LUCERNE TRIALS IDENTIFY ADAPTED CULTIVARS

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Farmers confidence in lucerne was badly shaken by the arrival of the spotted alfalfa aphid (SAA) and the blue green aphid (BGA). Within a year more than $100M worth of damage had been caused and the use of lucerne as a mainstay of perennial legume pastures was brought into jeopardy. Not surprisingly, the area sown to lucerne plummeted by 51% and the search commenced to find a replacement for the traditional cultivar, Hunter River.

Many cultivars have been tested in an effort to solve the lucerne aphid problem. Many cultivars were imported from overseas and, more recently, cultivars which have been developed in local breeding programs have become available. This lead to a proliferation of cultivars in the market place many of which were untested in the major lucerne growing environments of Australia.

The objective of the NSW Agriculture & Fisheries lucerne evaluation program was to assess these cultivars for their commercial potential in a range of irrigated and dryland situations. This has involved a combination of both glasshouse screening to quantify pest/disease resistance and field testing to measure yield and persistence. The overall goal is to recommend only those cultivars that are adapted to local situations (Figure 1).

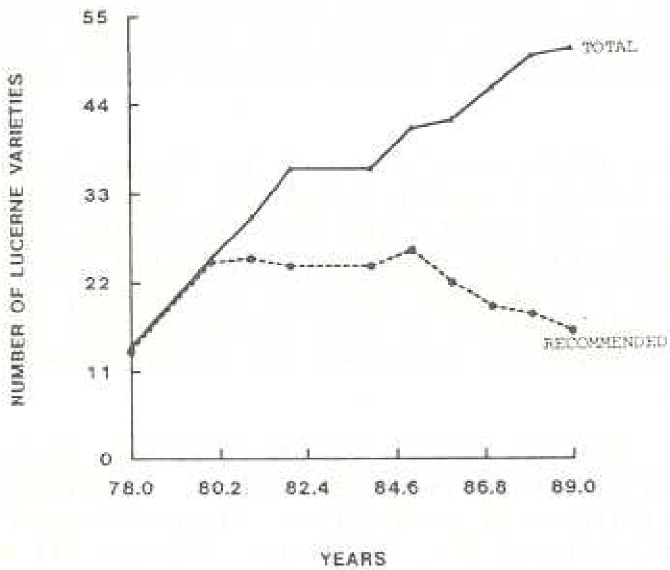

Figure 1. A comparison of the total number of cultivars on the market and the number recommended by NSW Agriculture & Fisheries, 1978-1989.

RESULTS

Glasshouse

Results from glasshouse trials indicate that between 1978 and 1989, substantial progress has been made in the number of cultivars that are resistant to SAA and Phytophthora root rot (PRR), (Table 1). Progress in BGA and Colletotrichum crown rot (CCR) resistance has been slower with only one cultivar, "Aurora", exhibiting adequate resistance to both pests and both diseases.

Table 1. The percentage of cultivars that are at least moderately resistant to SAA, BGA, PRR and CCR.

Year	No. of Cultivars	SAA	BGA	PRR	CCR
1981	35	86	3	57	20
1989	19	100	10	84	31

Field Experiments:

Trials conducted at Tamworth Agricultural Research Centre have focused on the performance of cultivars under dryland grazing conditions. In the 1984 trial, seed of 24 cultivars was inoculated and broadcast sown at 5 kg/ha $^{-1}$. Dry matter yield, percent dry matter and persistence (the ability of the plant to survive from one season to the next) measurements were taken.

The yields of the plots were measured by forage harvesting of $5m^2$ quadrats at approximately 7 weekly intervals. Subsamples were collected to estimate percent dry matter and for laboratory analyses. Plant persistence is measured by the grid frequency method (the number of 10 cm x 10 cm cells in a 1 m^2 quadrat that are occupied by all or part of a lucerne crown). This method is more reliable than estimating plant density because it does not encounter the difficulties of identifying individual plants.

