Leucaena (Leucaena leucocephala (Lam.) de Wit) and gliricidia (Gliricidia sepium (Jacq.) Walp.) are perennial leguminous trees native to Central America with a wide distribution in the tropics and subtropics. Both are utilized for forage, wood, fuel, shade, green manure, live fencing, and erosion control.

Leucaena is commonly propagated from seed. However, vegetative propagation is essential to maintain the genetic purity of superior genotypes, such as psyllid resistant hybrids. Commercial production of hybrid seed may also depend on our ability to clone one of the parent genotypes.

There is conflicting evidence in the literature concerning propagation of leucaena from stem cuttings. Hu and Chih-Cheng (1981) report the propagation of leafy cuttings under mist spray, and Bristow (1983) successfully propagated softwood cuttings after imposing a 60-minute wilting period prior to planting. Successful propagation by grafting (Versace 1982), stump transplanting (Petheram et al. 1982), and by the bare stem method (Dalton 1980) have also been reported. In contrast, Jones et al. (1982) reported, and general experience has shown, that leucaena is difficult to propagate asexually.

Conversely, gliricidia is readily propagated from long stem cuttings. Chadhokar (1982) reported that establishment was best achieved using older stems (3.6-4.0 cm diameter) approximately 90 cm in length cut from the base of trees. No special treatment of stakes was necessary.

This study reports the results of field and glasshouse trials designed to investigate factors affecting root initiation of leucaena stem cuttings. Gliricidia was included in the study as a check. Treatment variables studied were age and length of stem cuttings, leafy twig versus older stem cuttings, treatment of cuttings with boron or the plant hormone indolebutyric acid (IBA), and warm temperature callusing in peat. Each of these treatments has been reported to stimulate root initiation from stem cuttings (Hartmann and Kester 1975).

Experiment 1.

Materials and methods. Experiment 1 was conducted in the field at the University of Queensland research farm at Mt. Cotton, located 50 km southeast of Brisbane. The climate is subtropical with 70% of the 1480 mm mean annual rainfall falling in summer. The site was a sloping, infertile podzolic soil (Ultisol) which was cultivated to a depth of 15 cm and leveled before planting.

The experimental design was a randomized complete block experiment. Treatments applied to both gliricidia and leucaena cv. Cunningham in factorial combination were:

- age of stem cuttings (2-6, 6-12, and 12-24 months),
- length of stem cuttings (15, 30, 45, and 90 cm), and
- immersion, or not, of the basal 2 cm of cuttings for 5 seconds in a concentrated solution (4,000 ppm) of IBA.

There were five replications and the experiment was duplicated in full sun and under Sarlon shade cloth which reduced light transmission by 50%. The experiment was planted and conducted for a 10-week period on 14 December 1983. The area was sprinkle-irrigated daily to maintain a high soil moisture status.
At the conclusion of the experiment, the number of initiated shoots, shoot dry weight, and extent of rooting were measured. The latter was measured using an empirical rating system (0 to 6) (see Table 1).

**Results.** The mean daily maximum and minimum temperatures and humidity over the experimental period were 27.6°C, 18.5°C and 69%, respectively. Total rainfall was 403 mm with 32 wet days.

Leucaena stem cuttings failed to initiate roots even though 10 cuttings, all aged between 12 and 24 months, developed shoots.

The average root initiation of gliricidia was 65%. Root initiation increased with stem length (from 28 to 90%) and with stem age (from 57 to 78%), but was decreased by shade (from 74 to 55%) (Table 1). Root initiation was not affected by treatment with IBA. These same trends were observed for extent of root development and for shoot weight and number.

**Table 1.** Effect of age of cuttings, length of cuttings, and shade on root initiation and shoot growth of *Gliricidia sepium*.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Age (months)</th>
<th>Length (cm)</th>
<th>LSD</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-6</td>
<td>6-12</td>
<td>12-14</td>
<td></td>
</tr>
<tr>
<td>Germination (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun</td>
<td>33</td>
<td>95</td>
<td>95</td>
<td>70</td>
</tr>
<tr>
<td>Shade</td>
<td>23</td>
<td>58</td>
<td>85</td>
<td>43</td>
</tr>
<tr>
<td>Shoot dry weight (g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun</td>
<td>0.8</td>
<td>1.5</td>
<td>5.4</td>
<td>4.18</td>
</tr>
<tr>
<td>Shade</td>
<td>0.1</td>
<td>0.4</td>
<td>1.7</td>
<td>0.47</td>
</tr>
<tr>
<td>Root rating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun</td>
<td>0.9</td>
<td>2.0</td>
<td>3.4</td>
<td>0.77</td>
</tr>
<tr>
<td>Shade</td>
<td>0.4</td>
<td>1.0</td>
<td>1.7</td>
<td>0.54</td>
</tr>
<tr>
<td>Shoot number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun</td>
<td>2.5</td>
<td>5.0</td>
<td>4.3</td>
<td>1.71</td>
</tr>
<tr>
<td>Shade</td>
<td>1.0</td>
<td>2.9</td>
<td>3.2</td>
<td>1.46</td>
</tr>
</tbody>
</table>

Note: 0 = no root development; 1 = root callus development; and 2-6 = increasing levels of root development to 2 g dry weight/cutting.

