International Grassland Congress Proceedings | 22nd International Grassland Congress

Selection of Psyllid-Resistant Forage Varieties from an Inter-Specific Breeding Program of *Leucaena leucocephala* with *L. pallida*

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The 22nd International Grassland Congress (Revitalising Grasslands to Sustain Our Communities) took place in Sydney, Australia from September 15 through September 19, 2013.

Proceedings Editors: David L. Michalk, Geoffrey D. Millar, Warwick B. Badgery, and Kim M. Broadfoot

Publisher: New South Wales Department of Primary Industry, Kite St., Orange New South Wales, Australia

Presenter Information

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Keywords: Ppsyllid damage, leafiness, better branching, forage legumes.

Introduction

Leucaena (*Leucaena leucocephala*) pastures for beef cattle production are productive and sustainable; however, susceptibility to the psyllid insect (*Heteropsylla cubana*) has limited expansion of current commercial cultivars into more humid areas (>800 mm/yr) (Shelton and Dalzell 2007). Psyllids can also cause intermittent damage in lower rainfall regions during humid periods.

The psyllid, which arrived in Australia in 1986, is a leaf-sucking insect specific to the *Leucaena* genus, feeding on the growing tips of susceptible cultivars (Bray 1994). Psyllid damage can reduce production by as much as 50-70% in humid regions and 20-50% in subhumid environments (Bray 1994; Mullen and Shelton 2003). Work on psyllid resistance in the *Leucaena* genus through the 1990s showed that several *Leucaena* species, including the tetraploid *L. pallida*, had good levels of resistance (Mullen *et al*. 2003).

A breeding program to develop psyllid-resistant varieties began in 2002 at The University of Queensland (UQ) based on the F1 inter-specific hybrids between *L. leucocephala* and *L. pallida* (known as 'KX2'), developed at the University of Hawaii (Brewbaker 2008). Between 2002 and 2005, UQ initiated a program of recurrent selection in an attempt to produce stable outcrossed KX2-derived lines but inbreeding depression for yield and poor forage quality led to a change in the breeding strategy, and a backcrossing program was implemented between 2005 and 2008. Two cycles of backcrossing to elite *L. leucocephala* ssp. *glabrata* material were completed followed by 2 cycles of progeny testing and selection for self-compatibility to achieve stability and uniformity (2009 - 2012). Forty elite psyllid-resistant lines were then evaluated to identify the most suitable lines for release to industry. This paper describes the results of these trials.

Methods

Six replicates of 40 elite lines were compared, with 4 commercial *L. leucocephala* cultivars (Peru, Cunningham, Tarramba and Wondergraze) as controls. The randomised block design experiment was conducted at the Redlands Research Station (27°53'S; 153°25'E), 30 km east of Brisbane, Australia, from October 2011 to March 2013. The station receives an annual rainfall of 1322 mm and was an ideal location to conduct psyllid-resistance trials owing to the high challenge from the insect over significant periods of each year. Each plot contained 12 plants of each line, spaced 0.5 m apart. Buffer and border rows of the highly susceptible cv. Peru were included to ensure even psyllid pressure across the site. Psyllids were controlled with dimethoate until plants were well established.

Traits assessed were: (1) psyllid damage rating of growing tips (PDR) (1 = no damage, 9 = dead) (Wheeler 1988); (2) yield index based on basal diameter^2 × height (Stewart *et al*. 1992) adjusted to a 1-5 scale; (3) floral development rating (FDR) (1 = vegetative, 5 = mature seed pods); (4) leafiness and branching ratings (1 = low, 5 = high); and (5) *In vitro* dry matter digestibility (IVDMD) of the first fully expanded leaves from 10 plants per plot.

Minitab was used to create 'box and whisker' plots for each trait. The elite lines were then compared with the controls with respect to the median, lower and upper quartiles, range and skewness of the data.

Results and Discussion

All elite lines tested were superior to the commercial cultivar controls in psyllid damage rating (PDR), but had higher variability (Fig. 1). The median PDR was 2.8 for the elite lines compared with ~7.8 for controls. This difference was evidence that the breeding program was successful as a PDR<3 indicates minor damage under psyllid attack, while a PDR>8 indicates severe damage and large productivity losses. The digestibility and associated spread for the elite lines (median of 69%) were similar to the controls (median of 68.3%). High forage quality is one of the most important characteristics of leucaena, and a lower digestibility in the elite lines was expected due to the lower IVDMD of *L. pallida.* The results indicate that selection for psyllid resistance will be possible without seriously compromising digestibility.

