HAY PRODUCTION OF LUCERNE CULTIVARS IN THE LOCKYER VALLEY, SOUTH-EAST QUEENSLAND

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ABSTRACT

The ability of aphid-resistant lucerne cultivars to produce hay has been the subject of considerable debate. While small-plot cutting experiments satisfactorily evaluate the growth potential of cultivars, they are not able to evaluate their hay-making capabilities. An unreplicated investigation was conducted over a 4-year period to assess the production and hay quality of 8 cultivars. Sufficiently large areas were sown to each cultivar (0.22 ha) so that commercial equipment could be used for hay making and irrigation.

Trifecta produced 17 t/ha more hay over the 4 years than Hunter River, and made hay which generally was of similar quality. Only in mid winter was its hay of slightly lower quality than that of Hunter River. However, it was not as badly downgraded as that produced by some highly winter-active cultivars. There was little difference in hay yield between the other cultivars or a mixture of 7 cultivars. Most cultivars made prime quality hay in the period of active growth (September to April).

RESUMEN

La habilidad para producir heno de cultivares de alfalfa resistentes a áfidos, ha sido tema de considerable debate. Mientras cortes en experimentos de pequeñas parcelas satisfactoriamente evalua el potencial de crecimiento, estos no son aptos para evaluar la capacidad de los cultivares para la elaboración de heno. Un estudio fue dirigido por un periodo de 4 años para evaluar la producción y calidad de heno de 8 cultivares. Areas suficientemente grandes se sembraron para cada cultivar (0.22 ha), debido a esto equipo comercial pudo ser utilizado para la elaboracion de heno y riego.

Durante los 4 años Trifecta rindió 17 t/ha mas heno que el cultivar Hunter River, y produjo heno generalmente de calidad similar. Solamente a mediados de invierno su calidad fue ligeramente inferior que la Hunter River. Sinembargo, no tan baja como las exhibidas por algunos cultivares altamente activos en invierno. Asimismo hubo poca diferencia en el rendimiento de heno entre los otros cultivares o en la mezcla de los 7 cultivares. Durante el periodo de crecimiento activo (septiembre-abril), la mayoria de los cultivares produjo heno de primera calidad.

INTRODUCTION

Many aphid-resistant lucerne cultivars imported from USA or bred in Australia were shown to be higher yielding and more persistent than cv. Hunter River in small-plot cutting experiments (Brownlee *et al.* 1984; Lowe *et al.* 1985; Lowe *et al.* 1987a) but they did not always show the same superiority when used for commercial hay production. Furthermore, many of these cultivars reputedly produced lower quality, less leafy hay. Some of these problems could be attributed to different cutting management requirements of winter-active cultivars compared with Hunter River. However, the inconsistent performance of some cultivars can not be explained completely in this way.

Mixtures of cultivars have been used in U.S.A. to improve production and extend the growing season. Although this technique had not been evaluated in Australia, it was thought that combining the higher productivity of highly winter-active lines with

the longer persistence of the semi-dormant cultivars might successfully improve hay production.

Therefore, an investigation was undertaken in the Lockyer Valley, a major haymaking area in south-east Queensland, to evaluate the haymaking potential of the highest-yielding and best-persisting cultivars from earlier small-plot cutting experiments (Lowe *et al.* 1985; Lowe *et al.* 1987a). A mixture containing all the cultivars except Trifecta (of which there was insufficient supplies of commercial seed at the time) was also included to compare its performance with single cultivar swards.

MATERIALS AND METHODS

Site

The soil was a dark self-mulching medium clay alluvium (Ug 5.12, Northcote 1971) located at Gatton, south-east Queensland. An annual maintenance application of 125 kg/ha of superphosphate was applied to counteract any possible deficiency (Dickson and Asher 1974).

