Tropical Agricultural Research Vol. 1 1989

Evaluation of *Leucaena leucocephala (Lam) de. Wit* Germplasm for Psyllid Resistance

H.M.G.S.B. Hitinayake, H.P.M. Gunasena and I.P. Wickramasinghe

Postgraduate Institute of Agriculture, University of Peradeniya
Peradeniya.

ABSTRACT. *Of all fast growing legumes* ***Leucaena leucocephala*** *offers the widest assortment of uses. In Sri Lanka, it is used in agro-forestry, particularly under highland cropping, in livestock production as feed and very commonly as a source of energy among the rural poor. The highest constraint to its use is the susceptibility to the jumping plant lice,* ***Heteropsylla cubana*** *which was first seen in February 1987. It has spread widely and attacks all the species of* ***Leucaena*** *grown locally.*

A National Committee was formulated to study the problem of Psyllids and the main activity of this Committee at present is the evaluation of several Leucaena species for Psyllid resistance in collaboration with the NFTA, Hawaii. Although the trial is only six months old, very encouraging results are observed. Based on the preliminary information the species tested may be categorized as follows.

Resistant – *L. pallida K376, L. collinsii, Hybrid K x 2, L. diversifolia # 46568*

Moderately resistant – *Hybrid K x 1, L. diversifolia K785, L. esculanta*

Susceptible – *L. leucocephala K636, L. diversifolia K156, L. diversifolia # 33820*

Highly susceptible – *L. leucocephala K8, Hybrid K x 3*

INTRODUCTION

Of all fast growing legumes *Leucaena leucocephala* probably offers the widest assortment of uses. Through its many varieties, *Leucaena* can produce highly nutritious forage, firewood, timber and rich organic manures. Its diverse uses include revegetating tropical hill slopes liable to erosion, wind breaks, fire breaks, shade and ornamentation. Other than those specified above, it has been identified as an ideal legume for use in agro-forestry systems. This is mainly attributed to its rapid growth rate, high coppicing ability, quick regeneration and the aggressive growth even under adverse soil and climatic conditions, where many other tree legumes fail to perform so well.

Leucaena was introduced to Sri Lanka about a decade ago and within this short period it has naturalized itself remarkably well showing its wide adaptability for diverse local conditions. It has the highest potential as the tree component in agro-forestry systems in subsistent agriculture in the dry Intermediate Zones of Sri Lanka. It is widely used under these systems to simulate shifting cultivation for conservation of soil water and for provision of organic matter and fuel wood for subsistant farmers. In the mid country areas *Leucaena* is mainly used as livestock feed, primarily for cattle and small ruminants. There are large plantations of over 300 ha. grown by Nestle's Ltd. for harvesting leaf for animal feed manufacture which has greatly assisted to maintain the cost of animal feed within reasonable limits.

However, the greatest blow to its use in agriculture and in animal husbandry is the susceptibility to the jumping plant lice *Heteropsylla cubana* which was first observed in the mid country around February, 1987. Thereafter it has spread widely to various parts of the country where *Leucaena* has been growing. Several efforts have been made by local scientists to overcome this problem, but it was apparent that no quick solution could be found. A National Committee was formulated with a membership consisting of the Coconut Research Development Board, Department of Agriculture and the Faculty of Agriculture, University of Peradeniya. The main activity of this Committee at present is the evaluation of different lines of *Leucaena* obtained from the Nitrogen Fixing Tree Association, Hawaii which is reported in this paper.

MATERIALS AND METHODS

The following varieties are being evaluated at the University Experimental Station, Dodangolla.

1. *L. leucocephala* K636
2. *L. pallida* K376
3. *L. collinsii*
4. Hybrid K x 1 (*L. diversifolia* x *L. pallida*)
5. Hybrid K x 2 (*L. leucocephala* x *L. pallida*)
6. Hybrid K x 3 (*L. diversifolia* x *L. leucocephala*)
7. *L. diversifolia* K156
8. *L. diversifolia* # 46568
9. *L. diversifolia* # 33820
10. *L. leucocephala* K8
11. *Gliricidia sepium*
12. *L. diversifolia* K785
13. *L. esculanta*

The measurements are made according to the methodology provided by NFTA, Hawaii.

