Adaptation of new species of *Leucaena* in Costa Rica, Central America. Preliminary results

P. J. Argel and G. Pérez[1]

There are 17 species of *Leucaena* identified that are all native to the New World; however, the more researched and utilized species worldwide continues to be *L. leucocephala* (Lam) de Wit, that is known by its high forage quality, but deficient cold and drought tolerance, poor growth on acid soils, heavy pod production, low wood durability and susceptibility to a defoliating psyllid (Hughes 1993). Other species of *Leucaena* are little known despite that indigenous people, particularly of Mexico and Central America, have utilized them for centuries as sources of food, firewood, timber for construction and feed for domestic animals.

In 1996 CIAT agree to collaborate with the Oxford Forestry Institute (OFI) of England to evaluate the adaptation and potential use of new species of *Leucaena* along the tropics of Latin America. OFI provided experimental seed of 18 new lines of *Leucaena*, supplied the inoculum and the experimental methodology for evaluation. During the last year, seed has been distributed to collaborators in Costa Rica, Mexico, Honduras, Nicaragua, Belize, Panamá, Colombia, Venezuela and Brazil. The trials are coordinated from a regional CIAT office located at the headquarters of the Instituto Interamericano de Cooperación para la Agricultura (IICA) in San José, Costa Rica.

Preliminary results of the first trial established in Costa Rica are presented.

Materials and methods

The experimental site is located at the Escuela Centro Americana de Ganadería (ECAG) in Atenas, Costa Rica. This locality is placed at 9º 58' lat N and 84º 23' long W at 200 m.a.s.l.; it is classified as subhumid tropical forest with 23.7 ºC mean temperature and 1600 mm of annual rainfall distributed from May to November. The soils are inceptisols of medium fertility that have the following characteristics: pH 5.9 (H_2O); 7.6 % OM; 3.6 ppm of P; 9.5, 6.0 and 0.24 meq/100 g respectively of Ca, Mg and K; the Al content is negligible.

Seed of 18 species of *Leucaena* were scarified with sand paper, inoculated and planted directly in the field placing two seeds per site. Plants were thinned lately to one per site for a total of 10 plants per plot spaced at 0.50 m between plants. Checks were made of one line selected by CIAT of *L. leucocephala* (CIAT 17263), one introduction of *Calliandra callothyrsus* from Australia (CPI 115690) and the shrub *Cratylia argentea* (CIAT 18668). Each species was replicated four times.

Measurements of plant height and diameter, foliar retention and plant mortality were taken 3.5 months after planting at the end of the dry season. Plant height was measured again 9.8 months after planting, before the uniformity cut made at 0.50 m height. At this age the form and growth habit of the different accessions was ranked using a scale suggested by OFI.

[1] Centro Internacional de Agricultura Tropical (CIAT). Regional Office at IICA, Apdo 55-2200, San José, Costa Rica.

Evaluation cuts at 0.5 m height have been carried out at 8 weeks of regrowth during the period of the rains; the material harvested is separated in edible component (leaves and thin stems) and woody parts. Dry weight is taken after drying the samples for 48 hours in a forced air oven. Psyllid damage has been monitored at monthly intervals.

Results and discussion

Considerable variation has been observed in growth vigour between *Leucaena* species as indicated by plant height, stem diameter, foliar retention and plant mortality at the end of the 6 months dry period (Argel and Pérez 1997). Most *Leucaena* species showed strong apical dominance, with the exception of *L. pallida* 79/92, *L. leucocephala* CIAT 17263 and *L.* hybrid 1/95.

Table 1 indicates that plant height increments varied from 0.49 m to more than 1.5 m 9.8 months after planting, with ten lines reaching more than 1 m height. The best growth was recorded in *L. collinsii* 52/88, which outyielded 3 times the poorest species (*L. multicapitulata* 81/87). Other outstanding lines up to this date were *L. salvadorensis* 17/86, *L. diversifolia* subspp. *stenocarpa* 53/88 and *diversifolia* 83/92, *L. leucocephala* subsp. *glabrata* 34/92 (K 636) and *L. macrophylla* subsp. *nelsonii* 47/85. These observations are in agreement with those reported by Karachi and Lefofe (1997) in a different environment at Morale, Botswana; however, none of them has showed adaptation to acidic ultisols (pH = 4.7) with Al saturation of 49 % (Castillo et al. 1997).