Treatments and Design

Eight lucerne cultivars (Table 1) and a mixture of all the cultivars except Trifecta were sown in unreplicated plots of 0.22 ha. These plots were large enough that commercial haymaking equipment could be used to make hay separately from each. The cultivars were grouped in 2 blocks, one containing 4 highly winter-active cultivars and the other containing the 4 winter-active or semi-dormant types and the mixture. This arrangement allowed each group of cultivars to be given the management which best suited that activity level (Gramshaw *et al.* 1981). The positions of the 2 blocks, and of cultivars within them, were randomly allocated.

Management

Plots were sown by combine drill on July 21, 1983, with a seeding rate of 15 kg/ha. Irrigation was applied using both handshaft equipment and a travelling irrigator. During the 4-year period, 50 mm was applied every 2-3 weeks unless more than 25 mm of rain fell in the preceding 7-day period.

Areas were mown to a total of 9, 10, 11 and 11 times in the first, second, third and fourth years, respectively. Hunter River had to be managed separately from the others in its grouping on one occasion because a severe spotted alfalfa aphid attack restricted growth. The highly winter-active cultivars were defoliated 41 times, Hunter River 39 times and the remaining cultivars 40 times over the 4-year measurement period.

Hay management was kept as close as possible to commercial techniques (Mills 1985), with baling being conducted during the cool early-morning period to avoid leaf loss. Cutting time of each block of cultivars was determined when the tiller buds of the majority of the cultivars reached the desired maturity (Gramshaw *et al.* 1981). Bale numbers were recorded, and 3 representative bales weighed to measure average bale weights. To compensate for the drying of the sward between baling the first and last plots, baling was done from one end of the block at one defoliation, and the order reversed for the next. Checks on moisture content at baling suggested that variation was only small ($\pm$ 1.5%); most hay was baled at around 26% moisture.

The quality of hay produced by the cultivars was evaluated by submitting 2 bales of each cultivar to a local produce merchant in mid-summer and mid-winter of the second year of the investigation (1984/85). There is no defined method of rating hay in Queensland, but produce merchants usually conduct a visual appraisal which covers such attributes as leafiness, stem thickness, aroma and the degree of bleaching.

Plant population was assessed in autumn or spring of each year by counting plants in 50 random quadrats (each 0.5 $\times$ 0.5 m) within each cultivar area. Comparative leaf-disease damage ratings using the technique of Lowe *et al.* (1987b) were conducted on 2 occasions when substantial outbreaks of the diseases occurred.

RESULTS AND DISCUSSION

Plant establishment and persistence

All cultivars established with an adequate stand density (Gramshaw 1978). The somewhat lower density at establishment for Trifecta (Table 1) was the result of using the first available commercially-harvested seed containing a proportion of green seed. It was also observed that Trifecta had less vigorous seedlings than the other cultivars but these differences disappeared after the first 3 weeks (data not presented).

The stand density of all cultivars dropped rapidly in the first 12 months but remained reasonably constant thereafter (Table 1). This pattern of population decline was similar to that predicted by Gramshaw (1978) and exhibited in cutting experiments (Lowe *et al.* 1985; 1987a). Trifecta exhibited the best percentage stand survival (35%), but Hunter River and Pioneer 581 still retained higher plant numbers after 5 years by virtue of their higher initial populations. These latter cultivars had smaller plant crowns than Trifecta and this allowed the more rapid invasion of summer weeds such as summer grass (*Digitaria* spp.), Rhodes grass (*Chloris gayana*) and blue couch (*Digitaria didactyla*).

TABLE 1

Persistence of lucerne cultivars under commercial hay making management at Gatton, s.e. Queensland

Cultivar	Plant density					% survival
	Initial (Sept 83)	Aug 84	Sept 85	Jun 86	Apr 87	Apr 87
			(plants/m^2)			(%)
Matador	198	81	60	57	56	28
Maxidor 2	186	77	74	51	50	27
Granada	247	88	71	58	57	23
CUF101	220	73	69	57	54	25
Baron	258	98	89	64	62	24
Trifecta	175	88	76	64	61	35
Hunter River	250	95	97	82	73	29
Pioneer 581	275	89	85	86	87	32
Mixture	253	80	83	59	56	22