Other than those, following additional parameters are also measured.

1. Germination rates of different *Leucaena* entries.
2. Time taken for psyllid infestation to reach 50%.
3. Psyllid count and damage ratings at field planting.
4. Growth parameters of *Leucaena* species at the end of the nursery period.

RESULTS AND DISCUSSION

Nursery seedling stage

Germination (%)

The rate of germination was high in Hybrid K x 3 (89%) *L. esculanta* (83%) and in *L. leucocephala* (69%). In all the other entries the rate of germination was below 40%. *Gliricidia sepium* also recorded germination of 83% (Table 1).

Psyllid Infestation

The Psyllid infestation was first observed in *L. leucocephala* (K8) followed by *L. leucocephala* (K636) and Hybrid K x 3. Nearly 50% of plants of those entries were infested between 7 – 8 weeks after seeding (Table 2). This indicates their susceptibility to Psyllids immediately after germination and thereafter. However, *L. diversifolia* # 46568, Hybrid K x 1, *L. pallida, L. collinsii* and *L. esculanta* reached the 50% infestation mark only between 11 – 12 weeks after germination indicating their relative resistance to the psyllids in the early stages of growth. *G. sepium* was free of any infestation and showed complete resistance to this insect.

Psyllid Population

The observations of psyllid infested foliage of *Leucaena* germplasm from 6 weeks after planting onwards was as follows. The psyllid were very tiny insects and the adults were 1 – 2 mm in length. They lay yellow eggs on young terminal leaves and a few days later nymphs of different sizes were observed feeding on young leaflets. The biggest of these nymphal instars were 2 – 3 times small in size than that of an adult. Their colour ranged from green, brown to whitish.

The populations increased rapidly covering most of the terminal leaves, causing severe infestation. This high psyllid infestation, feeding on young leaflets in combination with slow growth of young shoots during the nursery stage, caused rapid defoliation in many entries. These were rated as 10, due to the difficulty in finding standardized samples. Psyllid populations greatly reduced as defoliation increased as it depended upon the amount of growing young shoots present, in plants.

Table 1. Germination Rates of *Leucaena*

Entry	Rate of Germination
1. *L. leucocephala* K636	69.3
2. *L. pallida* K376	21.3
3. *L. collinsii*	34.7
4. Hybrid K x 1 (L. diversifolia x L. pallida)	20.0
5. Hybrid K x 2 (L. leucocephala x L. pallida)	8.7
6. Hybrid K x 3 (L. diversifolia x L. leucocephala)	89.3
7. *L. diversifolia* K156	38.7
8. *L. diversifolia* # 46568	12.9
9. *L. diversifolia* # 33820	5.3
10. *L. leucocephala* K8	36.7
11. *L. diversifolia* K785	20.7
12. *L. esculanta*	83.3
13. *Gliricidia sepium*	82.9

Table 2. Time Taken for Psyllid Infestation to Reach 50%

Entry	Time Period (Weeks after planting)
1. *L. leucocephala* K636	8
2. *L. pallida* K376	11
3. *L. collinsii*	11
4. Hybrid K x 1	12
5. Hybrid K x 2	9
6. Hybrid K x 3	8
7. *L. diversifolia* K156	9
8. *L. diversifolia* # 46568	12
9. *L. diversifolia* # 33820	10
10. *L. leucocephala* K8	7
11. *L. diversifolia* K785	10
12. *L. esculanta*	11
13. *G. sepium*	–

However, *L. pallida* K376, *L. collinsii*, Hybrid K x 1 and *L. diversifolia* # 46568 showed, high resistance even at high populations of psyllids (Table 3). No defoliation was observed in these entries.

