Psyllid Resistance in the Leucaena Genus

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PSYLLID RESISTANCE IN THE *LEUCAENA* GENUS

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ABSTRACT

Leucaena species varied from highly susceptible to highly resistant in their response to the psyllid insect (*Heteropsylla cubana*) at 2 sites, a high psyllid environment at Brisbane, Australia and a moderate psyllid environment at Los Baños, Philippines. *L. leucocephala* was the most susceptible species. There was considerable intraspecific variation in psyllid resistance within *L. collinsii*, *L. diversifolia* and *L. pallida*. Plant reponse to psyllid challenge between environments was highly correlated but not linear. The higher psyllid challenge environment at Brisbane permitted greater discrimination between species and fewer *Leucaena* species were ranked as psyllid resistant.

INTRODUCTION

The rapid spread of the leucaena psyllid (*Heteropsylla cubana*) westward during the mid 1980s from tropical America to Asia, Australia and finally to Africa has restricted the utilisation of the important multi-purpose tree legume *Leucaena leucocephala* (Geiger *et al*. 1995). The initial devastation of *L. leucocephala* stands by the psyllid has been alleviated to some extent, as populations of natural control agents increased (Geiger *et al*., 1995), but damage can still be severe. In Australia, yield reduction due to psyllids of *L. leucocephala* cv. Cunningham of 52% and 79% for leaf and stem respectively was reported (Bray and Woodroffe, 1991).

Psyllid resistance was identified within the *Leucaena* genus by Wheeler (1988). However, reports were limited in scope by the restricted numbers of lines of *Leucaena* available both across and within species.

The objective of the present study was to assemble a comprehensive collection of *Leucaena* lines representing the available biodiversity in the genus, and to assess variability in psyllid resistance under different environmental conditions.

MATERIALS AND METHODS

The experiment was established at Redland Bay 45 km southeast of Brisbane, Australia (27° S, 153° E), and at the International Rice Research Institute at Los Baños in the Philippines (14° S, 121° E), in mid 1995. Redland Bay has a sub-tropical climate with annual rainfall of 1270 mm and maximum/minimum temperatures of 28/21°C in January and 21/9°C in July. The Los Baños site has a humid tropical climate with a distinct 4 month dry season, annual rainfall of 1900 mm and maximum/minimum temperatures of 30/22°C in January and 31/24°C in July.

One hundred and sixteen *Leucaena* lines from 27 species and subspecies were planted on 3 March 1995 at Brisbane and on 1 September 1995 at Los Baños, in a randomised complete block design with 2 replicates. Ten plants of each *Leucaena* line were planted 50 cm apart into rows 5 m long. Rows were positioned 3 m apart.

Psyllid damage ratings were taken monthly throughout the experimental period (May 1995 to June 1996 at Brisbane; November 1995 to June 1996 at Los Baños) using the damage scale developed by Wheeler (1988) (ratings of 1-9, rating 1 = no damage observed, rating 9 = blackened stems with total leaf loss). Trees were not cut during this period.

Only damage ratings in months when mean site rating was greater than 2.5 were used in the analysis of psyllid resistance, in order to maximise expression of differences. For simplicity, the psyllid data were averaged for each species and shown with range for Brisbane and Los Baños in Table 1.

RESULTS AND DISCUSSION

Resistance and susceptibility among species. The data show a wide range of psyllid damage responses from highly resistant to highly susceptible. There was broad agreement in the findings between the two sites. *Leucaena collinsii* subsp. *collinsii, L. confertiflora,* and *L. esculenta* subsp. *esculenta* and subsp. *matudae* were highly resistant at both sites, whereas *L. leucocephala* and *L. multicapitula* were highly susceptible at both sites. Other species were intermediate and fell into either resistant or susceptible categories as shown in Table 1.

There was considerable variation in psyllid resistance within some species. *Leucaena collinsii* subsp. *collinsii* was highly resistant to psyllids at both sites, whereas *L. collinsii* subsp. *zacapana* was moderately susceptible at Brisbane and moderately resistant at Los Baños. Variation within *L. pallida* and *L. diversifolia* indicated that the mean ratings for each species in Table 1 were an oversimplification. At the Brisbane site, damage ratings for individual *L. pallida* lines varied from highly resistant (K376 and OFI 44/87) to moderately resistant (K953 and OFI 92/94). For *L. diversifolia*, damage ratings in subsp. *diversifolia* and subsp. *stenocarpa* also varied from highly resistant (K778 and OFI 53/88) to moderately susceptible (OFI 82/92 and OFI 4/91). The ranges were less at Los Baños although the general trends were similar. The only other taxa to show high variability in damage ratings were the interspecific hybrids. This was expected due to the polarity of parental psyllid resistance. Lack of variability in other species may be due to the limited representation of provenances in those species.