Hay production

Trifecta produced 88.3 t/ha of hay over 4 years, outyielding the other aphid-resistant cultivars by 9-13 t/ha and Hunter River by 17 t/ha (Table 2). This superiority occurred in all 4 years (Fig. 1) and mirrors the performance of Trifecta in small-plot cutting experiments (Lowe *et al.* 1987a). The difference in hay yields between the imported cultivars and the mixture was small, amounting to only 4.5 t/ha over 4 years. Hunter River was lower yielding than Trifecta in all years, but the differences were greatest in the first year. This reflects the susceptibility of Hunter River to *Pytophthora* root rot (Gramshaw *et al.* 1985), a disease which is endemic in the clay soils of south-east Queensland (Irwin 1974; 1977).

The stands became quite grassy in the fourth year; a check of weed content of the baled material in late summer (1987) showed that hay from the highly winter-active or winter-active lines (Matador, Maxidor 2, Granada, CUF 101 and Baron) contained more than 25% of grass while 21% of the mixture and Hunter River hay was also grassy weed. Only Trifecta (11%) and Pioneer 581 (13%) contained acceptable contaminant levels at this time.

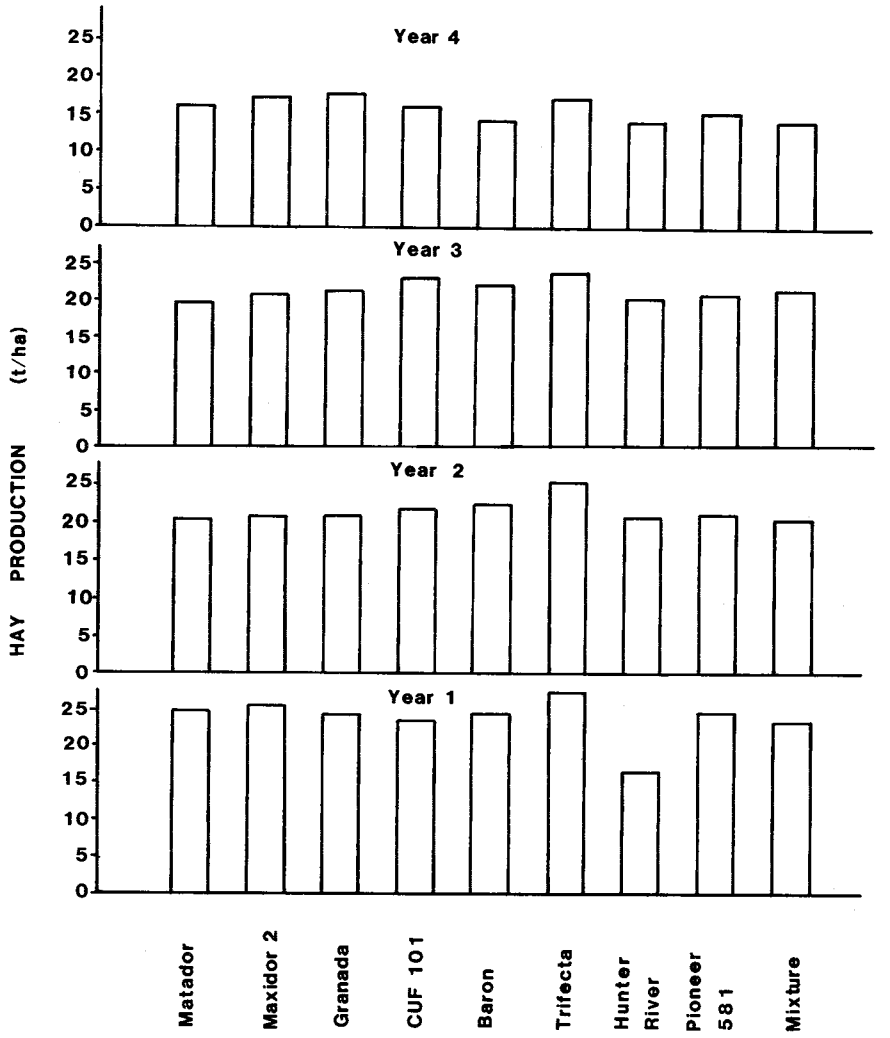

FIGURE 1

Hay production (av. 26% moisture content at baling) of 8 lucerne cultivars and a mixture containing seed of all cultivars except Trifecta over 4 years at Gatton Research Station.

