AGRONOMIC PERFORMANCE OF 118 *LEUCAENA* ACCESSIONS IN THE SUBTROPICAL ENVIRONMENT OF SOUTHEAST QUEENSLAND, AUSTRALIA

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ABSTRACT

The DM productivity in contrasting environments of 118 *Leucaena* accessions was evaluated in sub-tropical Australia over a 2 year period. Harvests were timed to coincide with hot/wet and cool/dry seasons and data were analysed to compare growth in these environments. Eleven accession groups were identified by cluster analysis. Group 1, which contained F1 and F4 interspecific hybrids, were highly productive in all environments. Growth of *L. leucocephala* accessions was severely checked by psyllids in hot/wet environments. Four groups comprising 60 accessions were unproductive in all environments. Identification of specific adaptation to cold temperature within groups in psyllid susceptible accessions was confounded because low psyllid pressure occurred only in the cold environment.

KEYWORDS

leucaena, agroforestry, cold tolerance, genotypic variation

INTRODUCTION

A primary objective of our program on "New Leucaenas for Southeast Asian, Pacific and Australian Agriculture" (ACIAR Project 9433) was to evaluate the agronomic potential of the *Leucaena* genus in terms of DM productivity and adaptation to growth limiting factors, such as the psyllid insect and low temperatures. A comprehensive collection of *Leucaena* accessions was sourced principally from the Oxford Forestry Institute, with additional accessions from the University of Hawaii and CSIRO, and planted at 2 sites:- Redland Bay, Southeast Queensland, Australia and Los Banos, Luzon Province, Philippines. This report overviews preliminary results from the Redland Bay evaluation.

MATERIALS AND METHODS

Site: The Redland Bay site has a fertile, free-draining Krasnosem soil. From soil analysis, no limitations to growth of effectively nodulated leucaena were expected. Climate is subtropical with summer-dominant rainfall (1200mm annually).

Germplasm and sampling procedures: One hundred and eighteen *Leucaena* accessions were raised in polybags and subsequently planted into the field in March 1995. Line plots 5m long were planted with seedlings at 50cm spacing. A completely randomised block design with 2 replicates was used. After a 10 month establishment period, trees were harvested to 50 cm above ground-level to determine DM productivity. Dry matter was separated into edible and wood fractions. Subsequent harvests were scheduled based on regrowth within an "environment" period (e.g. hot/wet or cool/dry) and continued until February 1997. Psyllid damage ratings were collected monthly using the scale of Wheeler *et al.* (1985).

Environments and data analysis: Two distinct "environments" were identified at the Redland Bay site from long-term weather data. These were a hot/wet period of 7.5 months receiving 136 mm/month rainfall and mean day/night temperatures of 28/19^{o}C from mid-October to the end of May, and a cool/dry period of 4.5 months receiving 43mm rainfall and mean day/night temperatures of 23/15^{o}C from June to mid-October. Two harvests were taken during the hot/wet period and a single harvest was taken during the cool/dry period. The establishment period unavoidably spanned environments. Accessions were grouped, according to their DM response to each environment, by a hierarchical, agglomerative clustering technique, using S-Plus data analysis software. The mean relative performance of each group was then calculated from DM data for each environment.

RESULTS

Psyllid damage: Redland Bay experienced high psyllid pressure (damage ratings >2.5) for up to 8 months of the year during the experiment (Figure 1). Pressure was lowest during late-winter/early-spring. This period was characterised by low temperatures, low rainfall and low relative humidity. Psyllid pressure during other times of the year was periodically reduced by discreet climatic events such as intensive rainfall or 3-5 days of hot, dry winds. The relative susceptibility/resistance of individual *Leucaena* species is given in Mullen *et al.*, 1997 (this proceedings) and will not be repeated here, although psyllid susceptibility of accessions strongly influenced group membership.

DM productivity: Group 1 contained 5 interspecific hybrids and outperformed all other groups in all environments, suggesting broad adaptation (Figure 1). The group was dominated by *L. pallida* x *L. leucocephala* subsp. *glabrata* F1 hybrids produced by Charles Sorrenson at the University of Hawaii. No methods are currently available for commercial production of these F1 hybrids and this is clearly a priority for further investigation. The other accession in this group was a *L. diversifolia* subsp. *diversifolia* x *L. leucocephala* F4 hybrid also produced at the University of Hawaii. This accession needs further testing to determine its genetic stability over generations. Preliminary *in vitro* herbage quality estimates indicate that these hybrid accessions are high quality forages (unpublished data).

Group 2 consisted of 4 psyllid resistant accessions that established rapidly but were poorly adapted to cold. Included were *L. pallida* K376 and *L. diversifolia* OFI 53/88, 2 accessions previously thought to possess cold adaptation. Group 3 contained accessions from 4 taxa, including *L. pallida* (CQ3439) and *L. diversifolia* (K778) and was moderately productive in hot/wet environments. All Group 3 accessions were moderately psyllid resistant. Group 4 contained 5 *L. leucocephala* accessions and hybrids that appeared to possess some cold adaptation and included *L. leucocephala* cv. Tarramba. Group 5 was dominated by *L. diversifolia* accessions (e.g. K784 and OFI 83/92) that were slow to establish but yielded relatively well in the final period (hot/wet '97 environment).

Groups 6 and 7 contained 32 accessions dominated by *L. leucocephala* subsp. *glabrata* (18 accessions). High psyllid susceptibility reduced yields of these groups in warm environments and their higher relative performance during the cool/dry '96 environment was probably more related to the low psyllid pressure than to cold adaptation.

Approximately 60 accessions in groups 8, 9, 10 and 11 were of consistently low productivity including *L. greggii*, *L. retusa*, *L. involucrata*, *L. macrophylla*, *L. lanceolata*, *L. pulverulenta*, *L. cuspidata* and *L. confertiflora*. These accessions were highly variable in their psyllid resistance.

The use of environmental periods and cluster analysis to identify specific adaptation to cold temperature and psyllid challenge was only partially successful, because the low temperature environment coincided with the period of lowest psyllid pressure. Only those accessions of very high psyllid resistance can be accurately rated for cold tolerance.

ACKNOWLEDGEMENTS
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REFERENCES

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Figure 1
Psyllid insect pressure at Redland Bay based on mean monthly psyllid damage ratings[1] for 118 *Leucaena* accessions

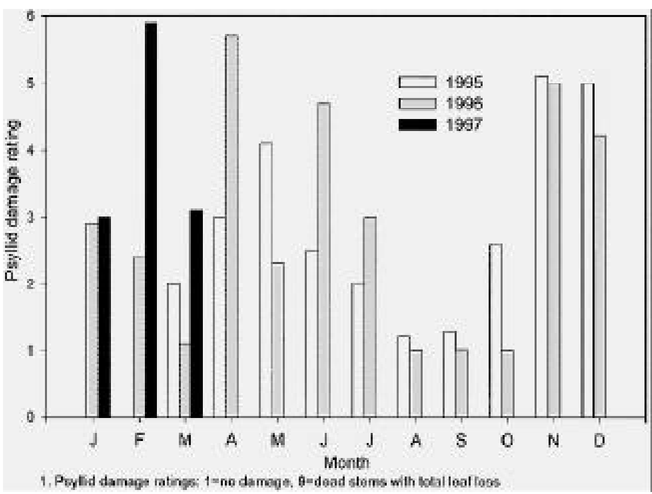

Figure 2
Mean relative performance of *Leucaena* accession groups grown at Redland Bay during 4 environmental periods