GENOTYPIC EFFECTS ON CONDENSED TANNINS IN THE *LEUCAENA* GENUS

S.A. Dalzell and H.M. Shelton
Department of Agriculture, The University of Queensland, Australia

ABSTRACT
One hundred and eighteen accessions of the *Leucaena* genus were assayed for extractable and bound condensed tannins (CT). *Leucaena* taxa varied from low or no CT (0-1%) to extremely high levels (>15%). There was considerable intraspecific variation in CT within key taxa. The proportion of bound tannin decreased with increasing total CT content.

KEYWORDS
condensed tannins, leucaena, genotypic variation

INTRODUCTION
A comprehensive collection of accessions from the *Leucaena* genus, compiled from international germplasm collections, was evaluated for condensed tannins. The study formed part of a larger and comprehensive program of evaluation of the agronomic and forage quality characteristics of the *Leucaena* genus being conducted by The University of Queensland with support from the Australian Centre for International Agricultural Research (ACIAR). Condensed tannins (CT) have been implicated in both adverse and beneficial effects on animal nutrition and have been found to occur in significant concentrations in a number of tropical forage tree species eg. *Calliandra* (Shelton *et al.* 1996). Selection of agronomically desirable accessions must be coupled with knowledge of their CT status. High concentrations of CT in plant tissues will adversely affect forage quality. Consequently, the objectives of the experiment were to identify and quantify genotypic variation in CT concentration in *Leucaena* spp.

MATERIALS AND METHODS
A *Leucaena* germplasm collection of 118 accessions under evaluation by the ACIAR Project was established at The University of Queensland research farm at Redland Bay (27°37'S:153°19'E) in 1995. The youngest fully expanded leaves of each species (YFEL) were sampled, field frozen, and lyophilized on the 8/4/96 (Dalzell and Shelton, 1997). The extractable CT (ECT) concentration was measured using the technique developed at The University of Queensland by Dalzell and Kerven (1997) and total-bound CT (TBCT) content was estimated using the method of Perez-Maldonado and Norton (1996). TBCT measurements estimate the combined protein-bound and fibre-bound CT present in sample residues after the removal of ECT. All CT concentrations were expressed as *Leucaena pallida* CT equivalents based on the use of a *L. pallida* standard CT in the proanthocyanidin assay.

RESULTS AND DISCUSSION
Total condensed tannin (TCT) concentrations in 118 accessions of the *Leucaena* genus varied widely from 0 – 30.6 % DM TCT in the youngest fully expanded leaves (YFEL) sampled (Table 1). In general, the genus could be divided into four categories on the basis of TCT concentrations. These were:

(a) Species/subspecies with low or no TCT (0-1%) including *L. collinsii collinsii*, *L. collinsii zacapana, L. shannonii magnifica, L. lempirana, L. lanceolata sousae, L. salvadorensis, L. trichodes.*

(b) Species/subspecies with medium TCT (1-7%) including *L. lanceolata lanceolata, L. leucocephala glabrata, L. leucocephala ixtahuacana, L. leucocephala leucocephala, L. macrophylla, L. macrophylla nelsonii, L. multicapitulata, L. retusa, L. shannonii shannonii*, KX2 hybrids *L. pallida x L. leucocephala glabrata*, KX3 hybrids *L. diversifolia diversifolia x L. leucocephala glabrata.*

(c) Species/subspecies with high TCT (7-15%) including *L. diversifolia diversifolia, L. diversifolia stenocarpa, L. esculenta esculenta, L. esculenta matudae, L. involucrata, L. pallida, L. pueblana,* and

(d) Species/subspecies with extremely high TCT (>15%) including *L. confertiflora, L. cuspidata, L. greggii, L. pulverulenta.*

There was also considerable intraspecific variation in TCT within key taxa including:

L. leucocephala glabrata	0.5 – 4.0%
L. diversifolia diversifolia	5.7 – 18.5%
L. diversifolia stenocarpa	0.4 – 22.6%
L. pallida	4.9 – 11.6%

Generally, the proportion of total bound CT, increased with increasing TCT concentration. At very low TCT (<1%), the majority was in bound form, between 5-15% TCT approximately 10-30% was in bound form, whilst above 15% TCT approximately 10% was in bound form (Table 1).

In conclusion, there was considerable genotypic variation in CT concentrations detected in the YFEL of *Leucaena* spp., with the potential to select lines that have low levels of CT, both between and within taxa. It is also possible to select psyllid resistant *Leucaena* accessions that are low in CT (e.g. *L. collinsii collinsii*).

ACKNOWLEDGEMENTS
We acknowledge the assistance of R.C. Gutteridge, B.F. Mullen, M. Faint and A.K.M. Shamsul Islam in the collection of data. We also acknowledge the funding assistance of the Australian Centre for International Agricultural Research (ACIAR).

