Development of sustainable lucerne pastures for wool production

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There has been a decrease in the productivity and sustainability of lucerne pastures used in the grain cropping regions of the Western Cape. One of the problems is aphid infestation. This resulted in a decline in the yield of SA Standard, previously the only locally available cultivar. New more aphid resistant cultivars are therefore imported. Many of these cultivars are not persistent under the close grazing employed. Using the correct lucerne cultivar for grazing is therefore of utmost importance. As cultivars change, the process of evaluation of new cultivars for persistence and yield under grazing is a continuous research area. The seed of the new imported lucerne cultivars is, however, very expensive and research also has to be conducted to reduce seeding rates, improve establishment and to increase the lifespan of lucerne pastures.

A Trial was conducted to evaluate 17 lucerne cultivars for yield and persistence under dryland and local grazing conditions in the Caledon district of the Overberg on the Roodebloem Experiment Farm of Overberg Agri. The trial has now completed a five year period (2009 to 2014). The trial was planted in a larger paddock and is utilized and grazed by Merino sheep as part of the farm's grazing system. The cultivars varied in winter activity. The winter activity class of the cultivars is shown in Table 1.

Roodebloem receives 67% of its average 550 mm annum^{-1} of rainfall during the period May to October. The average maximum/minimum temperature during this period is 19.4^{o}C/7.7^{o}C, while the drier November to April period has an average maximum/minimum temperature of 26.5^{o}C/14.3^{o}C.

The experimental sites were previously planted to barley and wheat for five seasons and cultivated twice just before sowing, using a standard shallow tine implement. The soil is of shale origin, stony and of the Klapmuts form and were analysed and fertilised and limed to lift the P (> 30 mg kg^{-1} P, citric acid method), K (> 50 mg kg^{-1} K) and pH_{KCl} (> 5.5) levels.

Individual plot sizes are 16m x 9m. Seed was sown shallowly at 15 kg ha^{-1} in 150 mm wide rows during May of 2009 using a small plot planter. All seeds were inoculated with the standard commercial lucerne inoculant strain using the standard pH neutral commercial glue, developed for this purpose, before sowing.

The lucerne stand density of each cultivar was determined thrice, once during each of 2012, 2013 and 2014. In the past it was estimated as the number of squares containing parts of lucerne within 60 grid 0.25

m^2 quadrates was used as index of cover. But due to the grazing management practices applied to the present trial, lucerne plants were physically dug up the last two years in one 0.40 m^2 sample per plot, counted and weighed (top and root mass).

Lucerne yield is determined by cutting 0.17 m^2 samples with sheep shears to ground level every 6 to 8 weeks in and outside each of two round 0.72 m^2 randomly placed welded galvanised wire mesh exclosure cages per plot. The cages are moved to a new random position in a plot after each sampling. The cut samples are washed, dried to constant mass at 59^{o}C and weighed to determine the dry matter (DM) yield. Yield was calculated as the difference between the available DM outside each cage during the previous sampling date and the available DM within the cage on a particular sampling date. Yield is expressed as kg DM ha^{-1} $annum^{-1}$ over the whole period of the trial.

Table 1. Cultivars and their winter activity evaluated at Roodebloem, Caledon

Cultivar	Winter Activity
KKS7000	10
WL903	9
SuperStar	9
SuperCuf	9
KKS9911	9
Pegasis	8.5
SuperSiriver	8
Magna804	8
WL414	7
SuperAurora	7
SA Select	7
KKS4000	7
SA Standard	6
Magna601	6
Icon	6
WL357	5
Venus	5

The data were statistically analysed, using the SAS (2008) program to perform analysis of variance.

Results

Annual dry matter yield

The average dry matter yield and the estimated grazing capacity in DSU (dry sheep units)/ha of the 17 cultivars over the whole trial period

is shown in Table 2. There was a significant ($P \leq 0.05$) interaction in the yield and season for the cultivars. Magna 804 tended to be highest yielding, followed by KKS4000, WL903, SA Select, Magna 601, Super Aurora and WL 414. SA standard was one of the lowest yielding cultivars during all seasons and had a 36% lower grazing capacity than Magna804.

