris 1999; Botha 2008, 2009), and careful consideration should be given to the most appropriate selection of species and how it will affect forage flow and availability.

The aim of this study was to quantify and compare the DM yield, forage quality, grazing capacity and milk production from Jersey cattle when grazing kikuyu over-sown with Westerwolds, Italian or perennial ryegrass.

Materials and methods

The study was conducted for 2 years on 9 ha of an established irrigated kikuyu pasture. The 3 treatments consisted of Italian ryegrass, Westerwolds ryegrass and perennial ryegrass over-sown into kikuyu. The pasture was grazed by Jersey cattle to a residual height of 50 mm prior to planting ryegrass. In March, Italian ryegrass was planted at 25 kg/ha with an Aitcheson direct drill seeder after the kikuyu had been mulched to ground level (Botha *et al.* 2008). Westerwolds ryegrass seed was broadcast at 25 kg/ha and then mulched (Botha 2003). In April, perennial ryegrass was planted at 20 kg/ha using an Aitcheson seeder following mulching of kikuyu. All treatments were re-established using the same methods and time of establishment in year 2. Pastures were strip-grazed by Jersey cows according to a 28 day grazing cycle in a put and take system. All treatments were grazed simultaneously, with animal numbers adjusted according to DM production. A fresh strip of grazing was allocated after

twice daily milking. Pastures were fertilized with N fertiliser at equivalent of 50 kg N/ha after each grazing.

Dry matter production was calculated using a rising plate meter (Stockdale 1984; Fulkerson 1997), which was calibrated 3 times a month for each treatment. Botanical composition was determined once a month by cutting 3 samples per treatment, pooling samples, taking a grab sample and dividing it into 3 fractions (kikuyu, ryegrass and other). Samples were dried and weighed to determine percentage contribution of each fraction. Samples for quality analyses were collected and analysed for *in vitro* organic matter digestibility (IVOMD), crude protein (CP), Phosphorous (P) and calcium (Ca). Metabolisable energy (MJ/kg DM) was calculated from the IVOMD (ME = 18.4 X IVOMD% x 0.81).

Animal measurements were taken on 15 multiparous Jersey cows per treatment that were blocked according to calving date, lactation number and 4 % fat corrected milk (FCM) production for the previous lactation. The same 15 cows grazed only one treatment for the duration of their lactation (305 days). Fifteen new cows were allocated to each treatment at the commencement of the second year. The cows were allocated fresh pasture twice a day to achieve 9 kg DM intake per day. The diet was supplemented with 4 kg (wet weight) of concentrate fed at 2 kg per milking. Daily milk yield was recorded by an automated milk machine and milk composition was determined on a monthly basis. Calculations were made on grazing capacity (cows/ha), 305 day milk yield, fat corrected milk production and milk production per ha.

Results and discussion

The total seasonal DM production of kikuyu over-sown with ryegrass species is shown in Table 1. The Italian ryegrass pasture had the highest (P>0.05) spring production in years 1 and 2 and the lowest (P<0.05) during summer. The high production in spring was attributed to high growth rates of ryegrass which out-competed the growth of kikuyu. The long-term effect was a reduction in production from kikuyu during summer. The Westerwolds pasture recorded the highest (P<0.05) DM production during summer in both years, but had the lowest (P<0.05) DM production during spring. Westerwolds tillers commenced set seed and senescence in spring earlier than the other ryegrasses, which provided the opportunity for kikuyu plants to grow and dominate the pasture. Subsequently production from kikuyu during summer was high. During year 2, DM production of the perennial ryegrass-kikuyu pasture was either higher (P<0.05) or similar to the other ryegrass-kikuyu pastures in different seasons.

The total annual DM production of pastures on completion of years 1 and 2 is shown in Table 2. All treatments recorded a similar DM production during year 1 with approximately 18,000-19,000 kg DM/ha. In year 2 DM production of the perennial ryegrass-kikuyu pasture was higher (P<0.05) than the other 2 pastures, with 16,202 kg/ha. The increased total production in this pasture occurred because it maintained high DM production during periods when the other pastures underwent production decreases.

The kikuyu component increased for all treatments from winter to summer, resulting in an increase in DM and NDF content, while the ME content decreased. It was found that if ryegrass was maintained at higher levels in the kikuyu-based pastures during summer and autumn (as for the Italian ryegrass-kikuyu treatment during year 1 and the perennial ryegrass-kikuyu treatment during year 2), it resulted in higher ME values of pastures during these seasons. Forage quality was thus, in general, positively related to the proportion of ryegrass in the pasture. All pastures were deficient in calcium (Ca) and did not meet the requirements for dairy cows throughout the experimental period. Therefore, dairy cows grazing kikuyu over-sown with ryegrass should be supplemented with Ca. The phosphorous (P) content of the kikuyu-based systems was also deficient, especially for high producing dairy cows during summer and autumn. The Ca:P ratio of all the ryegrass-kikuyu pastures was below the recommended ratio of 1.6:1 for dairy cows (NRC 1998).

