VEGETATIVE PROPAGATION OF *ACACIA MANGIUM* BY STEM CUTTING: THE EFFECT OF SEEDLING AGE AND PHYLLODE NUMBER ON ROOTING

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DARUS HAJI AHMAD, THOMPSON, S. & PIRRIE, A. 1990. Vegetative propagation of *Acacia mangium* by stem cutting: the effect of seedling age and phyllode number on rooting. The rooting percentage of *Acacia mangium* stem cuttings decreased significantly with increasing age of stock plants. Cuttings taken from 6 and 12-*mth*-old stock plants rooted faster than stem cuttings of old stock plants and produced higher rooting percentages of 71.3 and 65.0% respectively. The presence of phyllodes is also an important factor for rooting success of *A. mangium* stem cuttings. Those with one phyllode or a half-cut phyllode produced better rooting percentages (66.0 to 76.0%), a faster rooting rate, and a very low mortality rate compared to leafless cuttings or cuttings with two phyllodes.

Key words: *Acacia mangium* - stem cutting - phyllode - seedling age - rooting

Introduction

It is now well established that age of stock plants from which cuttings are taken is one of the most important factors affecting rooting of cuttings. For example, Hu and Shen (1986) reported that cuttings of 1 and 3-*y*-old *Acacia auriculiformis* seedlings gave 41.0 and 7.0% success rate respectively. Davidson (1974) found that stem cuttings taken from *Eucalyptus deglupta* seedlings up to 12-*mth*-old rooted better than cuttings from trees aged five years which completely failed to root. In addition to rooting percentage, Girouard (1974) stated that the speed of rooting, the root length and number, survival and growth of rooted cutting also decreased with increasing age of the parent trees.

The difficulty in rooting of cuttings from mature trees may possibly be related to three important factors: 1) increase in production of rooting inhibitors as the plants grow old (Ooyama 1962); 2) decrease in phenolic levels which act as an auxin cofactor or synergist in root initial of stem cuttings (Hess 1968); and 3) presence of anatomical barriers such as sclerenchymatous sheath (Beakbane 1961).

The other factor affecting the rooting success is the presence of leaves and buds. Bilan (1974) reported that stem cuttings of 3-*y*-old *Liquidambar styracifolia* without leaves failed to root even when treated with indole-3-butyric acid (IBA). However, cuttings with leaves and treated with IBA at the same concentration gave better rooting percentages.

We describe in this paper investigations on: 1) the rooting of stem cuttings of *A. mangium* from seedlings aged 6, 12, 18 and 24-*mth*-old; and 2) the effect of phyllode on rooting percentage of *A. mangium* stem cuttings.

Materials and methods

For studying the effect of seedling age on rooting performance, the cuttings were taken in batches from 6, 12, 18 and 24-*mth*-old healthy stock plants grown in a greenhouse. Depending on the age of the seedlings, stems were cut into single internode cuttings 4.0 to 5.0 *cm* long and 0.5 to 1.5 *cm* in diameter. Every portion of the stem within this diameter range was used in this experiment. The terminal internodes were discarded because of their succulent nature. The cuttings were treated with a hormone rooting powder (Seradix 3) and then inserted into humidified rooting chambers containing a mixture of Irish spagnum peat moss and sand in equal proportions. They were planted in a randomised manner, with ten replicates of nine cuttings per replicate per treatment.

For studying the effect of phyllode number on rooting, cuttings were taken from 1-*y*-old greenhouse grown stock plants. The stems were cut into several one-internode and two-internode cuttings, then divided into four groups: 1) two-internode stem cuttings with two phyllodes; 2) one-internode stem cuttings with one phyllode; 3) one internode stem cuttings with the phyllode cut transversely in half; and 4) one-internode cuttings without phyllode. They were then treated with Seradix 3 and planted in a humidified rooting chamber which contained a similar rooting mixture to the earlier experiment. For this experiment, a completely randomised design was used, and each treatment was replicated five times with ten cuttings per replicate.