Table 2. The average dry matter yield of 16 lucerne cultivars at Roodebloem, Caledon from 2009 to 2014

Cultivar	Yield kg ha^{-1} d^{-1}	Yield (kg $annum^{-1}$ ha^{-1})	Grazing capacity DSU ha^{-1}	Data with same letter do not differ (P<0.05)
Magna 804	5.55	2024	2.8	a
KKS4000	5.45	1989	2.7	a
WL903	5.23	1907	2.6	a
SA Select	4.89	1785	2.4	ab
Magna 601	4.84	1765	2.4	ab
Super Aurora	4.78	1746	2.4	abc
WL414	4.77	1742	2.4	abc
Icon	4.62	1687	2.3	abc
Venus	4.43	1618	2.2	abc
Super Siriver	4.37	1594	2.2	abc
Pegasis	4.33	1580	2.2	abc
WL357	4.18	1525	2.1	abc
Super Star	4.00	1461	2.0	abc
SA Standard	3.62	1322	1.8	bc
KKS7000	3.46	1262	1.7	bc
KKS9911	3.45	1258	1.7	bc
Super Cuf	3.24	1182	1.6	c

Lucerne population

The average number of lucerne plants differed significantly ($P<0.05$) between cultivars. The results are shown in Table 3. SA Select tended to have the most plants and KKS 4000.

Table 3. Average number of lucerne plants over 16 lucerne cultivars during three years (2012 to 2014) at Roodebloem, Caledon

Cultivar	Number of Plants m^{-2}	Data with same letter do not differ (P<0.05)
SA Select	**64.7**	a
Pegasis	**63.8**	ab
SA Standard	**61.0**	abc
Venus	**53.1**	abcd
Magna 601	**49.1**	abcde
Icon	42.1	bcdef
WL 414	39.1	cdef
Super Siriver	37.8	def
Super Cuf	35.8	def
Super Aurora	35.8	def
WL 357	35.3	def
Magna 804	33.6	def
Super Star	30.2	ef
WL 903	30.0	ef
KKS 9911	28.1	ef
KKS 7000	21.7	f
KKS 4000	21.2	f

The number of lucerne plants declined significantly (P<0.05) from 2012 to 2013, but the cultivars did not respond significantly (P<0.05) differently. The average plant numbers during consecutive seasons are shown in (Table 4).

Table 4. Average number of lucerne plants over 16 lucerne cultivars during three years (2012 to 2014) at Roodebloem, Caledon

Year	Number of Plants m^{-2}	Data with same letter do not differ (P<0.05)
2012	47.8	a
2013	34.2	b
2014	38.4	b

The average mass individual lucerne $plant^{-1}$ increased from 2012 to 2014 (Table 5).

Table 5. Average total lucerne mass over 16 lucerne cultivars during three years (2012 to 2014) at Roodebloem, Caledon

Year	Lucerne mass kg ha^{-1}	Data with same letter do not differ (P<0.05)
2012	1074	b
2013	1278	b
2014	1530	a