Foliar retention and plant survival is very important in environments like Atenas with 6 months dry season. *L. shannonii* subsp. *magnifica* 19/84, *L. leucocephala* subsp. *glabrata* 34/92 (K 636) , *L. macrophylla* subsp. *nelsonii* 47/85 and *L.* hybrid 1/95, all combined both, over 60 % foliar retention and nil or very little plant mortality under the conditions of the trial. On the other hand, *L. multicapitulata* 81/87, an introduction from Los Santos (Panamá) and the check *C. calothyrsus* DPI 115690 had high plant mortality.

Considerable variation has been recorded in individual plant dry matter yield. Table 2 indicates that there is significant variation within and between species of *Leucaena. L. diversifolia* subsp. *stenocarpa* 53/88, *L. collinsii* 52/88, *L.* hybrid 52/87 and *L. pallida* 14/96 are among the best yielders; meanwhile that *L. diversifolia* subsp. *diversifolia* 83/92 and *L. collinsii* subsp. *zacapana* 56/88 have yielded significantly much less ($P<0.05$). Other species of poor yields have been the check *L. leucocephala* CIAT 17263, *L. lempirana* 6/91, *L. trichodes* 61/88 and *L. multicapitulata* 81/87. However, all lines have produced a high proportion of edible forage.

Table 1. Plant height, diameter, foliar retention and plant mortality of *Leucaena* and other species planted for evaluation in Atenas, Costa Rica. (Adapted from Argel and Pérez 1997).

Species		Plant *		Plant **		Plant***
	(ID No.)	Height (cm)	Diameter (mm)	Height (cm)	Foliar retention	Mortality (No.)
L.collinsii zacapana	56/88	51	3.6	112	3.4	0
L. collinsii	52/88	63	5.6	151	3.5	0
L.diver. diversifolia	83/92	35	3.2	119	2.8	0
L.diver. stenocarpa	53/88	54	5.0	121	3.1	0
L.esculenta esculenta	47/87	52	5.6	81	1.9	0
L. hybrid	52/87	40	3.2	110	1.9	1
L. pallida	79/92	57	4.7	97	2.9	0
L.hybrid	1/95	44	4.0	94	4.0	0
L. lanceolata	43/85	45	4.7	96	3.5	0
L. lempirana	6/91	45	3.4	111	3.1	0
L. l. glabrata	34/92	45	4.3	116	4.4	0
L. macrophylla nelsonii	47/85	38	3.4	115	4.1	1
L. multicapitulata	81/87	25	2.8	49	2.5	14
L. pallida	14/96	58	5.0	111	3.1	1
L. pulverulenta	83/87	28	2.9	59	3.4	0
L. salvadorensis	17/86	64	4.7	140	3.9	1
L. shannonii magnifica	19/84	47	4.0	94	4.0	1
L. trichodes	61/88	32	2.8	67	2.5	6
L. leucocephala CIAT	17263	38	3.6	84	3.8	0
C. calothyrsus DPI	115690	27	3.8	94	2.9	11
C. argentea CIAT	18668	38	4.2	149	4.5	0

* Measurements taken 3.5 months after planting.

** Measurements taken 9.8 months after planting and before the uniformity cut at the end of the dry season 1997.

Foliar retention scale: 1= less than 20% foliar retention; 2=20 - 40%; 3 = 40 - 60%; 4= 60 - 80% and 5 >80% foliar retention.

*** Plant mortality at the end of the 6 months dry season.

The shrub *C. argentea* CIAT 18668 is placed between the best *Leucaena* species in terms of DM yields and foliar retention during the dry season (Table 1 and 2). This plant develops a kind of 'climbing branches' that makes it difficult to determine a clear pattern of growth; under cutting it produces multiple branches that replace the main stem. *L. leucocephala* CIAT 17263 is within the intermediate group of *Leucaena* species with comparable yields to *C. calothyrsus* DPI 115690, although with better plant survival (Table 1).

Table 2. Psyllid damage and dry matter (DM) yields of *Leucaena* and other species established in Atenas, Costa Rica (Mean of 2 evaluations cuts after 8 weeks of regrowth during the wet season).