After 22 harvest periods, total yields averaged 23.6 tonnes ha^{-1}. Significant differences were recorded between cultivars, percent dry matter and annual patterns of production. Figure 2 summarises the total yield and dormancy rating of the cultivars. Pioneer 577 was the highest yielding with a total of 26.9 tonnes ha^{-1} producing significantly more than Granada, Pioneer 581, Siriver and Pioneer 532.

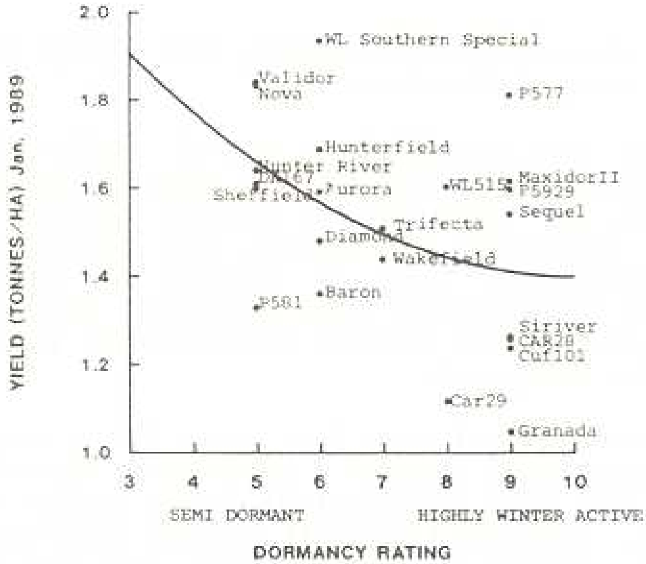

Figure 2. A comparison between yield (kg/ha-1) and dormancy rating of 24 lucerne cultivars at Tamworth (increasing dormancy rating indicates increasing late autumn/winter growth).

The total yields of cultivars were accumulated in different patterns. Cultivars such as Maxidor II yielded constantly above average, while the yield of cultivars such as Granada declined rapidly over time (Figure 3).

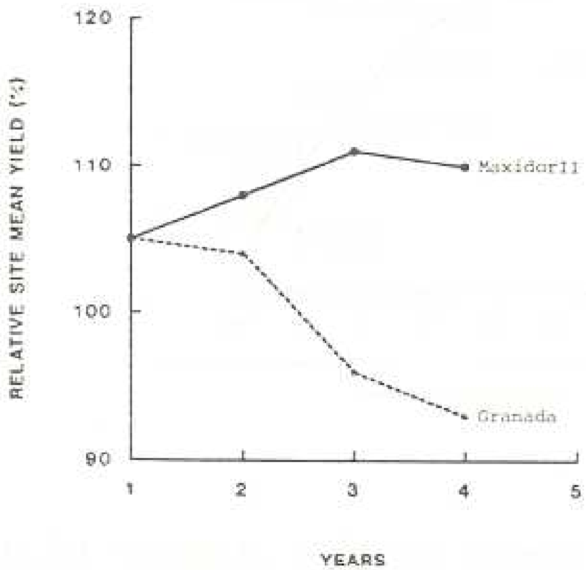

Figure 3. A comparison of the relative site mean yields (%) of two lucerne cultivars at Tamworth 1985-1989.

Highly winter active cultivars (dormancy rating 8-10) regularly yielded better than semi dormant cultivars (dormancy rating 4-5 and including WL Southern Special) from May to September each year. Semi dormant cultivars were generally able to produce more than the highly winter actives during summer provided the rainfall was adequate. Two very dry harvest periods, November 1986 and February 1987, severely restricted the growth of all cultivars and the semi dormants have never been able to make up the yield advantage established by the highly winter actives during the previous autumn and winter.

