Identifying lucerne growers' usage and needs through a survey for breeding new generation lucerne varieties

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Abstract

Lucerne is a pasture legume, predominantly used for livestock grazing and haymaking over extensive areas of Australian farms where improved pastures are grown. Australian studies have shown that livestock grazing requires varieties which have high levels of persistence, pest and disease tolerances and high biomass yield.

A survey questionnaire was sent by NSWDPI's lucerne breeding program based at Tamworth to growers in New South Wales, Queensland, South Australia and Victoria to develop an understanding of the current usage of lucerne in Australian farming systems and characteristics required in future varieties by lucerne growers. It was expected that the survey would assist in determining if the breeding program objectives matched with growers' requirements. The results of the survey showed that the characteristics required by growers are complex and controlled by multi-genetic interactions. It is necessary to develop new varieties and technologies to address their requirements. Through the development of new acid soil tolerant varieties, there is a potential to expand production into acidic soil areas where currently it is not possible to grow lucerne productively. Australian lucerne grower's longer term needs can be achieved through significant investment in breeding programs focussed on the development of such varieties in Australia.

Key words: survey, Australian growers, lucerne, breeding, desired traits, Medicago sativa

Introduction

It is estimated that a total of 3.2 million hectares of lucerne are sown into dryland production systems with approximately 16% of the area being re-sown annually (Robertson 2006). Over half of the approximately 65 varieties currently in the market are in dormancy class 9 with high winter activity and these lack longer term persistence and as such are more suited to short-term rotations. Lucerne varieties with dormancy classes 5, 6 and 7 are considered to be more suited to livestock grazing. To develop a new generation of varieties, there is a need to understand current needs of growers in terms of new or additional traits required and prioritise the incorporation of these traits to ensure the breeding program develops varieties relevant to the needs of the lucerne producers who are typically the end-users.

Materials and methods

Survey methodology

A survey questionnaire was distributed in 2007 to 872 growers located in the states of New South Wales (NSW, 662) Queensland (Qld, 50), South Australia (SA, 100) and Victoria (Vic, 60), predominantly in the wheat–sheep belt and amongst growers considered to have experience in lucerne production. All effort was made to widely distribute the questionnaire via various agronomists in each state. The states of Western Australia and Tasmania were not included in the survey as they are not major lucerne production areas. The majority of the survey forms were distributed in NSW as it has the largest area of lucerne production in Australia estimated at 2.5 million hectares annually (Marshall and Jones 2006).

The survey questionnaire consisted of 27 questions and included several background and specific questions pertaining to desired traits in lucerne and new technologies. Each question contained several specific options to choose from and an additional option choice was provided if the farmer chose to provide an alternate answer. It was expected that by understanding the practices used by growers, usage of lucerne and the characteristics desired by current growers, breeding programs would gain knowledge and enable prioritization of traits selected for in future varieties.

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Results

From a total of 872 questionnaires distributed, responses were obtained from 228 participants; a response rate of 26%, although some respondents did not answer all of the questions. Responses were obtained from each of the states and 87 different postcodes. Victoria had the highest percentage of respondent postcodes (42%) followed by SA (30%), NSW (25%) and Qld (16%). The data was collated, analysed and presented as percentages. Only a small subset of survey responses are reported in this paper.

Lucerne –background information

Rainfall data as indicated by the respondents clearly showed that lucerne was being grown under a wide range of rainfall zones; with reported annual rainfall ranging from 100 mm to 1125 mm.

To gain an insight into selection of pastures, farmers were asked if they had annual and/or perennial pastures. Of the total number of respondent farmers from all four states, over 75% had annual pastures and over 94% of the farmers had some type of perennial pasture. Eighty two percent of all respondents indicated that lucerne was their preferred perennial pasture either as a pure or mixed stand. Around 85% (NSW), 86% (SA), 81% (Vic) and 57% (Qld) of respondents grew lucerne as a preferred pasture. However, the sample size in Qld may have been too small (36 growers) to draw any definite conclusions. The overall results corresponded to reports by Dear *et al.* (2010) that showed that lucerne was a widely grown perennial pasture (84% as preferred pasture) in the target area of the mixed farming zone of southern NSW.