There was little variation in psyllid resistance in either subspecies of *L. leucocephala* reflecting the narrow genetic diversity within this species (Hughes, 1993).

Relationship between Brisbane and Los Baños data. A significant relationship existed between damage scores at Brisbane and Los Baños (r^2=0.74)(Figure 1), although the mean damage score was lower at Los Baños (3.4) than at Brisbane (4.1). Whilst this gives confidence that the psyllid resistance rankings of the species are robust, there were differences between the two data sets. Most notable was *L. salvadorensis* which was moderately susceptible at Brisbane but highly resistant at Los Baños. This relationship was non-linear and gave greater numbers of highly and moderately resistant lines at Los Baños than at Brisbane.

During periods of extreme psyllid pressure at the Brisbane site, normally resistant lines were attacked and showed some damage. During periods of lower psyllid pressure these lines were undamaged, while more susceptible lines were damaged at all times. Therefore, periods of low psyllid pressure reduced the expression of differences in psyllid resistance between lines and increased the number of lines in the resistant categories. This explains the early flatness of the relationship between the data from the two sites, and the subsequent steeper slope when more susceptible lines were compared. The lower psyllid pressure at Los Baños erroneously classified some moderately resistant lines as highly resistant, and some moderately susceptible lines as moderately resistant.

Variation in damage with environmental factors. The differences in psyllid damage between the two sites can be related to biocontrol and climatic factors. Since the arrival of the psyllid into the Philippines in late 1985, the level of damage caused by the pest has gradually reduced due to a build up in natural predators (Gieger *et al*., 1995). The psyllid arrived in Australia in 1986 and the damage to *L. leucocephala* has continued at a high level, especially at Brisbane.

Damage score ratings. Whilst the damage score rating system used in this study is relatively objective and can be used to compare psyllid damage in different regions using different scorers, the component of subjectivity in the system needs to be assessed. In addition, incremental increases in damage rating provide no indication as to the level of damage suffered in terms of lost dry matter production. Damage ratings may not be linearly related to yield reduction and requires calibration against lost biomass so that the agronomic implications of the damage ratings can be better understood.

In conclusion, the data show a complete range of response in the *Leucaena* genus to psyllid challenge, from highly resistant to highly susceptible. The level of damage expressed varied between the sites. High psyllid challenge is required for selection of highly resistant *Leucaena* lines.

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Table 1
Psyllid damage and damage range of *Leucaena* species at Brisbane, Australia and at Los Baños, Philippines