Species	(ID No.)	Pysillid damage *	DM Yields (g/plant) Total		Edible	
L. diver. stenocarpa	53/88	1.1	111	a **	90	(81) ***
C. argentea CIAT	18668	1.0	106	ab	98	(92)
L. collinsii	52/88	2.1	90	abc	75	(83)
L. hybrid	52/87	1.8	84	bcd	65	(77)
L. pallida	14/96	1.2	83	bcd	72	(87)
L. l. glabrata	34/92	3.5	81	bcde	67	(83)
L. pallida	79/92	1.5	73	bcdef	63	(86)
L. diver. diversifolia	83/92	1.6	68	cdef	55	(81)
L. hybrid	1/95	2.4	64	cdef	61	(95)
L. pulveruleuta	47/87	1.0	64	cdef	59	(92)
L. salvadorensis	17/86	3.9	58	defg	51	(88)
L. macrophylla nelsonii	47/85	2.3	54	efgh	46	(85)
L. lanceolata	43/85	3.1	49	fgh	48	(98)
L. pulverulenta	83/87	2.1	48	fgh	48	(100)
C. calothyrsus DPI	115690	1.0	47	fgh	43	(91)
L. leucocephala CIAT	17263	2.6	47	fgh	44	(94)
L. shannonii magnifica	19/84	3.1	33	ghi	29	(88)
L. lempirana	6/91	3.7	31	ghi	29	(94)
L. collinsii zacapana	56/88	4.0	28	hi	27	(96)
L. trichodes	61/88	3.6	13	i	13	(100)
L. multicapitulata	81/87	4.1	7	i	7	(100)

* Mean of 4 ratings at monthly intervals. Scale used: 1= no damage; 2 = young leaves moderately curled; 3 = tips and young leaves curled and yellow; 4 = tips and young leaves severely curled, yellow and covered with sap; 5 = loss of up to 25% of young leaves; 6 = loss of up to 50% of young leaves; 7 = loss of up to 75% of young leaves; 8 = loss of up to 100% of young leaves and darkening of older leaves, and 9 = stained stems and loss of total foliage.

** Means followed by similar letters are not significantly different ($P < 0.05$)

*** Between brackets the percent edible DM relative to total, DM yield.

The psyllid insect has been present during the period of the observations; however, plant damage has been mild up to date. Table 2 shows that the lower yielding species of *Leucaena* have been slightly more affected by psyllid, but producing only curled young leaves and tips; however, in any case the defoliation of young leaves has been more than 25 per cent. *L. diversifolia* subsp. *stenocarpa* 53/88, *L. pallida* 14/96 and *L. pulverulenta* 47/87 have showed less susceptibility to the psyllid insect. This insect has natural enemies in the area that make an effective biological control; however, it has been mentioned that it could become a problem if the area planted with leucaena continues to expand (Schultze-Kraft 1994).

Mild attacks of the fungus *Camptomeris leucaenae* have been recorded, particularly in old leaves of *Leucaena* species. This fungus is particularly severe in species of *L. leucocephala*, but it has been reported that the species *L. diversifolia*, *L. esculenta*, *L. lanceolata*, *L. macrophylla* and *L. trichodes* are not affected (Moreno et al. 1988).

This trial will continue for another growing season.

Conclusions (preliminary)

Considerable variations have been recorded between *Leucaena* species in terms of plant height and vigour, foliar retention during the dry period, plant mortality and DM yields.
Most *Leucaena* species showed strong apical dominance as habit of growth.
L. diversifolia subsp. *stenocarpa* 53/88, *L. collinsii* 52/88, *L. hybrid* 52/87, *L. pallida* 14/96 and *L. leucocephala* subsp. *glabrata* 34/92 (K636) are among the best yielders, meanwhile that *L. lempirana* 6/91, *L. collinsii* subsp. *zacapana* 56/88, *L. trichodes* 61/88 and *L. multicapitulata* 81/87 have produced poor DM yields as an indication of poor adaptation to the climatic and soil conditions of the trial.
Only mild attacks of the psyllid insect have been recorded.

References

Argel, P. J. and Pérez, G. 1997. LEUCNET Leucaena trials in Mexico, Central and South America, and early results from Costa Rica. LEUCNET News, No 4 July 1997, 13-14.

Castillo, A. C., Acasio, R. N., Victorio, E. E., Moog, F. A. and Palis, R. 1997. Leucaena productivity on the highly acidic soil of Tany, Rizal, Philippines. LEUCNET News, No 4. July 1997, 20-22.

Hughes, C. E. 1993. Leucaena Genetic Resources. The OFI Leucaena seed collection and a synopsis of species characteristics. Oxford Forest Institute, Department of Plant Sciences, University of Oxford, 117 p.

Karachi, M. and Lefofe, B. M. 1997. The performance of *Leucaena* spp. at Morale, Botswana. LEUCNET News, No 4 July 1997, 11-12.

Moreno, J., Torres, C. G. and Lenné, J. M. 1987. Reconocimiento y evaluación de enfermedades de Leucaena en el Valle del Cauca, Colombia. Pasturas Tropicales-boletín 9(3), 30-35.

Scultze-Kraft, R. 1994. El 'psyllid' de Leucaena también puede ser un problema en América tropical. Pasturas Tropicales 16(2), 48-50.