**Experiment 2.**

**Materials and methods.** Experiment 2 was a glasshouse trial conducted with leucaena cv. Cunningham at the University of Queensland at Brisbane Australia for a nine week period from 13 April 1984. The objective was to study the poor root initiation characteristic of leucaena in more detail. The design of experiment 2 was a randomized complete block factorial with the treatments:

- IBA at 0, 2,000 and 4,000 ppm, and
- with and without treatment with boron.

The experiment was established with both leafy twig cuttings (Hu and Chih-Cheng 1981) and stem cuttings 12-24 months of age. There were 15 replications. The leafy twig cuttings were 15 cm in length and retained the terminal shoot. Stem cuttings were 30 cm in length and were stripped of leaf. Cuttings were treated with IBA as for the field experiment while the boron treatment consisted of a 15-minute soaking of the basal end of cuttings in a 0.5% borax solution. The cuttings were then placed in a misting cabinet in a fine gravel under an intermittent misting regime.
Shoot number and dry weight and root dry weight were determined at the conclusion of the experiment.

**Results.** Callus development was observed on the basal end of the leafy twig cuttings after 10 days; however, there was no further development of roots over the remainder of the trial period. While the stem cuttings exhibited good shoot development (2.5 per cutting), only 3% showed root development. IBA did not affect shoot weight or number. Boron also had no affect on shoot weight, but reduced shoot number.

**Experiment 3.**

**Materials and methods.** Experiment 3 was an unreplicated observational trial. Thirty 30-cm cuttings, 12-24 months of age, were stripped of leaves and treated with a concentrated IBA solution (4,000 ppm) as in the field experiment. The cuttings were then given a warm-temperature, callusing treatment in pre-moistened peat held at a constant temperature of 25°C for four weeks from 13 April 1984. They were then checked for root and bud development and placed in the misting cabinet and treated as described above. Root initiation parameters were measured after six weeks.

**Results.** Upon removal from the peat, two cuttings had developed roots while two showed root callus. However, many of the cuttings exhibited swelling below the outer bark layer. After six weeks growth in the misting cabinet, six cuttings had rooted while a further four had root callus development giving a total initiation of 31.3%. The mean shoot number of all cuttings was 2.1 while that of germinated cuttings was 3.1.

**Discussion.**

**Leucaena.** The poor field germination of stem cuttings of leucaena is in accord with other reported results (Jones et al. 1982) and the generally held view concerning the difficulty of vegetative propagation of leucaena.

Both leafy twig and stem cuttings failed to germinate in the more favorable environment of the glasshouse. The lack of success using the leafy twig cuttings technique reported by Hu and Chih-Cheng (1981) was not unexpected. Low carbohydrate reserves and high nitrogen concentrations in young shoots are factors that inhibit root initiation of stem cuttings (Hartmann and Kester 1975). In addition, the succulent cuttings were not robust and were easily damaged during handling.

Root initiation of older stem cuttings of leucaena under misting was also poor. Traditional methods of stimulating root initiation such as application of IBA and boron failed, indicating the possibility of an internal mechanism of inhibition of root initiation. Warm-temperature callusing in peat (Hartmann and Kester 1975) may have partially overcome this barrier for the 12-24 month old cuttings. The work of Bristow (1983) showed excellent germination of softwood cuttings from glasshouse-grown plants of leucaena if cuttings were first wilted for 60 minutes before placement in the rooting medium. It is possible that wilting may also break down inhibitory barriers. These results, together with the reported success of Hu and Chih-Cheng (1981) with young cuttings, may indicate that the inhibitory barrier is stronger in older tissue. This aspect merits further study.

**Gliricidia.** The rate of root initiation observed in gliricidia was higher than that obtained by Chadhokar (1982) and indicates the ease of propagation of this species. Age of cuttings exerted the major influence on initiation, with length of cuttings less important, especially in sunny locations. However, shoot growth was greater on longer cuttings due to the greater number of bud sites and this may be an important factor in high early biomass production. Cuttings older than six months, when grown in the sun, gave extremely high germination percentages (95%) indicating that the methods used were favorable for the root initiation of gliricidia if not leucaena.
Other treatments such as shading or use of the growth hormone IBA were not beneficial.

Conclusions. The results indicate that gliricidia can be readily propagated from stem cuttings even in the subtropics. Cuttings longer than 45 cm and older than six months were the best planting material in terms of root initiation and subsequent yield.

The failure of leucaena to initiate roots either in the field or under misting in the glasshouse confirms the commonly held belief that leucaena is difficult to vegetatively propagate. There was an indication that pretreatment of cuttings, such as warm temperature callusing, may help alleviate what appears to be an internal barrier to root initiation.

Acknowledgment. We thank Professor J. L. Brewbaker and Messrs. M. T. Austin and C. T. Sorensson for editorial advice on the manuscript.

References:


