New WRC guidelines helping dairy farmers to greener pastures

New irrigation guidelines for pasture production developed under the auspices of the Water Research Commission (WRC) are proving to farmers that with the efficient application of water and fertiliser the grass can be greener on their side of the fence. Article compiled by Lani van Vuuren.

According to the Milk Producers' Association, South Africa's dairy farmers are expected to produce 2 460 million litres of milk for 2012. As the human population increases and diets become more affluent, so the demand for animal protein (such as milk) increases. At the same time, farmers are under pressure to decrease their share of water and fertiliser usage.

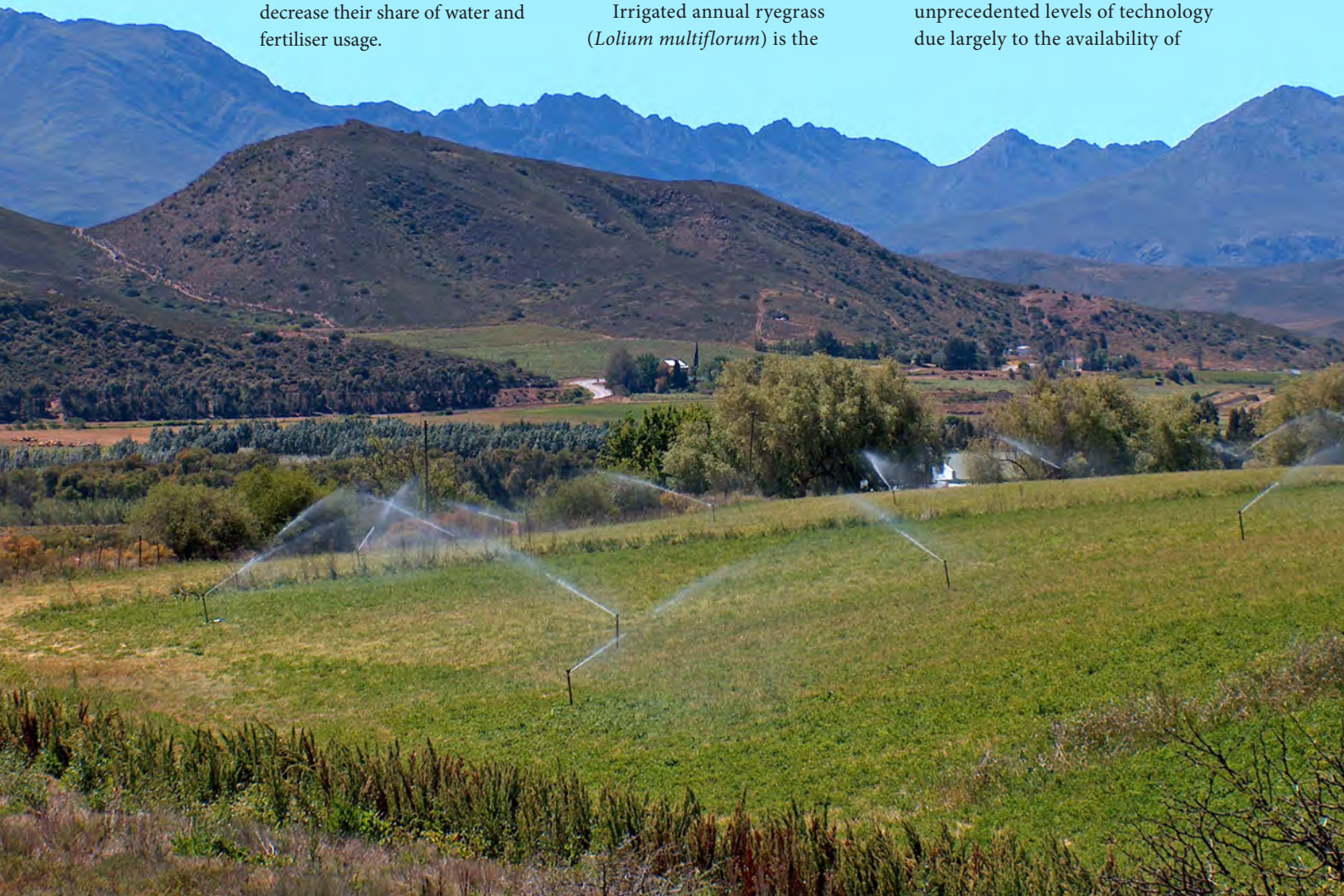
No wonder then that of all farming enterprises dairy farming places the highest demand on advanced technology. Expert knowledge is not only required for milking, but also to provide the milking cow with the kind of nutrition that will allow her to produce the optimum amount of quality milk.

THE NEED FOR PASTURES

As a result of South Africa's variable climate, general water scarcity, and often marginal soils, it is not unusual for dairy farmers to supplement their herds' feed with irrigated pastures. It is estimated that the total area utilised for irrigated pasture production is about 16% of the total area under irrigation in South Africa.

Irrigated annual ryegrass (*Lolium multiflorum*) is the primary sources of feed in the pasture-based dairy industry, and is mostly grown in the relatively higher rainfall areas, particularly the KwaZulu-Natal Midlands, Eastern Highveld, Eastern Cape and in the winter rainfall areas of South Africa. Annual ryegrass has high nutritional qualities, palatability, digestible energy, protein and mineral contents, playing an essential role in supplying good quality grazing between the winter and summer seasons. On the other hand, kikuyu (*Pennisetum clandestinum*) is the predominant summer grass pasture used for milk production along the east coast of South Africa.

