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Full Length Research Paper

Effect of cutting positions and growth regulators on rooting ability of *Gonystylus bancanus*

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The effect of cutting positions and growth regulators on rooting ability of *Gonystylus bancanus* were studied. This study, aims to determine the effects of cutting positions (top, middle, and bottom) and hormonal treatments (control, Seradix 3, Planton 3000, IBA 100 μg and IBA 150 μg) on the rooting ability of *G. bancanus*. The top position recorded the highest survival percentage of 90.7% followed by the middle and bottom with values of 86.0 and 74.7%, respectively. Hormonal treatments also showed significant differences (p 0.05) in which the untreated cuttings survived the highest (93.3%) followed by Planton 3000 (88.9%) and Seradix (83.3%). Top cutting showed the highest rooting percentage of 78.0 followed by middle and bottom positions with percentages of 76.7 and 65.3, respectively. There was no significant difference observed in the rooting ability in terms of hormonal application. However, results in terms of root development based on the number of roots and vigour showed otherwise (significant at p 0.05), whereby, cuttings from bottom positions treated with IBA 150 μg produced large number of roots which were thicker and healthier.

Key words: *Gonystylus bancanus*, cuttings positions, growth regulators, rooting ability.

INTRODUCTION

Field experience showed that, natural regeneration of Ramin in logged-over peat swamp forest is poor (Akhbar, 1995). Shamsudin (1996) reported that, seeds on forest floor are highly susceptible to insects and fungal attack. The flowering and fruiting also appear to be infrequent. Thus, the regeneration of Ramin forest would reduce the species diversity and results in the depletion of planting stocks.

In addition, collection of seeds posed some problems, as seeds are recalcitrant (Hendromono, 1999). The seeds began to germinate about 3 - 4 days after sowing and the percentage of seed germination immediately after collection was recorded at 63% (Shamsudin and Aziah, 1992) and can increase up to 80% (Ismail and Shamsudin, 2003).

Rehabilitation of logged-over or degraded peat swamp forest remains a great challenge to the future of forestry (Shamsudin and Aziah, 1992). In Indonesia, enrichment planting to ensure healthy regeneration was managed by the Indonesian Selective Felling and Planting System (Soerianegara and Lemmens, 1993). Vegetative propagation techniques are the most effective method to produce planting stocks for rehabilitation and enrichment planting (Shamsudin and Aziah, 1992; Akhbar, 1995; Ismail et al., 2002). The objective of this study is to determine the effects of cutting positions and hormone treatments on rooting ability of *Gonystylus bancanus*, Ramin.

MATERIALS AND METHODS

Seeds of *G. bancanus* were collected by the Forest Research Institute Malaysia (FRIM) from Pekan Forest Reserve, Pahang, Malaysia in April 2004. The seeds were germinated and the seedlings were later raised in the nursery of Forest Research Center, Sandakan in May 2004. The seedlings were raised for

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6 to 8 months and were treated with NPK blue fertilizer (0.2 - 0.3 g/polybag) for a month prior to the experiment.

A regular intermittent misting system was used on the leaves of the cuttings at every 10 s within ten minutes to maintain the water film and also to avoid drying. Cleaned river sand of less than 2 mm diameter treated with fungicide was used as rooting medium. Both droplet and dipped methods were used in this cutting experiment. Out of the five hormone treatments, namely 100 μg IBA, 150 μg IBA, Planton 3000, Seradix 3(0.8% IBA) and untreated which serves as positive control, only Seradix 3 was used in the dipped method. The hormone was applied on the base ends of the cuttings using the droplet method. This method which utilizes the pipette gave greater uniformity in hormone concentration and application.

The cuttings were taken from the vertical axis of seedlings, which contained several nodes with leaves. They were cut into three positions of bottom (first node); middle (the second node) and the top (the third node) from the base. The leaves of single node cuttings were trimmed at the top end to about 33% of their laminar area.