Hay quality

In Queensland, lucerne hay is sold on the basis of leafiness, aroma and lack of contaminants. Therefore, these attributes rather than nutritional measurements, define hay "quality" in a commercial sense although there is little definite evidence to relate nutritional quality to these attributes. Mid summer hay from all stands was rated either off-prime or prime in quality (Table 2), suggesting that all cultivars, irrespective of winter activity level can make top-quality hay if cut at the optimum time for that activity-grouping. On the other hand, only the semi-dormant cultivars, Hunter River and Pioneer 581, made top quality (prime) hay in winter. Those with higher winter-activity levels than Hunter River made hay which ranged from off-prime to poor quality. This was generally associated with hay that was too stemmy,

and contained a low proportion of leaf. Although these measurements are subjective and open to wide interpretation, they do indicate that there is a considerable problem in making hay from the more active cultivars in the cooler part of the year even when the best management strategies are used, and confirm the criticism made by hay producers.

TABLE 2

Total hay production, number of bales produced, average bale weight and the quality of hay produced by commercial haymaking equipment from 8 lucerne cultivars and a mixture of cultivars

Cultivar	Total hay production in 4 years[1]	Average number of bales		Average bale weight[1]	Average hay quality	
		per year	per cut		mid summer	mid winter
	(t/ha)	(no./ha)		(kg)		
Matodor	75.4	705	69	26.8	prime	off-prime
Maxidor 2	79.0	740	73	26.7	prime	off-prime
Granada	77.8	728	72	26.8	prime	poor
CUF101	79.0	747	73	26.4	off-prime	poor
Baron	77.8	733	74	26.4	off-prime	off-prime
Trifecta	88.3	776	78	28.3	prime	off-prime
Hunter River	71.4	663	71	26.8	prime	prime
Pioneer 581	76.7	714	72	26.8	prime	prime
Mixture	76.8	760	76	25.2	prime	-[2]

[1] Average moisture content 26%
[2] No sample submitted

Leaf diseases

Severe outbreaks of the leaf diseases Stemphylium leaf spot (*Stemphylium vesicarium*) and pepper leaf spot (*Leptosphaerulina trifolii*) became a major concern for hay producers while this study was in progress. To evaluate the relative susceptibility of the cultivars to the diseases, comparative ratings were conducted when substantial outbreaks occurred.

The 3 cultivars with the least winter activity (Trifecta, Hunter River and Pioneer 581) were always less affected by the diseases (Table 3), further emphasising the value of Trifecta and Pioneer 581 for cool season hay production. Leaf diseases were controlled from September 1986 onwards using strategies developed by Lowe and Langdon (1987) and Lowe *et al.* (1987b). Prior to this, hay quality was considerably downgraded on a number of occasions, especially in the most winter-active cultivars, by the effects of the diseases. However once control measures were implemented, subsequent damage was small and of no commercial significance.

TABLE 3

Leaf damage, on 2 occasions, to hay stands of 8 commercial lucerne cultivars cut for hay

Cultivar	Leaf damage rating[1]	
	May 84	Jul 86
Matador	2.83	4.13
Maxidor 2	2.24	3.84
Granada	2.06	4.83
CUF101	2.09	5.39
Baron	2.02	4.26
Trifecta	1.59	3.28
Hunter River	1.23	3.50
Pioneer 581	1.38	2.85

[1] Leaf damage rated on a linear scale of 1 to 10 where 1 = undamaged and 10 = 100% of the leaf area necrotic.