Although management of dairy farming has now attained unprecedented levels of technology due largely to the availability of



practical equipment and methods for managing (specifically planning and monitoring) most facets of dairy farming, this does not apply to the irrigation of pastures. In spite of the increasing role of pastures in milk production, farmers still generally rely on experience and tradition even for managing the most important pasture production factors.

Irrigation water and nutrients are resources that can be optimised by selecting an appropriate irrigation type, scheduling technique and pasture type. For sustainable pasture production, the best possible fertiliser and water regimes are required in order to attain high biomass yield with minimum inputs, which maximises profit while minimising the impact on the environment. The most appropriate and cost-effective management strategy would therefore be to integrate irrigation and nutrient (especially nitrogen) inputs, since nitrogen and water cannot be managed independently.

Despite the latest fertiliser and irrigation application equipment and scientifically-based guidelines, knowledge gaps have been identified between research and farming practices. A number of experiments have been carried out throughout the country on the effect of nitrogen on yield and quality of grass pastures; however, there is a lack of reliable information and data pertaining to ryegrass water requirements to facilitate efficient irrigation management.

To fill some of these knowledge gaps the WRC funded a five-year solicited project to study the irrigation management of ryegrass and kikuyu pastures under different management conditions. The research was undertaken by the universities of KwaZulu-Natal (UKZN) and Pretoria (UP) along with the CSIR. The main objective was to study water use of these pastures, with field experiments undertaken over a period of two years at two agricultural research sites (in Pretoria and KwaZulu-Natal). This has led to the recent publication of water use and irrigation guidelines for the major pasture growing areas of South Africa.

FIELD TRIALS

At UP's Hatfield experimental farm and UKZN's Cedara research station experiments were conducted to determine the effects of different water levels in combination with different nitrogen fertiliser applications on the growth rate and dry matter production, quality, water use and water use efficiency of annual ryegrass for two seasons.

The experiments showed that irrigation and nitrogen fertiliser affected yield and leaf area significantly. Higher frequency of irrigation coupled with high fertiliser application greatly improved dry matter yield. Interestingly, there was no significant difference in yield between the treatments that were irrigated twice weekly and once weekly at the high nitrogen application. In fact, the decrease in the frequency of water application (and the resultant water stress) resulted in a generally superior end product. The highest water use efficiency was achieved by irrigating once every two weeks. The study concluded that by irrigating once a week and fertilising with high nitrogen application rate after each harvest, optimum yield can be achieved with better quality pasture and a better water use efficiency.

MODELLING COMPONENTS

During the WRC project the use of numerical models was investigated for achieving optimised growth of ryegrass through efficient use of water and nitrogen fertilisation. Several crop models were tested, and in the end the Soil Water Balance (SWB) model was used. This model is already being used extensively to simulate crop growth and soil water balance of several cereals, vegetables and tree crops. The model is available on the Web and can be downloaded free of charge.

Graeme Williams/Media Club South Africa

South Africa's semi-arid climate leaves farmers no choice but to supplement their livestock's feed.

Lani van Vuuren

Table 1: Summary of measured water use and yield of annual ryegrass at the research sites

Site	N rate	Year	Growth cycles	Forage yield (t/ha)	Water use (mm)
Hatfield	0	Year 1 and 2	4	4.8-5.4	320-342
	30			7.5-8.3	344-386
	60			9.4-10.2	378-423
Cedara	0	Year 1	8	8.2	701
	30			13.2	779
	60			15.6	816
Cedara	0	Year 2	7	5.9	493
	20			10	547
	40			13	564
	60			13.8	571
Cedara	60	Year 2	45 days	-	161

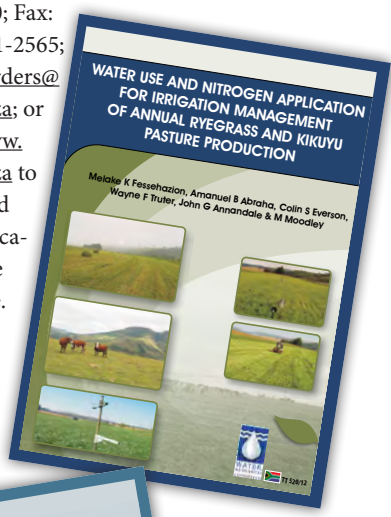
Source: WRC Report No TT 520/12

Pasture systems are highly temporally and spatially complex, as they involve interactions among crop growth, nutrient dynamics between soil, plant and animal and pasture management systems. Hence, it is difficult to evaluate the whole system with short-term monitoring experiments. Models, however, can be used to extrapolate research findings to pasture growing areas. This technology can also be useful in selecting the best management practices for specific sites and environmental conditions.

The SWB model was evaluated at two sites for different irrigation treatments in two ryegrass growing seasons. The simulated yield and leaf area index were in good agreement with the observed values. The simulated values of root zone soil water deficit and daily evapotranspiration were also in reasonable agreement with the measured values. The good agreement between observed and simulated data for different sites and irrigation regimes gives confidence that the SWB model can be used to predict long-term pasture growth and water use under different irrigation management scenarios.

In essence, the guidelines should prove a valuable addition to the dairy's farmers pasture management toolbox. ❑

- To order the reports, *Water use and nitrogen application for irrigation management of annual ryegrass and kikuyu pasture production* (**TT 520/12**) and *Irrigation guidelines for annual ryegrass pasture* (**TT 521/12**), contact WRC Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za; or Visit: www.wrc.org.za to download the publications free of charge.



Irrigated pastures are an inextricable part of livestock farming in many parts of South Africa.

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