Table 3. Psyllid count and damage ratings of different *Leucaena* entries at field planting

Entry	Psyllid count rating			Psyllid damage rating
	adults	Nymphs	eggs	
1. *L. leucocephala* K636	10	10	10	7
2. *L. pallida* K376	3.0	3.3	4.6	2
3. *L. collinsii*	2.0	3.3	4.6	2
4. Hybrid K x 1	2.5	2.4	3.3	2
5. Hybrid K x 2	10	10	10	6
6. Hybrid k x 3	10	10	10	7
7. *L. diversifolia* K156	10	10	10	7
8. *L. diversifolia* # 46568	2.9	2.8	5.5	3
9. *L. diversifolia* # 33820	10	10	10	7
10. *L. leucocephala*	10	10	10	10
11. *L. diversifolia* K785	10	10	10	7
12. *L. esculanta*	10	10	10	5
13. *G.sepium*	1	1	1	1

Psyllid damage

Psyllid nymphs and adults damage the plants by sucking the sap from young foliage. As a result of this feeding, leaflets turn yellow, then curled and wilt. In many instances, the seriously affected shoots were broken by the wind causing complete decapitation. Blackening of lower leaves and stems was also observed. These were due to the growths of sooty molds on honeydew, deposited by these insects.

Psyllid damage was highest in *L. leucocephala* K8 among all entries in the nursery (Table 3) and the terminal shoots were completely defoliated. Loss of 50 – 75% of young leaves were observed in, *L. leucocephala* K636, Hybrid K x 3, *L. diversifolia* K156, *L. diversifolia* # 33820 and *L. diversifolia* K785. Least damages were observed in *L. pallida* K376, *L. collinsii* Hybrid K x 2, and *L. diversifolia* # 46568.

Predators

No predators were found preying on psyllids during the nursery stage.

Growth of Seedlings

Highest values in all growth measurements were recorded for *L. pallida* K376, *L. collinsii*, Hybrid K x 1, Hybrid K x 2 and *L. diversifolia* # 46568 during the nursery period (Table 4). *L. diversifolia* K156 and *L. diversifolia* # 33820, showed very poor growth. This can be attributed to their respective abilities to overcome, psyllid damage.

FIELD PERFORMANCE

Psyllid Population

During the first month after field establishment a slight reduction in psyllid population was observed in all entries, specially in those which extensive defoliation occurred. This was due to lack of growing young shoots for feeding. The development of new shoots were delayed as the plants were subjected to a drought during this period. As the rains

Table 4. Growth parameters of *Leucaena* species at the end of the nursery period.

Entry	Plant height (cm)	Stem diameter above 5cm ground level	No. branches	No. leaves
1. *L. leucocephala* K636	35.1	0.23	8.2	27.4
2. *L. pallida* K376	35.6	0.47	16.6	131.6
3. *L. collinsii*	52.0	0.39	12.2	64.8
4. Hybrid K x 1	43.2	0.30	13.0	72.8
5. Hybrid K x 2	37.2	0.39	13.4	66.8
6. Hybrid K x 3	25.1	0.29	8.4	32.4
7. *L. diversifolia* K156	17.2	0.19	10.6	29.2
8. *L. diversifolia* # 46568	37.0	0.30	15.6	87.2
9. *L. diversifolia* # 33820	20.0	0.19	10.6	28.8
10. *L. leucocephala* K8	24.0	0.25	10.0	25.2
11. *L. diversifolia* K785	29.8	0.23	11.4	26.6
12. *L. esculanta*	30.4	0.30	13.0	56.3
13. *G. sepium*	38.0	0.58	12.0*	93.0**

* No of compound leaves
** No of leaflets.

were received in the following months the shoots grew and the psyllid population also build up rapidly. (Table 5).

However, entries in which high psyllid populations present before rains defoliation is low, psyllid populations first decreased and increased in following month. This temporary reduction may be due to migration of psyllids to other *Leucaena* plants in surrounding.

In all other entries psyllid population increased with formation of new shoots. (Table 5).