Patterns in percent dry matter data showed highly winter active cultivars had significantly higher dry matter compositions during summer. This result confirms the trend towards earlier maturity as dormancy rating increases. Conversely, in winter, the highly winter active cultivars were significantly lower in percent dry matter, although apparently not enough to exacerbate bloat problems. These data indicate that for maximum production and quality, highly winter active cultivars require more intensive management.

Plant frequencies have reduced over four years by an average of 44%. Significant differences exist between cultivars. Generally the semi dormant cultivars are more persistent than the highly winter active cultivars (Figure 4). The most persistent of each major dormancy group, WL Southern Special, Aurora and Pioneer 577, are not significantly different. It should be noted that in the absence of aphids and major root disease, the persistence of Hunter River is equal to the best.

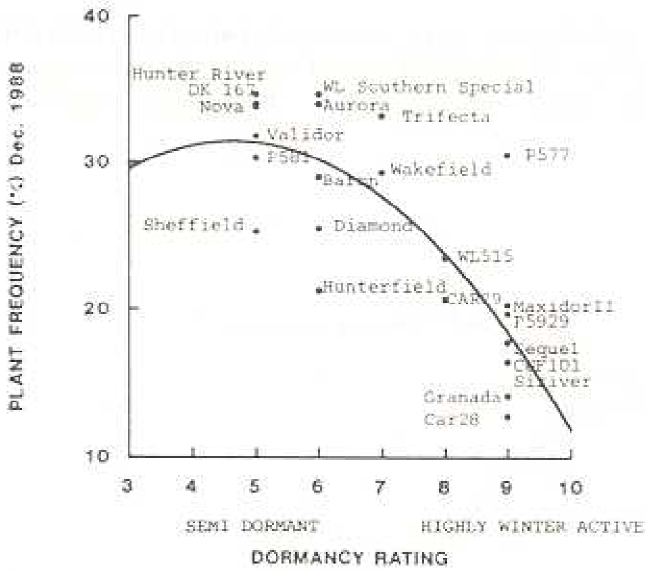

Figure 4. A comparison between the plant frequency (%) and dormancy rating of 24 lucerne cultivars at Tamworth (increasing dormancy rating indicates increasing late autumn/winter growth).

The correlation between yield and plant frequency indicates that maximum yields are not attained until plant frequency exceeds 40% (Figure 5). Preliminary analysis indicates that while all cultivars are capable of compensatory growth (maintaining yield over a range of plant frequencies) the highly winter active cultivars have higher yields than semi dormant cultivars at moderately low frequencies (12-20%). Nevertheless, the selection of the correct cultivarnegates the persistence considerations associated with dormancy classes.

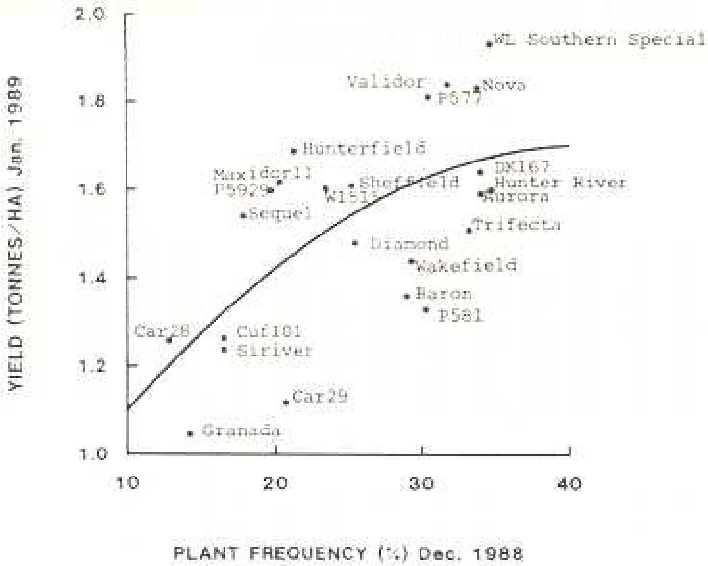

Figure 5. A model comparing the yield (kg/ha-1) and plant frequency (%) of 24 lucerne cultivars at Tamworth, 1989.