Yield index for the elite lines (median of 2.8) was

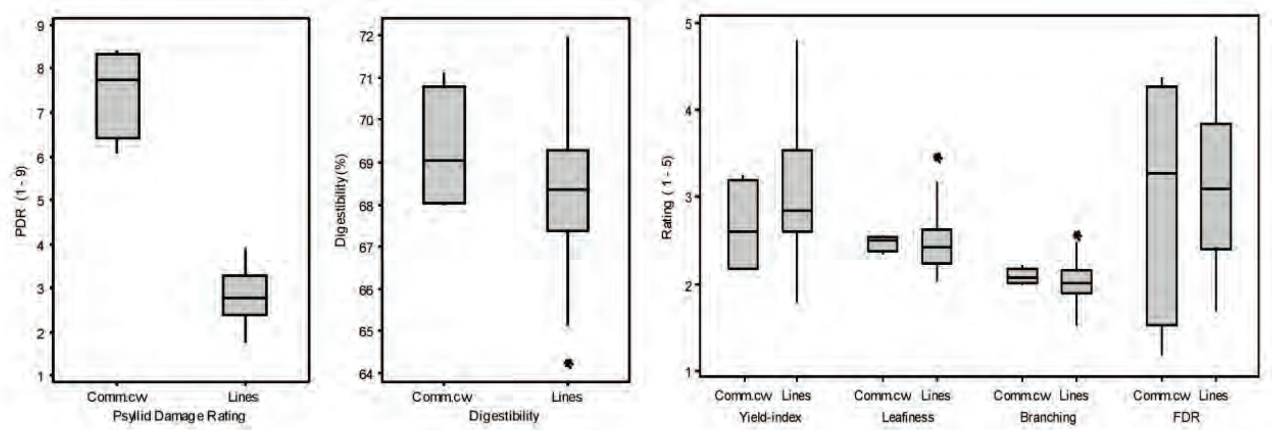

Figure 1. Box plot of psyllid damage ratings, digestibility and agronomic traits for leucaena breeding lines compared with commercial cultivars. FDR = floral development rating

similar to that of the controls (median of 2.6). However, the yield index was measured following a period of low psyllid challenge, so that yield differences due to psyllid damage were minimised. The range for this trait was large, reflecting the genetic diversity of the breeding lines. Elite lines were similar to the controls in leafiness, branching and floral development ratings, with the observed range in these traits again higher for the elite lines than for the controls. Regarding floral development, it is important to select lines that seed adequately to meet seed-production demands, but not excessively so as to pose a weed risk.

When all parameters were considered, together with minimum criteria established for each trait (including seed availability), 8 of the 40 breeding lines were selected to be carried forward in the commercial-isation process.

Conclusions

The breeding program has successfully developed elite lines with superior psyllid resistance compared with the commercial cultivars. This was achieved without significant reduction in yield, forage quality or floral development characteristics. Plant Breeder's Rights will be sought over the period 2013-2015 for eventual release of at least one of these lines to industry.

Acknowledgments

The statistical assistance of Mr Allan Lisle, and the laboratory assistance of Mr Peter Isherwood for DMD analysis were greatly appreciated. This project was funded jointly by The University of Queensland and Meat and Livestock Australia.

References

Bray RA (1994) The Leucaena Psyllid. In 'Forage Tree Legumes in Tropical Agriculture'. (Eds RC Gutteridge, HM Shelton) pp. 283-291. (CAB International: Wallingford, UK).

Brewbaker JL (2008) Registration of KX2 – Hawaii, Interspecific hybrid leucaena. *Journal of Plant Registrations* **2**, 1-3.

Mullen BF, Gabunada F, Shelton HM, Stur WW (2003) Psyllid resistance in *Leucaena*. Part 1. Genetic resistance in subtropical Australia and humid-tropical Philippines. *Agroforestry Systems* **58**, 149-161.

Mullen BF, Shelton HM (2003) Psyllid resistance in *Leucaena*. Part 2. Quantification of production losses from psyllid damage. *Agroforestry Systems* **58**, 163-171.

Stewart JL, Dunsdon AJ, Hellin JJ, Hughes CE (1992) Wood Biomass Estimation of Central American Dry Zone Species. Oxford UK, OFI Tropical Forestry Papers No. 26.

Shelton M, Dalzell S (2007) Production, economic and environmental benefits of leucaena pastures. *Tropical Grasslands* **41**, 174-190.

Wheeler RA (1988) Leucaena psyllid trial at Waimanalo, Hawaii. *Leucaena Research Reports* **8,** 25-29.