The mean annual grazing capacity, 305 day 4% Fat corrected milk (FCM) production, FCM milk production per ha and milk solids production per ha for kikuyu over-sown with Italian, Westerwolds and perennial ryegrass during year 1 and year 2 is shown in Table 3. Perennial ryegrass pasture recorded the highest (P<0.05) mean annual grazing capacity throughout the study, but had the

Table 2. The total annual dry matter production (kg DM/ha annum) of kikuyu pastures over-sown with Italian (KIR), Westerwolds (KWR) or perennial (KPR) ryegrass during year 1 and year 2

Pasture type	Year 1	Year 2
KIR	18.768 a	13.479 b
KWR	18.880 a	14.040 b
KPR	18.083 a	16.202 a
LSD (0.05)	819	713

*LSD (0.05) compares within year over seasons. abcd: Means with no common letter differ significantly

Table 1. The total seasonal dry matter production of kikuyu pastures over-sown with Italian (KIR), Westerwolds (KWR) or perennial (KPR) ryegrass during year 1 and year 2

	Year 1				Year 2			
Pasture	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
KIR	3.512 d	6.073 b	6.161 b	3.022 d	2,864 de	4,980 ab	4.385 bc	1.428 g
KWR	3.422 d	4.774 c	7.412 a	3.272 d	2.958 de	4.149 c	5.516 a	1.621 fg
KPR	2.084 e	5.117 c	7.380 a	3.502 d	3.273 d	5.610 a	5.044 ab	2.275 ef
*LSD (0.05)	780				687			

*LSD (0.05) compares within year over seasons. abcd: Means with no common letter differ significantly

Table 3. Mean annual grazing capacity, 305 day 4% Fat corrected milk (FCM) production, 4% FCM milk production per ha and milk solids production per ha for kikuyu over-sown with Italian (KIR), Westerwolds (KWR) and perennial (KPR) ryegrasses during year 1 and year 2.

Year	Parameter	Units	Treatments			LSD (0.05)
			KIR	KWR	KPR	
1	Grazing capacity	Cows/ha	6.44 b	6.49 b	6.93 a	0.273
	305-day 4% FCM production	kg/cow	5.551 ab	5.670 a	5.352 b	276.7
	Milk solids production	kg/cow	427 a	433 a	404 b	21.6
	4% FCM production per ha	kg FCM/ha	3.4556 a	3.4057 a	3.5268 a	1.698.90
	Milk solids production per ha	kg MS/ha	2.627 a	2.566 a	2.639 a	128.5
2	Grazing capacity	Cows/ha	5.34 b	5.52 b	5.96 a	0.35
	305-day 4% FCM production	kg/cow	5.773 a	5.769 a	5.182 b	358
	Milk solids production	kg/cow	432 a	433 a	387 b	27.5
	4% FCM production per ha	kg FCM/ha	3.0087 b	3.0052 b	3.3086 a	1.425.90
	Milk solids production per ha	kg MS/ha	2.247 b	2.258 b	2.457 a	106.6

ab: Means in the same row with different letters differed significantly at $P<0.05$. LSD (0.05) compares within rows across treatments

lowest 305-day FCM production and milk solids production per cow during both years. The FCM production per ha and milk solids production per ha of perennial ryegrass-kikuyu was, however, higher ($P<0.05$) or similar to that of the other treatments during both years. Thus, while the perennial ryegrass-kikuyu treatment had lower production per animal during both years, it sustained a higher production per ha because it maintained a higher grazing capacity.

Conclusions

Over-sowing kikuyu with ryegrass during autumn reduced the production potential of kikuyu during summer and autumn. The extent of the reduction was dependent on the DM production of ryegrass during spring. Interestingly, over-sowing with perennial ryegrass on an annual basis achieved a higher total DM accumulation compared to annual ryegrass. This may partly be due to the contribution of DM production from perennial ryegrass plants that survived and persisted following establishment in year 1.

A mixed pasture containing ryegrass and kikuyu improved the overall forage quality of kikuyu during summer and autumn. The perennial ryegrass pasture provided a consistent supply of feed throughout the experiment, which supported a higher stocking rate and achieved higher milk production compared to cows grazing kikuyu over-sown with Westerwolds and Italian ryegrass. In summary, over-sowing kikuyu with perennial or annual ryegrasses can be used to manipulate the dairy production system to either maximise milk production per animal or milk production per ha.

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