Methods used for lucerne establishment varied widely among growers. Among all respondents, 63% have used conventional sowing methods (cultivation prior to sowing), 29% direct drilled and 23% have used minimum till. Only a small percentage of respondents used a stubble burn and raking method prior to sowing.

Most lucerne was grown on soils in a pH range of 4.9–6.0. A small percentage of the respondents were growing lucerne in either more acidic or more alkaline soils. Developing varieties with improved tolerance to high pH and to low pH with and without aluminium and/or manganese toxicities could provide a perennial option for these growers.

Among all respondents, 84% used lucerne for grazing by livestock, 75% for hay making, 19% for seed production and 5% for silage. In Qld haymaking was the dominant use. Only SA growers engaged predominantly in seed production, although some seed production activities also occurred in NSW and Victoria.

For livestock, among all respondents, 41% had sheep, 24% had cattle and 26% had both sheep and cattle. Only 9% did not have any livestock. NSW and SA had the highest percentage of mixed sheep-cattle enterprises (30%). Qld had the highest percentage cattle enterprises (75%) among the respondents followed by Victoria (32%) and NSW (24%). Regarding grazing patterns used, among all respondents, most farmers used rotational grazing (56%) followed by a combination of set stocking and rotational grazing (30%). Only a small percentage (4%) reported using continuous grazing, set stocking or strip grazing.

Among all respondents, >30% obtained 5-6 cuts or grazings of their lucerne stands per year and >10% made 7-8 cuts or grazings annually. Only 3% of respondents achieved 10 cuts or grazings annually. A high proportion of respondents (29%) did not cut or graze their lucerne at all, which may have been associated with seed production however the survey did not quantify this. Thirty nine percent of all respondents indicated that they had the capacity to cut or graze year-round. The majority of the cuttings in all the states were conducted between the months of September –October.

Factors affecting variety choice

To understand the basis for lucerne variety choice, growers were provided with a list of characteristics and asked to nominate those which influenced their decision. When asked to choose the factors or traits which were desired by growers in new lucerne varieties, respondents rated persistence the highest (Figure 1), followed by high yield, grazing tolerance and recovery, ability to compete with weeds, quality and drought

tolerance. Traits such as high N fixation, establishment, acid soil tolerance and low bloat risk had moderate desirability. Other traits such as seed production had lower desirability among all respondents. These results were not surprising as lucerne is mainly used by the respondents for sheep grazing and hay making.

Growers were well aware of lucerne's capacity to fix N, however, this survey did not seek to ascertain how much value they placed on the levels of this fixed N available to subsequent cereal crops. Among all respondents, 68% expected a stand life of 5 years and 24% expected a stand life of 10 years, with 13% not indicating any expectation regarding stand life. The proportion of growers expecting a stand life of more than 10 years or less than 3 years was negligible.