Growth Rates and Psyllid Damage

The plants were subjected to a drought in the first month of field planting. Therefore, the growth rates were very slow. As the rainfall receipts were satisfactory in the subsequent months the *Leucaena* species grew rapidly. *L. pallida*, K376, *L. collinsii*, Hybrid K x 1, Hybrid K x 2 and *L. diversifolia* # 46568 recorded very high growth rates, while *L. diversifolia* K785, *L. diversifolia* K156 and Hybrid K x 3 showed poor growth rates among all entries (Table 6).

When the growth rates were slow due to drought in the first month, psyllid damage increased rapidly in all entries. However, as growth rates increased the psyllid damage was very much reduced. This is clearly shown in Table 7 and the most outstanding entries were *L. pallida*, Hybrid K x 1, *L. diversifolia* K785, *L. diversifolia* # 46568 and *L. collinsii*.

Predators

Of predators only very few Coccinellid beetles, of species *Olla abdominalis* (Say) were found during the first two months preying on psyllids. But, in the 3rd month they were much more common and both adults and lorvae were found preying on psyllids in all entries (Table 8).

These beetles were found frequently on *L. leucocephala* K636, Hybrid K x 3, *L. diversifolia* K156, *L. diversifolia* # 33820, *L. leucocephala* K8 and *L. diversifolia* K785.

Table 5. Monthly Psyllid count ratings of different entries.

Entry	Psyllid Count Rating								
	Adults			Nymphs			Eggs		
	1 MAP	2 MAP	3 MAP	1 MAP	2 MAP	3 MAP	1 MAP	2 MAP	3 MAP
1. *L. leucocephala* K636	10.0	2.6	3.5	10.0	2.1	3.0	10.0	6.8	6.3
2. *L. pallida* K376	2.4	1.3	3.1	2.5	1.0	2.3	4.0	1.0	2.3
3. *L. collinsii*	2.6	1.6	3.8	3.1	1.8	2.8	4.9	1.8	3.9
4. Hybrid x 1	2.1	1.1	2.8	2.0	1.3	2.3	3.4	1.5	3.1
5. Hybrid x 2	10.0	2.3	3.5	10.0	2.1	3.0	10.0	6.5	4.8
6. Hybrid x 3	10.0	3.0	4.0	10.0	2.4	2.8	10.0	5.8	3.9
7. *L. diversifolia* K156	10.0	1.3	3.5	10.0	1.8	3.0	10.0	2.6	5.3
8. *L. diversifolia* # 46568	2.6	2.1	3.4	2.9	1.9	2.3	5.0	2.3	2.8
9. *L. diversifolia* # 33820	10.0	2.1	4.3	10.0	1.9	3.3	10.0	2.5	5.8
10. *L. leucocephala* K8	10.0	3.3	3.5	10.0	2.5	2.5	10.0	5.8	6.0
11. *L. diversifolia* K785	10.0	2.1	3.0	10.0	2.1	2.5	10.0	2.9	3.0
12. *L. esculanta*	10.0	1.3	3.0	10.0	1.4	2.3	10.0	1.4	2.5
13. *G. sepium*	1.0	1,0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

* MAP = Months after planting.

Table 6. Plant height and stem diameter of different *Leucaena* entries

Entry	Plant Height (cm)			Stem Diameter (cm) 15 cm above ground level		
	1 MAP	2 MAP	3 MAP	1 MAP	2 MAP	3 MAP
1. *L. leucocephala* K636	37.6	43.5	58.8	0.24	0.43	0.82
2. *L. pallida* K376	41.0	55.0	82.4	0.58	0.80	1.29
3. *L. collinsii*	58.8	82.4	106.6	0.41	0.69	1.07
4. Hybrid K x 1	50.4	58.0	73.2	0.32	0.50	0.76
5. Hybrid K x 2	40.4	46.2	81.0	0.41	0.76	1.22
6. Hybrid K x 3	27.8	30.8	40.0	0.20	0.37	0.55
7. *L. diversifolia* K156	18.0	25.4	47.0	0.21	0.36	0.66
8. *L. diversifolia* # 46568	43.4	58.4	104.2	0.39	0.87	1.42
9. *L. diversifolia* # 33820	21.0	30.6	63.4	0.34	0.51	0.89
10. *L. leucocephala* K8	24.6	27.8	34.8	0.22	0.39	0.67
11. *L. diversifolia* K785	33.2	45.4	60.0	0.28	0.47	0.84
12. *L. esculanta*	34.8	42.8	-	0.32	0.53	-
13. *G. sepium*	41.2	45.2	60.6	0.66	0.82	1.21

* MAP = Months after planting.