CONCLUSIONS

This investigation complemented the results of small-plot, cutting experiments, showing that they are a reliable method of determining the potential of lucerne cultivars for haymaking. Trifecta was the most suitable cultivar for clay soils in south-east Queensland. There was little to choose between the other popular commercial cultivars in terms of hay production.

When making hay in the cooler period of the year (May to August), the use of semi-dormant cultivars will ensure that premium quality hay is produced. However, the use of fungicides to control leaf diseases will allow the production of acceptable quality hay from the highly active cultivars during the cool season. If haymaking is contemplated only in the period of active growth (September to April), cultivars should be chosen on their productive potential, as hay quality from all cultivars will not differ greatly.

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REFERENCES

BROWNLEE, H., CREGAN, P. D., LODGE, G. M. and MURISON, R. D. (1984)—The evaluation of aphid resistant lucerne varieties in New South Wales, 1977–81. (Department of Agriculture New South Wales: Sydney).

DICKSON, T. and ASHER, C. J. (1974)—The role of sulphur in maintaining lucerne yields in the Lockyer Valley. *Australian Journal of Experimental Agriculture and Animal Husbandry* **14:** 515–519.

GRAMSHAW, D. (1978)—A review of research on establishment, persistence and productivity of lucerne (*Medicago sativa* L.) at Biloela from 1950 to 1975. Agriculture Branch Technical Report No. 20. (Queensland Department of Primary Industries, Brisbane).

GRAMSHAW, D., LANGDON, P. W., LOWE, K. F. and LLOYD, D. L. (1985)—Performance of North American and Australian lucernes in the Queensland subtropics. 1. Field reaction to important root and crown diseases. *Australian Journal of Experimental Agriculture* **25:** 76–81.

GRAMSHAW, D., LLOYD, D. L. and LOWE, K. F. (1981)—Growing new lucernes in Queensland. *Queensland Agricultural Journal* **107:** 249–254.

IRWIN, J. A. G. (1974)—Reaction of lucerne cultivars to *Phytophthora megasperma*, the cause of a root rot in Queensland. *Australian Journal of Experimental Agriculture and Animal Husbandry* **14:** 561–565.

IRWIN, J. A. G. (1977)—Factors contributing to poor lucerne persistence in southern Queensland. *Australian Journal of Experimental Agriculture and Animal Husbandry* **17:** 998–1003.

LOWE, K. F., GRAMSHAW, D., BOWDLER, T. M. and LUDKE, D. H. (1985)—Performance of North American and Australian lucernes in the Queensland subtropics. 2. Yield and plant survival in irrigated stands. *Australian Journal of Experimental Agriculture* **25:** 82–90.

LOWE, K. F., GRAMSHAW, D., BOWDLER, T. M., CLEM, R. L. and COLLYER, B. G. (1987a)—Yield, persistence and field disease assessment of lucerne cultivars and lines under irrigation in the Queensland subtropics *Tropical Grasslands* **21:** 168–182.

LOWE, K. F. and LANGDON, P. W. (1987)—Lucerne leaf spot diseases. *Queensland Agricultural Journal* **113:** 69–72.

LOWE, K. F., LANGDON, P. W. and BOWDLER, T. M. (1987b)—Combined effects of leaf spot diseases caused by *Stemphylium vesicarium* (Wallr.) Simmons and *Leptosphaerulina trifolii* (Rostr.) Petr. on lucerne cultivars, and the efficacy of some fungicidal control methods. *Australian Journal of Experimental Agriculture* **27:** 59–65.

MILLS, W. D. (1985)—Haymaking. *in* 'Lucerne Management Handbook', P. J. M. Thompson and Graham M. Aisthorpe (Eds). Queensland Department of Primary Industries, Brisbane.

NORTHCOTE, K. H. (1971)—'A Factual Key, for the Recognition of Australian Soils'. Third edition. (Rellim Technical Publications: Glenside, S. Aust.).

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