Observations on both experiments were made every two weeks for three months after planting. A cutting was considered to have rooted when a newly developed root about 0.5 *cm* in length was seen. Once a cutting was observed to have rooted this was recorded. At three months after planting, the number of non-rooted and dead cuttings was recorded. A cutting was considered to be dead when the phyllode dropped and the stem turned brown.

Results and discussion

Effect of seedling age on rooting

Table 1 illustrates the percentage of rooted and non-rooted cuttings taken from four different ages of stock plants. A regression analysis showed that the rooting percentage of cuttings decreased significantly ($p=0.05$) with increas-

increasing age of stock plants. However, the cuttings taken from 6 and 12-*mth*-old stock plants did not differ in their rooting percentage.

Table 1. Rooting percentage of *Acacia mangium* stem cuttings (n=80) in relation to the age of stock plants at cutting time

	Age of stock plants (*mth*) at cuttings time			
	6	12	18	24
Total rooted cuttings	57	52	25	12
Total non-rooted cuttings	9	9	8	3
% rooted	71.3±4.6	65.0±5.2	31.3±2.1	15.0±1.7

± [standard error of mean, bars indicate a non-significant difference between treatment means (p=0.05)

Figure 1 shows the progress of rooting with time (weeks) of stem cuttings taken from four different ages of stock plants. Cuttings taken from young (6 and 12-*mth*-old) stock plants rooted more quickly than those from old stock plants.

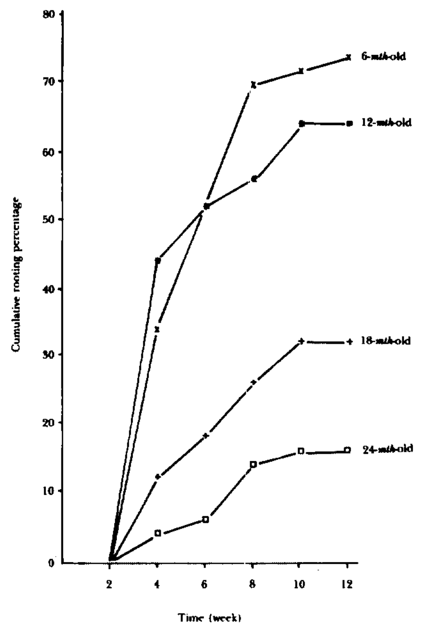

Figure 1. Cumulative rooting percentage over time (weeks) for *Acacia mangium* stem cuttings of different ages

It has been widely reported that age of stock plants from which the cuttings were taken is the most important single factor affecting root initiation on cuttings. Cuttings of "difficult to root" species taken from young seedlings normally root more easily than those from old stock plants. In this experiment, the rooting percentage decreased significantly with the increasing age of stock plants. Cuttings taken from 6 and 12-*mth*-old seedlings gave higher rooting percentage than cuttings taken from 18 and 24-*mth*-old seedlings. Similar results were reported on cuttings of some tropical hardwood species, for instance, *Shores bracteolata, Shorea leprosula* and *Dipterocarpus chartaceous* (Srivastava & Manggil 1981). Nanda *et al.* (1970) reported that they failed to root cuttings taken from old trees (the age is not mentioned by the authors) of three *Acacia* species, namely *A. mollisima, A. catechu, A. decurrens* and other tropical leguminous species, such as *Cassia fistula, C. javanica, Delonix regia, Albizia procera* and *A. lebbek.*

The decline in rooting percentage of *A. mangium* stem cuttings taken from old stock plants may possibly be due 1) the presence of sclerenchymatous cells which become a barrier for root initiation; and 2) the absence of preformed adventitious roots in the stem. It has been reported that this always occurred in old trees and caused difficulty in the rooting of cuttings (Beakbane 1961). Although histological studies of 1-*y*-old *A. mangium* seedlings clearly showed the presence of a continuous layer of sclerenchymatous cells, at this stage, it did not affect much on the rooting percentage of stem cuttings (Darus 1989). However, with the increase in age, this layer became thicker and acted as a barrier to penetration of water and initiation and emergence of adventitious roots.