Table 7. Monthly psyllid damage Ratings.

Entry	Damage ratings		
	1 MAP	2 MAP	3 MAP
1. *L. leucocephala* K636	7	3	3
2. *L. pallida* K376	3	1	1
3. *L. collinsii*	3	1	1
4. Hybrid K x 1	3	1	1
5. Hybrid K x 2	7	2	1
6. Hybrid K x 3	8	4	3
7. *L. diversifolia* K156	8	2	4
8. *L. diversifolia* # 46568	3	1	1
9. *L. diversifolia* # 33820	7	2	2
10. *L. leucocephala* K8	9	3	4
11. *L. diversifolia* K785	8	1	1
12. *L. esculanta*	6	2	2
13. *G. sepium*	1	1	1

* MAP = Months after planting.

Table 8. Number of predators (species: *Olla abdominalis*) found in different entries of *Leucaena*.

Entry	No of Predators		
	Adult (beetle)	Larvae	Total
1. *L. leucocephala* K636	12	5	17
2. *L. pallida* K376	4	0	4
3. *L. collinsii*	10	0	10
4. Hybrid K x 1	1	2	3
5. Hybrid K x 2	7	5	12
6. Hybrid K x 3	18	8	26
7. *L. diversifolia* K156	8	9	17
8. *L. diversifolia* # 46568	7	2	9
9. *L. diversifolia* # 33820	9	4	13
10. *L. leucocephala* K8	19	6	25
11. *L. diversifolia* K785	18	8	26
12. *L. esculanta*	1	1	2

These were also the entries which were severely damaged by psyllids in previous defoliation and recorded low growth rates.

However, still it is difficult to determine the extent of effectiveness of natural enemies in controlling psyllids damaging *Leucaena*.

Annexure 1

Psyllid counts will be scored empirically (1 – 9 rating) on a monthly basis. A large, hand – held magnifying glass (8 cm in diameter) will be used to count psyllid in all three stages (adults, nymphs and eggs). The scoring will be done early in the morning on juvenile leaves at the end of a stem. Eight trees are to be scored for each entry in each replication.

Psyllid count rating scale

Adults	Nymphs	Eggs (% leaf cover)
1 no adults	1 no nymphs	1 no eggs present
2 1–5 adults	2 1–5	2 occasional eggs present
3 6–10	3 6–10	3 eggs (not masses) on most leaflets
4 11–15	4 11–15	4 eggs masses on 10% of leaflets
5 16–20	5 16–20	5 egg masses on 25% leaflets
6 21–30	6 21–30	6 egg masses on 50% of leaflets
7 31–40	7 31–40	7 egg masses on 75% of leaflets
8 41–50	8 41–50	8 egg masses cover leaflets
9 50+	9 50+	9 egg masses cover leaves and stems
10 Total	10 Total	10 Total defoliation
Defoliation	Defoliation	

Annexure 2

Psyllid Damage

Psyllid damage will be scored empirically (1 – 9 rating) on entire terminal shoots. These shoots will be different than those used for psyllid counts, since psyllid counts must be done on selected, completely foliated samples. Eight trees to be scored for each entry in each replication.

Psyllid damage rating scale:

1. No damage observed.

2. Slight curling of leaves.

3. Tips and leaves curling and yellowish.

4. Tips and leaves badly curled and yellowish.

5. Loss of up to 25% of young leaves.

6. Loss of 26 to 50% of young leaves.

7. Loss of 51 to 75% of young leaves.

8. 100% loss of leaves and blackening of lower leaves.

9. Blackened stem with total leaf loss.