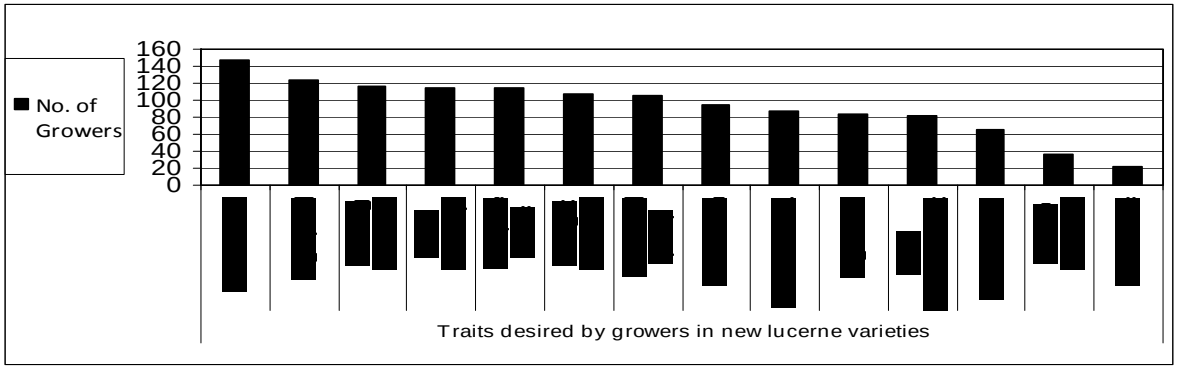

Figure 1. Traits desired in lucerne varieties by respondents

There was a positive response to both genetic modification (54%) and hybrid technology (47%) among respondents.

Discussion

This survey was part of the process of understanding how lucerne is used in south-eastern Australia and identifying new/additional traits required by farmers that could be incorporated into lucerne varieties to make them more desirable and utilized in Australian farming systems. It is clear that lucerne is the preferred pasture legume. Persistence and high yield are highly desired by growers along with grazing tolerance and quick recovery. Key factors limiting biomass yield improvement are yield stagnation and lack of genetic diversity (Musial 2002). Breeding programs need to use different methods of crossing and parent selection to incorporate genetic diversity and overcome yield stagnation.

In the states of NSW and SA there seems to be a shift towards direct drill and minimum till production systems with lucerne (28 and 40%, respectively). However, the performance of lucerne under reduced tillage compared with conventional sowing methods is largely unknown. New varieties selected for early germination and seedling vigour may enable higher germination and establishment under these conditions.

Persistence and high yield are complex physiological traits influenced by pests and diseases (Lodge 1991) and maintenance of the lucerne plant crown by farmers. Focusing on early generation selections for improved tolerances to pests and diseases could enable improvement in stand survival. Educating growers to maintain crown area, monitor for pest and disease attacks and follow recommended protocols for production and management are likely to improve lucerne persistence and yield (McDonald *et al.*, 2003).

The desirability of acid soil tolerance in lucerne varieties (NSW has the highest proportion of acidic soils). was reflected in the relatively high proportion of respondents in NSW (33%) requesting this trait. The NSW DPI breeding program in collaboration with the breeding program at the South Australian Research and Development Institute has been developing lucerne germplasm with tolerance to low pH soils (Venkatanagappa and O'Brien, 2010).

Seed production would be of importance to seed growers. A high percentage (66%) of growers expressed desirability for high seed production capacity in SA where the majority of seed production currently occurs. In lucerne, the seed production capacity of a variety is indirectly correlated to the genetic potential of

biomass production and to irrigation management (Cash 2003). Seed traits should be selected at the early generations rather than at a very late stage of development when seed quantities become available (Veronesi *et al.* 2010).

The two key uses of lucerne in Australia, *viz.* livestock grazing and hay making, require that varieties have certain overlapping trait requirements such as high yield, pest and disease tolerances, good establishment and stand density, irrespective of dormancy class. Quick recovery is also desired for hay making.

Since grazing was the predominant activity for the majority of respondents it is imperative that breeding programs should select varieties under grazing pressure through longer term trials (3-5 years), preferably using sheep as this was the dominant use pattern. The data shows that Australian breeding programs should use the rotational grazing method for selection of breeding lines for grazing tolerance rather than continuous grazing. The continuous grazing method runs the risk of inappropriate selections by not allowing a sufficient recovery period under dryland grazing conditions. Interestingly, low bloat and high N fixation did not rank very highly as desirable traits amongst respondents. However, issues such as bloat may be of higher importance to cattle rather than sheep producers, but this was not specifically addressed in this survey.

Conclusions

Breeding programs have an immense challenge in improving yield, while not sacrificing other traits desired by farmers. The survey confirmed that the beneficial aspects of lucerne are well known among lucerne growers. The attributes desired by lucerne growers are complex traits influenced/controlled by multi-genetic actions and it would be worthwhile to develop germplasm and breeding processes to achieve these target traits in new varieties. However, this can be achieved only when a significant investment is made in Australia towards the development of lucerne varieties over the longer term to meet the needs of growers.

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