Species	Brisbane			Los Baños		
	Psyllid damage[1]		Resistance	Psyllid damage		Resistance
	Mean	Range	category[2]	Mean	Range	category
L. greggii	1.4 *(1)*[3]	-[4]	HR	1.0 *(1)*	-	HR
L. esculenta subsp. *esculenta*	1.7 *(2)*	1.4-1.9	HR	1.3 *(2)*	1.3-1.4	HR
L. esculenta subsp. *matudae*	1.7 *(1)*	-	HR	1.5 *(1)*	-	HR
L. pueblana	1.7 *(2)*	1.4-2.0	HR	1.1 *(1)*	-	HR
L. retusa	1.7 *(1)*	-	HR	2.3 *(1)*	-	MR
L. collinsii subsp. *collinsii*	1.9 *(2)*	1.8-2.1	HR	1.0 *(2)*	1.0-1.0	HR
L. confertiflora	1.9 *(2)*	1.5-2.3	HR	1.4 *(1)*	-	HR
L. cuspidata	2.1 *(1)*	-	MR	1.1 *(1)*	-	HR
L. pallida	2.8 *(9)*	1.7-4.6	MR	1.8 *(6)*	1.0-3.0	HR
L. pallida x leucocephala	3.0 *(6)*	2.6-3.8	MR	1.8 *(2)*	1.3-2.3	HR
L. diversifolia subsp. *stenocarpa*	3.2 *(12)*	1.4-5.4	MR	2.4 *(12)*	1.0-3.6	MR
L. lanceolata subsp. *sousae*	3.2 *(2)*	3.0-3.4	MR	2.3 *(2)*	1.6-2.9	MR
L. diversifolia subsp. *diversifolia*	3.7 *(12)*	2.8-5.4	MR	2.4 *(10)*	1.3-4.1	MR
L. collinsii subsp. *zacapana*	4.1 *(3)*	3.4-5.0	MS	2.9 *(3)*	1.4-2.9	MR
L. macrophylla subsp. *macrophylla*	4.1 *(2)*	3.9-4.3	MS	3.2 *(2)*	2.5-3.9	MR
L. trichodes	4.2 *(2)*	3.9-4.4	MS	4.2 *(2)*	3.3-5.1	MS
L. macrophylla subsp. *nelsonii*	4.3 *(2)*	3.7-4.9	MS	4.0 *(3)*	3.5-4.3	MS
L. shannonii subsp. *magnifica*	4.3 *(2)*	4.1-4.4	MS	3.3 *(2)*	3.3-3.4	MR
L. leucocephala subsp. *ixtahuacana*	4.4 *(1)*	-	MS	-	-	-
L. diversifolia x L. leucocephala	4.5 *(9)*	3.0-5.8	MS	4.0 *(5)*	2.3-5.3	MS
L. salvadorensis	4.6 *(3)*	4.4-4.8	MS	1.5 *(3)*	1.4-2.1	HR
L. shannonii subsp. *shannonii*	4.6 *(4)*	3.7-5.3	MS	3.3 *(4)*	1.5-5.4	MR
L. lanceolata subsp. *lanceolata*	4.7 *(4)*	4.4-5.2	MS	3.7 *(4)*	3.1-4.8	MR
L. pulverulenta	4.7 *(3)*	4.5-4.8	MS	2.6 *(3)*	2.5-2.8	MR
L. involucrata	4.9 *(1)*	-	MS	6.1 *(1)*	-	HS
L. lempirana	5.2 *(2)*	5.1-5.3	HS	4.4 *(2)*	4.1-4.8	MS
L. multicapitula	5.2 *(2)*	5.2-5.3	HS	5.6 *(2)*	5.3-5.9	HS
L. leucocephala subsp. *glabrata*	5.5 *(19)*	5.1-5.9	HS	5.4 *(15)*	4.4-6.6	HS
L. leucocephala subsp. *leucocephala*	5.7 *(6)*	5.6-5.9	HS	6.0 *(4)*	5.3-6.8	HS

1 Psyllid damage rating: 1 = no damage to 9 = blackened stems with total leaf loss (Wheeler, 1988)
2 Resistance categories: HR = highly resistant (rating of 1-2); MR = moderately resistant (rating of 2-4); MS = moderately susceptible (rating of 4-5); HS - highly susceptible (5-9)
3. Values in parenthesis are number of lines
4. One line only, therefore no range

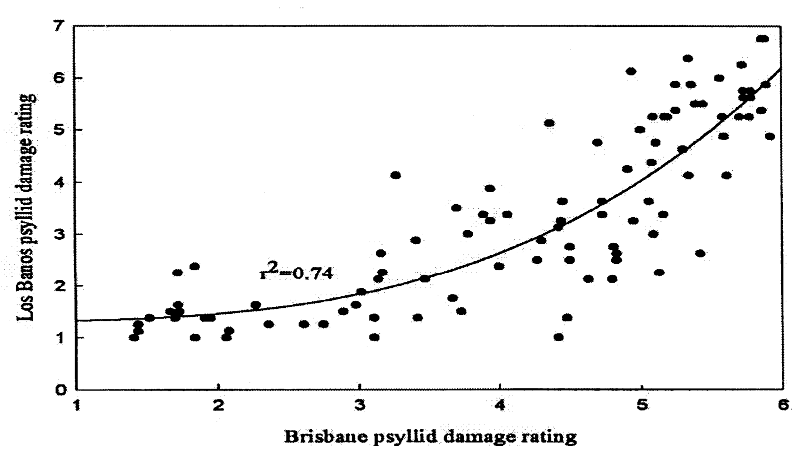

Figure 1
Relationship between psyllid resistance in the Leucaena genu at Brisbane, Australia and los Banos, Philippines.