Breeding a Psyllid-Resistant Interspecific Hybrid *Leucaena* for Beef Cattle Production in Northern Australia

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The XX International Grassland Congress took place in Ireland and the UK in June-July 2005. The main congress took place in Dublin from 26 June to 1 July and was followed by post congress satellite workshops in Aberystwyth, Belfast, Cork, Glasgow and Oxford. The meeting was hosted by the Irish Grassland Association and the British Grassland Society.

Proceedings Editor: D. A. McGilloway

Publisher: Wageningen Academic Publishers, The Netherlands

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Keywords: psyllid-resistance, recurrent selection, *Leucaena*

Introduction Production of the valuable fodder tree legume *Leucaena leucocephala* (leucaena) is limited to the subhumid (600-800 mm annual rainfall) areas of northern Australia by the psyllid insect pest *Heteropsylla cubana*. Defoliation caused by severe psyllid infestations can suppress forage yields of commercial leucaena varieties by 50-80%. Susceptibility to psyllid damage is a major impediment to grazier adoption of leucaena pastures in the more humid tropical areas of Australia. A comprehensive international agronomic evaluation of the entire *Leucaena* genus (Mullen et al., 2003) revealed that the artificial interspecific F_1 hybrid of *L. pallida* × *L. leucocephala* ssp. *glabrata* (called KX2) had a high degree of psyllid resistance, excellent vigour and broad environmental adaptation. The KX2 F_1 hybrid also had superior forage quality compared to other psyllid-resistant taxa, such as *L. pallida*, *L. trichandra* and *L. diversifolia*. Commercial utilization of the KX2 F_1 hybrid by Australian graziers has been prevented by a lack of planting material. To date, seed production of the F_1 hybrid has only been possible by laborious hand pollination. The KX2 F_1 hybrid has been successfully vegetatively propagated for smallholders in SE Asia, however cloned cuttings are expensive to produce and are not suited to broad acre leucaena planting in Australia. A recurrent selection breeding program was initiated to produce a genetically stable, advanced generation KX2 hybrid that breeds true-to-type and is suitable for commercial release. We anticipate that 4 cycles of selection will be required to achieve this objective. This paper reports the agronomic evaluation of the KX2 F_2 generation.

Materials and methods The base population of the breeding program comprised 5 superior KX2 F_1 hybrids originally bred by The University of Hawaii: K806 × cv. Tarramba; K748 × cv. Tarramba; K748 × K584; K748 × K658; and K748 × K481. These parental lines were open-pollinated (bees) to produce F_2 seed. Field evaluation of 4,900 KX2 F_2 seedlings was conducted under high-psyllid pressure at Brisbane (27° 37'S, 153° 19'E), Queensland, Australia. Ten seedlings (2 from each half-sib family) were randomly planted at 0.5 m spacings between reference trees in contiguous rows 2 m apart in December 2001. Alternating reference trees of cv. Tarramba and the KX2 F_1 hybrid were used to benchmark psyllid damage (susceptibility) and biomass yield respectively, and were arranged in an ∝-lattice design. Psyllid damage rating (PDR) (Wheeler, 1988), tree form rating (degree of branching), leaf production rating and self-compatibility were recorded in May 2002. Dry matter (DM) yield was estimated from a non-destructive yield index (plant height × basal stem diameter^2) and analysed using a linear mixed model by residual maximum likelihood (REML) (ASReml, New South Wales Agriculture, Australia) to produce best linear unbiased predictors for the DM yield for each plant. Superior trees were selected by interrogating the data with Microsoft Access® and subsequent field validation. Later selection cycles will also evaluate forage quality, i.e. condensed tannin activity, to ensure the bred KX2 hybrid variety is of high nutritive value.

Results The F_2 population segregated widely for all traits observed, with individuals exhibiting the full range of traits characteristic of both parental species. Elite F_2 individuals (n = 240) that were highly psyllid resistant, vigorous, of good form and self-incompatible were selected. Their average DM yield was 190% that of cv. Tarramba and 70% that of the KX2 F_1, indicating that a significant amount of heterosis was retained. Median psyllid resistance of the elite trees (PDR = 1, no damage) was greater than that of the KX2 F_1 (PDR = 2, minor damage) and much higher than that of psyllid-susceptible cv. Tarramba (PDR = 6, loss of 50% of young leaves). Elite trees had excellent form for forage shrubs, with greater basal and secondary branching than cv. Tarramba.

Conclusion Elite F_2 individuals were identified that were highly psyllid resistant, vigorous, of good form and self-incompatible. These trees were retained for F_3 seed production. Heritability of these traits will be estimated from the F_3 progeny that are currently under evaluation. Each selection cycle takes approximately 18 months to complete. We anticipate F_6 seed of a psyllid-resistant KX2 hybrid will be commercially available in 2009.

Acknowledgements Meat and Livestock Australia Limited funded this research program (NBP.307).

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