Effect of phyllode number and trimming on rooting

Table 2 shows the percentage of rooted and non-rooted cuttings in relation to phyllode presence. The average rooting percentages of cuttings with one phyllode and cuttings with half phyllode were equally good and were not significantly different (p=0.05). However, the average rooting percentage of cuttings with two phyllodes decreased sharply and differed significantly from the rooting percentage of cuttings with half phyllode. Cuttings without phyllode yielded the lowest rooting percentage and was significantly different (p=0.05) from other treatments.

Table 2. Rooting percentage of 1-*y*-old *Acacia mangium* stem cuttings (n=50) in relation to phyllode presence

	Cuttings with two phyllodes	Cuttings with one phyllode	Cuttings with half phyllode	Cuttings without phyllode
Total rooted cuttings	23	33	38	6
Total non-rooted cuttings	12	5	0	0
% rooted	46.0±2.4	66.0±9.3	76.0±7.5	12.0±2.1

± [standard error of mean, Bars indicate a non significant difference between treatment means (p=0.05)]

Figure 2 illustrates the progress of rooting percentage with time (weeks). It seems that stem cuttings with half phyllode rooted faster than cuttings with either one or two phyllodes. Stem cuttings without phyllode started to form roots very late, six weeks after the experiment began.

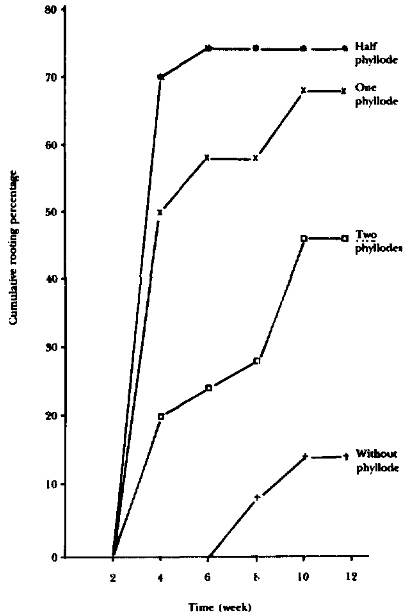

Figure 2. Cumulative rooting percentage of 1-y-old *Acacia mangium* stem cuttings in relation to phyllode presence

The results of this experiment demonstrate that the presence of a phyllode on *A. mangium* stem cuttings was very important. When a phyllode was cut transversely into half, the rooting percentage was even higher then cuttings with one or two entire phyllodes. A similar finding was reported for stem cuttings of *Eucalyptus camaldulensis* (Geary & Harding 1984).

The failure of *A. mangium* leafless stem cuttings to produce higher rooting percentage may possibly due to a lack of carbohydrate. It has been reported that the presence of leaves is essential to stem cuttings in order to produce and supply carbohydrate to those stem tissue involved in root formation. Leaky *et al.* (1982) reported that a low rooting percentage of *Triplochiton scleroxylon* leafless cuttings was clearly caused by the depletion of carbohydrate content.

Although leaves are important for rooting, *A. mangium* stem cuttings with two entire phyllodes yielded a lower rooting percentage and a higher mortality rate than cuttings with half or one phyllode. This may be due to greater loss of water from phyllodes by transpiration compared to one or half phyllode cuttings and as a result the cuttings died before root formation could take place. The other possibility is that the rooting medium dried out because it was covered by phyllodes. It is also suggested by Avidan and Lavee (1988) that a large number of leaves or high leaf surface area on stem cuttings can produce a higher concentration of growth inhibitors which depress root formation.

Conclusion

The results from these experiments indicate that under favourable environmental conditions and right age of stock plants, *A. mangium* could be readily propagated by stem cuttings. Cuttings taken from 6 and 12-*mth*-old stock plants rooted faster and produced higher rooting percentages than stem cuttings of 18 and 24-*mth*-old stock plants. The rooting percentage declined and mortality increased with increasing age of stock plants. Stem cuttings with a half or an entire phyllode produced a higher rooting percentage and faster rate of rooting compared to leafless cuttings or cuttings with one or more phyllodes.

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