Analyses indicated that the new cultivars were not significantly different from Hunter River in some important components affecting quality (leaf to stem ratio, phosphorus or nitrogen). Herbage quality was also assessed using in vitro techniques. All cultivars proved to be highly digestible, averaging 71%. These results indicate that while minor differences in digestibility do exist, they are primarily the result of small variations in the ratio of leaf to stem.

When data from this trial are combined with results from other similar trials (McDonald et al 1989) the overall performance of a cultivar can be divided into one of four categories (above average performance to below average performance). By grouping data according to irrigation/dryland/altitude/geographic area, the number of potential suitable cultivars for a specific location can be reduced from 19 to 6 or less (Table 2).

CONCLUSION

The evaluation of new lucernes in the glasshouse and field has successfully identified cultivars that are suitable for all major lucerne growing environments, and has reduced the number of cultivars on the market from 36 to 19.

Cultivars are significantly different in their annual and total production patterns; however, after 4 years persistence will primarily govern yield. While indications are that decreasing winter activity is linked to improved persistence, the best cultivars from each dormancy group perform equally well. Therefore, dormancy should be used as the outright factor in cultivar selection except in disease free situations, when long term persistence is required, or in environments with unreliable summer rainfall.

Table 2: The yield and persistence of recommended lucerne cultivars sown in field trials 1980-1989.

VARIETY	YIELD: Inland Dryland	Inland Irrigated	Inland-Nth-Dryland	Sth-Dryland	Inland-Nth-Irrig	Inland-Sth-Irrig	Tablelands	Peel Valley	Hunter Valley	Coastal	PERSISTENCE: Inland Dryland	Inland Irrigated	Inland-Nth-Dryland	Inland-Sth-Dryland	Inland-Nth-Irrig	Inland-Sth-Irrig	Tablelands	Peel Valley	Hunter Valley	Coastal
Pioneer 545																				
Pioneer 581	*	*			*	*	*	*		*		*			*	*				
Nova		*			x	*		*	*	x						*				
Valdor								*				*			*	*		*	*	*
WL Sthn Sp		*				*														
Aurora		*																		
Hunterfield		*				*						*		*		*				
Trifecta		*				*		*				*		x				x		x
WL 516																				
Pioneer 577		*				*		*		*	*	*	*	*		*		*	*	
Maxidor II		*				*			*	*	x		*	*				*		*
Sequel		*				*						x								
Siriver		*				*	x	x	*	*	x	x	x	x	x	x	-	x	x	x
WL 605																				
Pioneer 5929		*				*					x	x	x			*		x		*
CUF 101		*			*	*	*	*	x	*	x	x	x	x	x	*		x	x	x

KEY:
= Above average performance (Min. 4 trials ≥ 105% RSMY or RSMF)
* = Average performance (Min. 4 trials 96 - 104% RSMY OR RSMF)
x = Below average performance (Min. 4 trials ≤ 95% RSMY or RSMF)
= Insufficient data available.

RSMY or RSMF = Relative site mean yield or relative site mean frequency is the yield or frequency (measure of plant crown cover) of a particular variety relative to the average performance of all the varieties tested at the specific site, i.e. RSMY of 110 for a variety means that the yield of that variety was 10% greater than the average yield of all varieties at that site.

Locations include both irrigated and dryland trials unless otherwise specified. Northern sites include locations north of and including Wellington. "Coastal" includes those sites east of the Great Dividing Range excluding the Upper Hunter Valley.

REFERENCE

McDonald, W.J., Waterhouse, D.B., Falconer, G.W. and Williams, R. (1989). Lucerne cultivars: 1989-90. Agfact P2.5.13 NSW Agriculture & Fisheries.