The experiment involved factorial combination of three cutting positions that is, top, medium and bottom, with five hormone treatments viz; Planton 3000, IBA 100 μg, IBA, 150 μg, Seradix 3 and control, giving rise to a total of 15 treatments. Each treatment was replicated for 30 seedlings and the cuttings were allocated at random in the propagation bed. The observations were made on the following parameters; survival percentage, the timing of root formation, root length, number of roots and rooting percentage.

RESULTS AND DISCUSSION

Effects of cutting positions on the survival and rooting percentages

There was a significant difference (p 0.05) in the rooting ability and survival percentage of cuttings taken from different positions Table1. Top cuttings showed the highest rooting ability (78.0%) followed by middle (76.7%) and bottom position (65.3%). The top position recorded the highest survival rate of 90.7%, followed by the middle position (86.0%) and the bottom (74.7%) (Figure 1).

Top cutting produced good responses due to the presence of juvenile tissues, which are actively differentiating compared to the bottom and middle positions (Choummaravong, 1998; Ling, 1993; Tchoundjeu and Leakey, 2001).

The slower activity or responses in older tissues lead to higher mortality rate in bottom positions as compared to top and middle cuttings. Darus (1989) also mentioned that, the rooting percentages of cuttings taken from older tissues decreased sharply probably due to anatomical barrier such as thickening of sclerenchymatous cells, which becomes a barrier for root initiation.

Effect of hormonal treatments on rooting and survival percentages

There was no significant difference in rooting ability of cuttings treated with and without hormones. However, hormonal treatments had significantly affected the survival percentage of the cuttings (Table 1). The highest survival percentage IBA-treated cuttings were shown in Planton 3000 (87.8%) followed by Seradix 3 (83.3%) (Figure 2).

However, untreated cuttings gave the highest survival percentages and also the best rooting percentages as compared to other treatments. This suggests a lower level concentration of hormone that has been reliable in stimulating the root production in *G. bancanus*. Choummaravong (1998) found that, untreated cuttings produced higher rooting percentages, and IBA 50 g and IBA 100 g gave better rooting responses in *Azadirachta excelsa* cuttings. Ling (1993) also found that, IBA 100 g, gave an optimum result in the root development of *Shorea acuminata*.

Hendromono (1999) found those untreated cuttings (0 ppm IBA) of *G. bancanus* gave the best rooting percentage (90.0%), while cuttings treated with 3000 ppm IBA gave 92.5%. This was further supported by Siagian et al. (1989), who found that untreated 3 months old stumps (control) of *S. leprosula* and *S. selanica* gave a good survival percentage of 83.3 and 86.7%, respectively, as compared to cuttings treated with Rootone F 80.0 and 73.3%, respectively. In contrast, Akhbar (1995) found that, untreated cuttings (0 ppm IBA), 1000 and 6000 ppm IBA of *G. bancanus* taken from wildings gave a poor survival percentage (10%). However, the experiments conducted by both Hendromono (1999) and Siagian et al. (1989), were on fogging and misting system, respectively, as compared to Akhbar (1995) who studied the non-mist system. Similar result was obtained in Forest Research Centre, Sandakan, Sabah, in which *G. bancanus* untreated and treated with Planton 3000, IBA 100 g and IBA 150 g in non-mist system gave a zero percentage of survival. It was assumed that relative humidity of 80 - 95% with a temperature ranging between 25 -29.5^{O}C gave a good result (Hendromono, 1999).

Effect of hormonal treatments and cutting positions on root development

Root development in terms of number of cuttings, had a variable rate with different hormonal treatments. For instance, root development was found to be very slow in Seradix 3 treated cuttings: no cuttings rooted on week four as compared to the positive control and the treatments which were treated with Planton, IBA 100 g and IBA 150 g.

Different cutting positions had also significantly affected the rooting parameters which include root number and length Table 2. Significant interaction effects between positions and hormones were observed only on root number. Hormone application increased the number of roots.