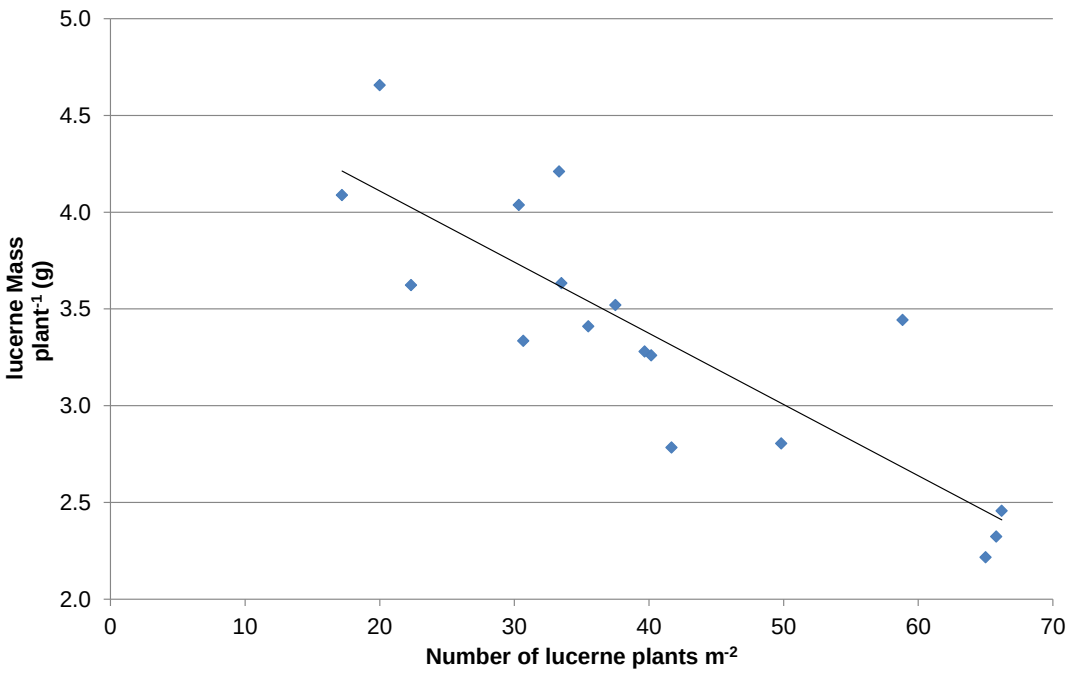
The mass per plant differed significantly (P<0.05) between cultivars and KKS 7000 tended to have the largest mass per plant and SA Select lowest (Table 6).

Table 6. Average individual lucerne plant mass of 16 lucerne cultivars over three years (2012 to 2014) at Roodebloem, Caledon

Cultivar	Lucerne mass g plant^{-1}	Data with same letter do not differ (P<0.05)
KKS 7000	**6.17**	a
WL 357	**4.89**	ab
Magna 804	4.79	b
Super Star	4.37	bc
Super Aurora	4.22	bc
KKS 4000	4.06	bcd
Magna 601	3.87	bcde
WL 414	3.86	bcde
KKS 9911	3.86	bcde
Super Cuf	3.76	bcde
Super Siriver	3.66	bcde
WL 903	3.60	bcde
Icon	3.37	cde
Venus	2.82	de
Pegasis	2.63	e
SA Select	2.55	e
SA Standard	2.53	e

The relationship between lucerne plant number and plant size is shown in Figure 1.

Figure 1. Relationship between the number of lucerne plants and the mass per plant over two years (2012 and 2013) at Roodebloem, Caledon



The data clearly shows that there was a negative relationship between plant number and plant mass. Individual plant size thus declined with increased plant numbers over cultivars and in time. Lucerne cultivars with the most plants thus had smaller plants, while plant size increased as plant numbers declined. This explains the fact that Lucerne production does no decline as fast as plant number and that relatively few lucerne plants will still produce substantial amounts of dry matter.

Conclusions

Research executed over many years, have shown lucerne to be very responsive to grazing management. The yield, quality and persistence of this pasture legume are severely influenced by the frequency and intensity of utilization, although cultivars differ in their sensitivity to grazing management. Level and frequency of grazing further also influences the competitiveness of lucerne with annual winter broad leaf and grass weeds in the winter rainfall area. The fact that this trial, in contrast to the previous two conducted from 2001 to 2009, was not fenced of and grazed continuously and severely may have influenced the results. The more winter active cultivars therefore performed relatively better in contrast to those which are more winter dormant and perhaps more prone to competition from annual winter weeds.

The grazing management of the trial could therefore have influenced the relative yield of the cultivars. It is, however, clear and also welcomed that some of the more winter active cultivars performed well in comparison to the more dormant cultivars. The trial should continue

for at least another season. Future trials should, however, again be fenced off to allow the proper management of the trial, without undue interference with the running of the farm.