REFERENCES
Dalzell, S.A. and G. Kerven. 1997. A Revised Method for Condensed Tannin Analysis of Leaf Tissues in *Leucaena* spp. Proceedings XVIII International Grassland Congress, 8-17 June, Manitoba and Saskatchewan, Canada. in press.

Dalzell, S.A. and H.M. Shelton. 1997. Methods of field preservation and selection of sample tissue for condensed tannin analysis in *Leucaena* species. Animal Feed Science Technology. in press.

Perez-Maldonado, R.A. and B.W. Norton. 1996. The effects of condensed tannin from *Desmodium intortum* and *Calliandra calothyrsus* on protein and carbohydrate digestion in sheep and goats. British Journal of Nutrition **76**:515-533.

Shelton, H.M., B.W. Norton, B.F. Mullen, R.C. Gutteridge and P.J. Dart. 1996. Utilisation and nutritive value of *Calliandra calothrysus* for forage: A review of research at The University of Queensland. Pages 210-221, *in* D.O. Evans, ed. International Workshop on the genus Calliandra, Bogor, Indonesia, January 23-27, 1996. Winrock International. pp. 210-221.

Table 1
Condensed tannin (CT) concentrations in species and subspecies of the *Leucaena* genus.

Species	Subspecies	No. Accessions	Extractable		Total Bound		Total	
			CT %	FDWt	CT %	FDWt	CT%	FDWt
			Mean	Range	Mean	Range	Mean	Range
L. collinsii	*collinsii*	2	0.0	0.0-0.0	0.1	0.1-0.1	0.1	0.1-0.1
L. collinsii	*zacapana*	3	0.0	0.0-0.0	0.2	0.1-0.2	0.2	0.1-0.2
L. confertiflora		2	19.4	15.2-23.5	2.1	1.6-2.7	21.5	16.8-26.2
L. cuspidata		1	29.1	-	1.5	-	30.6	-
L. diversifolia	*diversifolia*	12	10.8	4.0-16.6	2.1	1.1-3.8	12.9	5.7-18.5
L. diversifolia	*stenocarpa*	12	8.5	0.2-20.5	2.0	0.2-3.1	10.4	0.4-22.6
L. diversifolia x L. leucocephala		10	4.1	1.7-7.3	1.2	0.4-1.8	5.2	2.1-9.1
L. esculenta	*esculenta*	2	11.2	10.0-12.3	1.3	1.2-1.4	12.5	11.2-13.7
L. esculenta	*matudae*	1	12.3	-	0.9	-	13.2	-
L. greggii		1	18.4	-	1.3	-	19.7	-
L. involucrata		1	13.5	-	1.3	-	14.8	-
L. lanceolata	*lanceolata*	4	0.7	0.3-1.2	0.4	0.2-0.5	1.0	0.6-1.6
L. lanceolata	*sousae*	2	0.2	0.2-0.2	0.1	0.1-0.1	0.3	0.3-0.3
L. lempirana		2	0.2	0.2-0.2	0.1	0.1-0.1	0.3	0.3-0.4
L. leucocephala	*glabrata*	22	1.8	0.5-4.0	0.8	0.4-1.3	2.6	0.9-4.8
L. leucocephala	*ixtahaucana*	1	4.2	-	0.9	-	5.1	-
L. leucocephala	*leucocephala*	3	1.6	1.2-2.2	0.8	0.5-1.2	2.4	1.7-3.5
L. macrophylla	*macrophylla*	2	1.3	0.9-1.7	0.3	0.3-0.4	1.6	1.3-2.0
L. macrophylla	*nelsonii*	2	0.8	0.6-1.0	0.4	0.2-0.6	1.2	1.2-1.2
L. multicapitula		2	0.5	0.0-1.1	0.6	0.2-0.9	1.1	0.2-2.0
L. pallida		9	6.9	1.8-15.9	1.0	0.6-1.6	7.8	2.4-17.1
L. pallida x L. leucocephala		5	4.4	3.0-6.1	1.2	1.2-1.2	5.6	4.2-7.3
L. pueblana		2	10.0	9.3-10.6	0.5	0.5-0.6	10.5	9.9-11.1
L. pulverulenta		3	14.6	11.8-18.3	1.3	1.0-1.8	15.9	13.0-19.4
L. retusa		1	2.3	-	1.2	-	3.5	-
L. salvadorensis		3	0.0	0.0-0.1	0.2	0.1-0.2	0.2	0.2-0.2
L. shannonii	*magnifica*	2	0.0	0.0-0.0	0.1	0.1-0.1	0.1	0.1-0.2
L. shannonii	*shannonii*	4	0.7	0.0-1.7	0.5	0.4-0.7	1.3	0.5-2.3
L. trichodes		2	0.1	0.1-0.1	0.2	0.1-0.2	0.2	0.2-0.3

Notes:

* CT measured in *L. pallida* condensed tannin equivalents
* FDWt=Freeze-dried weight