Cuttings treated with IBA 150 g showed the best rooting

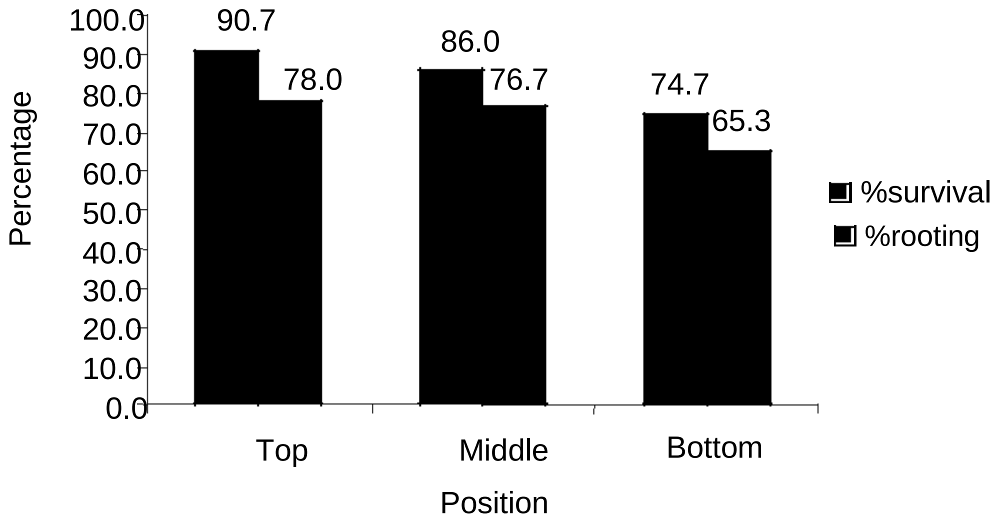

Figure 1. Effects of cutting positions on the survival and rooting percentages.

Table 1. Analysis of variance based on survival and rooting percentages.

Sources	df	Survival		Rooting	
		SS	F value	SS	F value
Total	449	106.88		151.31	
Position	2	3.55	7.8*	2.54	3.84*
Hormone	4	2.55	2.8*	2.39	1.81ns
Error	443	100.78		146.38	

* : Significant difference at p 0.05; n: not significant at p 0.05. ss: Sum of squares.

