Effect of Nailing Density for Agar Formation in Agar Trees (*Aquilaria malaccensis* Lamk.)

W. Parvin, M. W. Baksha, M. R. Islam, M. Z. Rahman and S. Nasreen
Bangladesh Forest Research Institute
P.O. Box 273, Chittagong-4000, Bangladesh
E-mail: bfri_fpd@ctpath.net

Abstract

The effect of nailing density in agar formation through artificial wounding was observed in agar trees. Five different nailing densities like; 1 cm x 1 cm, 2 cm x 2 cm, 3 cm x 3 cm, 4 cm x 4 cm and 5 cm x 5 cm were used as treatments in 25 selected agar trees in three locations with the five experimental sites, Boroduara (Chittagong), Fashiakhali (Cox's Bazar), Bagaihat (Rangamati), Bagmara and Lathitila (Moulvibazar). The age of the treated agar trees were 8, 10 and 15 years respectively. The experiment was conducted in June 2008 and agar wood core samples were collected after two years of the nailing treatments. Among the different densities, 4 cm x 4 cm nailing distance was found to be the best nailing density for maximum agar formation. On an average, 95% oleoresin deposit was found in 15 years old agar tree.

সারসংক্ষেপ

আগর গাছে কৃত্রিম ক্ষত সৃষ্টির মাধ্যমে আগর উৎপাদনে ভিন্ন ভিন্ন ঘনত্বে নেইলিং এর প্রভাব পর্যবেক্ষণ করা হয়। ৫টি পৃথক নেইলিং ঘনত্ব যথাক্রমে ১ সে.মি. x ১ সে.মি., ২ সে.মি. x ২ সে.মি., ৩ সে.মি. x ৩ সে.মি., ৪ সে.মি. x ৪ সে.মি. এবং ৫ সে.মি. x ৫ সে.মি. এ নেইলিং করা হয়। পরীক্ষাটি ৩টি এলাকার ৫টি পর্যবেক্ষণ সাইটে মোট ২৫টি নির্বাচিত আগর গাছে করা হয়। পর্যবেক্ষণ সাইটগুলি যথাক্রমে বড়দুয়ারা (চট্টগ্রাম), ফাসিয়াখালি (কক্সবাজার), বাঘাইহাট (রাঙ্গামাটি), বাঘমারা ও লাঠিটিলায় (মৌলভীবাজার) অবস্থিত। নির্বাচিত আগর গাছের বয়স ৮, ১০ ও ১৫ বছর ছিল। পরীক্ষাটি ২০০৮ সালে করা হয় এবং ২ বছর পর পরীক্ষিত গাছ থেকে আগর wood core সংগ্রহ করে পর্যবেক্ষণ করা হয়। বিভিন্ন ঘনত্বের নেইলিং এর মধ্যে ৪ সে.মি. x ৪ সে.মি. দূরত্বে সর্বোচ্চ পরিমাণ আগর পাওয়া যায় এবং শতকরা ৯৫% oleoresin ১৫ বছর বয়সের আগর গাছে পাওয়া যায়।

Key words: Agar formation, agar trees, artificial wounding, nailing density, tree age

Introduction

Agar or agar wood is the most exalted perfumery raw materials obtained from the oleoresin- enriched wood of agar trees. In the past, agar trees naturally grow in the forests of greater Sylhet, Chittagong and Chittagong Hill Tracts of Bangladesh (Baksha *et al.* 2009). But at present, the natural stocks have been largely depleted and only found as planted stocks in Sylhet district. Agar trees are also found in Assam, Monipur and Nagaland of India, Nepal, Bhutan, Myanmar, China, Laos, Cambodia, Vietnam, Thailand, Malaysia, Indonesia and Papua New Guinea (Burkhill 1966). Economically agar is an

important tree crop. Its oil is used as perfume (agar-attar) and agar wood with heavy oleoresinous deposits is used as incense and medicine. Now, agar and its products are exported to different countries and earn valuable foreign currencies for Bangladesh.

The process of agar deposition in the tree is not well known. It is believed that fungus is responsible for oleoresin formation in agar trees but association of specific fungus could not be substantiated from the available information. Gibson (1977) reported agar deposition is not due to fungal activity, but occurs as a reaction of the tree wounding. Rahman and Basak (1980) mentioned that wounding produced color changes in the wood with some 'oleoresin' deposits. They also postulated that the presence of an exposed, open wound seemed to be of more importance than the presence of certain species of fungi within a wound. Under natural condition agar formation is initiated through the interactions caused by wounding followed by invasion of pioneer fungi which enter primarily through the openings created by broken branch stubs (Rahman and Khisa 1984).

Local people traditionally insert iron nails of different sizes (5-15 cm long) into agar tree trunks for inducing agar formation. Nailing at a distance of 3 to 7 cm starts into the trees of 7-10 years old and left for 3-4 years. It was reported that if the trees were nailed during the winter and at a shorter distance at least 10% of the treated plants succumbed to death. So it is better to nail the trees during the rainy season and September is the best month for nailing (Baksha *et al.* 2009). Nail in agar tree is a wound aerating method of producing agar wood by forming an artificial wound into the xylem (Blanchette 1992). Rao and Dayal (1992) studied the formation of agar wood under microscope and reported the tree age, within-tree, seasonal variation that environmental variations are the key factors for agar formation. Reports revealed that 50-60 years old tree produce the best yields of agar (Sadgopal 1959, Menon 1960). But, there is no information on the nailing distance which can give the better agar production. Therefore, the present study was conducted to find out a suitable nailing density for maximum agar production in agar trees.