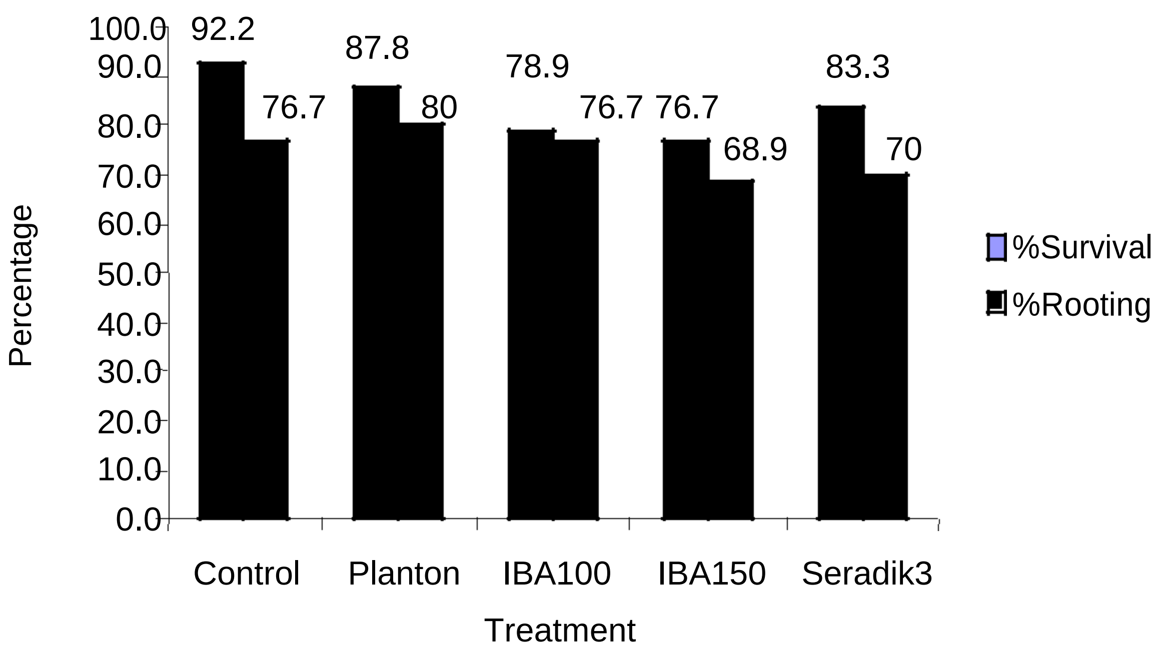

Figure 2. Effects of hormone concentrations on the survival and rooting percentages.

Table 2. Analysis of variance on root number and root length.

Sources of variances	df	Root number		Root length	
		SS	F value	SS	F value
Total	376	1.51		3.17	
Hormone (Hor)	4	0.22	17.02*	0.05	1.46^{ns}
Position (Pos)	2	0.07	12.83*	0.05	2.89*
HorXPos	8	0.07	2.65*	0.09	1.31^{ns}
Error	362	1.17		2.99	
CV		4.90%		11.12%	

Note: * = significant at $p < 0.05$; ns = not significant at $p < 0.05$.

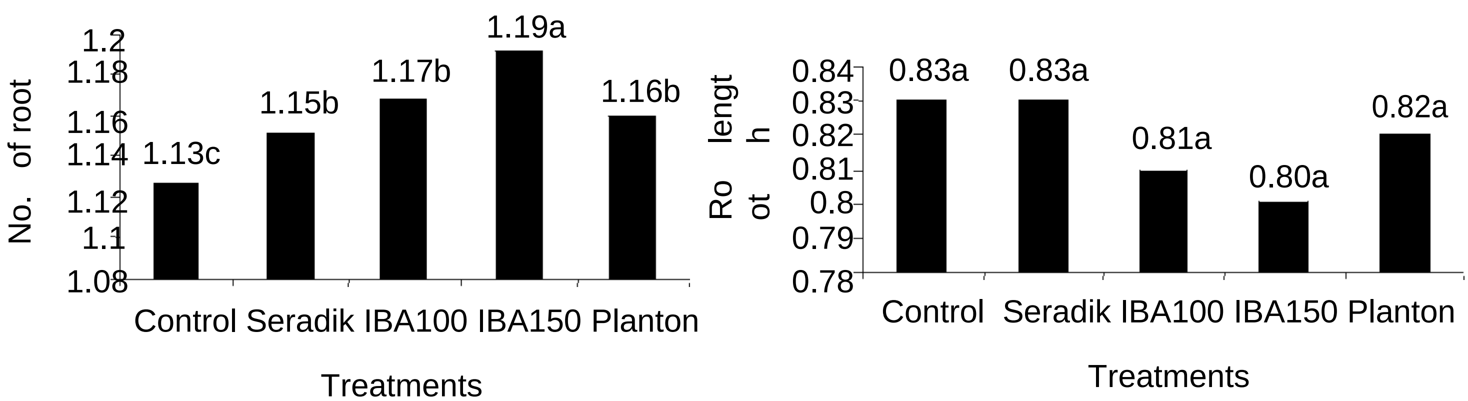

Figure 3. The effect of hormone concentrations on means of number of root and root length.

ability followed by IBA 100 g, Planton and Seradix Figure 3. On contrary, the untreated cuttings performed better in terms of root length.

The bottom position produced the highest root number as compared to the middle and top cuttings (Figure 4). Bottom positions have larger area for nutrient storage. Soonhuae and Limpiyaprapant (1996) mentioned that, cuttings of *Dipterocarpus alatus* taken from bottom positions produced better rooting percentages because the bottom positions was not lignified at the time hedging, but was larger in size with a better storage of carbohydrates. Lyon and Kimuin (1997) also found that, the rooting from the apical cuttings of *Acacia mangium* was low due to the low storage of carbohydrates.

However, in terms of root length, the top position of the cutting was the best. This finding is similar to that of Hendromono (1999) indicating all cuttings treated with or without hormone has no significant difference. Hendromono also reported that *G. bancanus* cuttings treated with hormone gave high significant difference in terms of root number. Interaction between cutting positions and hormone treatments was significant on root number. Cuttings taken gave the best growth in terms of root number (Table 3).

Conclusion

Stem cuttings of ramin (*G. bancanus*) could be successfully rooted when using appropriate positions of cuttings and level of hormone concentrations. Cutting positions affected root number and root length while hormones only affected the former. Top positions produced long, thin and single root whereas, bottom positions produced many short and thick roots. Cutting taken from bottom positions treated with 150 g IBA gave the best growth in terms of root number and form. Hormone treated cuttings produced good root growth with reasonably good survival and rooting percentages ranging from 76.7 - 78.9% and 68.9 - 76.7%, respectively. Thus, rooting of stem cuttings of *G. bancanus* presents a viable propagation system to be used in enrichment planting programmed of peat swamp forest

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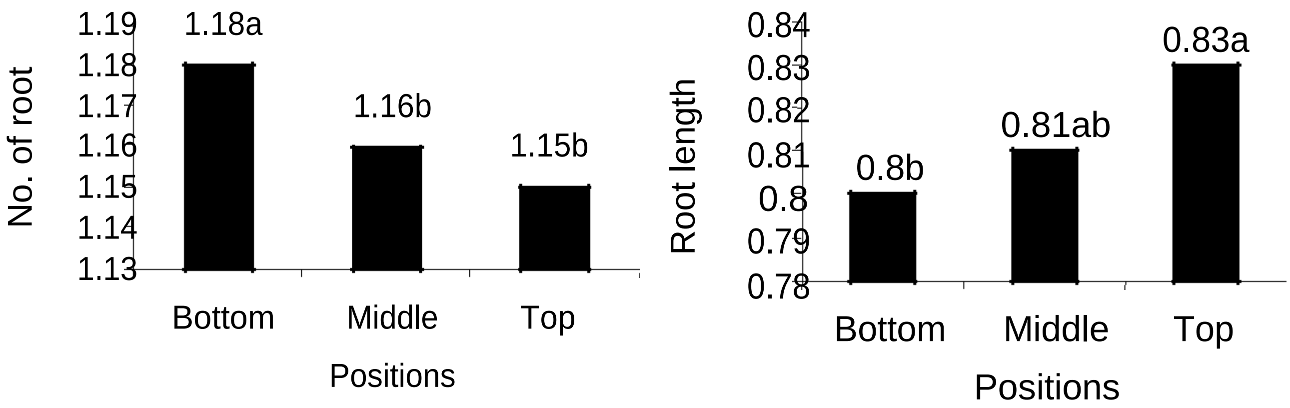

Figure 4. The effect of cutting positions on means of number of root and root length.

Table 3. The interaction effects of cutting positions and hormone treatments on root growth.

Interaction	Number of root	Root length
Top x Control	1.60	2.54
Top x Seradix 3	1.18	1.68
Top x 100 g IBA	2.24	1.64
Top x 150 g IBA	3.29	1.64
Top x Planton 3000	2.08	2.29
Middle x Control	1.50	1.70
Middle x Seradix 3	2.89	2.39
Middle x 100 g IBA	2.55	1.33
Middle x 150 g IBA	3.65	1.22
Middle x Planton 3000	2.26	1.64
Bottom x Control	1.18	1.58
Bottom x Seradix 3	3.30	1.73
Bottom x 100 g IBA	4.40	1.52
Bottom x 150 g IBA	5.56	1.27
Bottom x Planton 3000	2.96	1.27

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