Materials and Methods

The experiment was conducted in three locations namely, location-1 (Boroduara in Chittagong and Fashiakhali in Cox's Bazar), location-2 (Bagaihat in Rangamati) and location-3 (Bagmara and Lathitila in Moulvibazar) of Bangladesh. The plantations of the three locations were established in 2001, 1999 and 1995 respectively. Five agar trees were selected randomly in each experimental plot. In the experiment, 10 cm long iron nails were used for nailing the agar trees. Five blocks were made on the stem in each tree and inserted nails at different densities which were 1 cm x 1 cm, 2 cm x 2 cm, 3 cm x 3 cm, 4 cm x 4 cm and 5 cm x 5 cm (Fig. I). In each block nailing was made with nine nails in three rows. The nails were inserted in the selected trees at 8 cm above the ground level. The distance between one block to another was 4 cm. The experiments were set up in February 2008. Ten wood core samples were taken by increment borer from each site after two years in 2010. Collected cores were put into sterilized test tubes and closed with cotton plug. The core samples were preserved in the Forest Protection Laboratory of Bangladesh Forest Research Institute, Chittagong to observe the nature of agar and determine the percentage of agar deposition due to nailing.

Results and Discussion

The percentage of oleoresin deposition of the collected wood core samples for each treatment in relation to the age of the treated agar trees was observed. The results are given in Table 1.

The highest core length of oleoresin formation (78%) was found at 4 cm x 4 cm nailing density at Boroduara and Fashiakhali site and the lowest 21% was found in 1 cm x 1 cm nailing density. At Bagaihat site, the highest percentage of oleoresin formation (85%) was found at 4 cm x 4 cm nailing density and the lowest 30% was found at 1 cm x 1 cm nailing density. At Bagmara and Lathitila site, the highest percentage of oleoresin formation (95%) was found at 4 cm x 4 cm density of nailing (Fig. 6) and the lowest 30% was found at 1 cm x 1 cm nailing density. The mean value of 8 years old agar tree was the lowest (52.4%). The highest mean value (67.4%) was found in 15 years old agar tree. The result showed that the percentage of agar production increased with the age of the tree. This finding is also supported by Rao and Dayal (1992). The nature and colour of oleoresin are given in Table 2.

Table 1. Agar production in different nailing treatments in five experimental sites.

Experimental sites and plantation year	Age of tree (years)	Nailing distance (cm x cm)	Length of core containing oleoresin (mm) out of 100 mm core length	Highest core length of agar (oleoresin) formation (%)	Average wood core for oleoresin formation (%)
Location-1 (Boroduara in Chittagong) and Fashiakhali in Cox's Bazar) 2001	8	1x1	21	78	52.4
		2x2	28		
		3x3	66		
		4x4	78		
		5x5	69		
Location-2 (Bagaihat in Rangamati) 1999	10	1x1	30	85	61.4
		2x2	45		
		3x3	70		
		4x4	85		
		5x5	77		
Location-3 (Bagmara and Lathitila in Moulvibazar) 1995	15	1x1	30	95	67.4
		2x2	50		
		3x3	80		
		4x4	95		
		5x5	82		

Figure 1. Nailing density at 1,2,3,4,5 cm distance

Figure 2. Agar formation at 3 cm x 3cm

Figure 3. Agar formation at 2 cm X 2 cm density

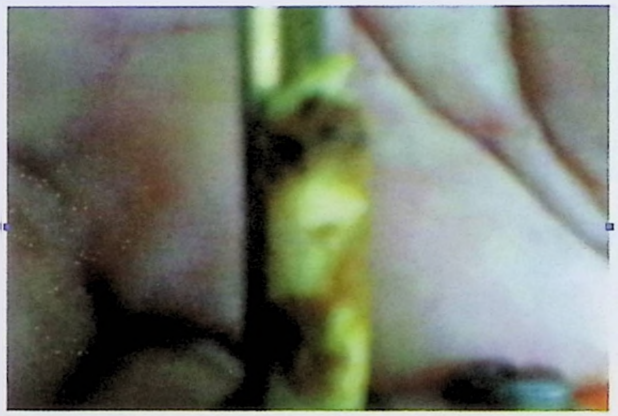

Figure 4. Agar formation at 5 cm X 5 cm density

Figure 5. Splitted nailed agar tree shows agar formation

Figure 6. Agar formation at 4cm x 4cm nailing density

Oleoresin formed were of vertical, spiral and partial in nature (Fig. 2, 3 & 4). The major colours of the core were white, brown and dark brown. The maximum nature of oleoresin formation was found in vertical type in each treatment. The maximum number oleoresin formation percentage was found at 4 cm x 4 cm nailing density for different ages of agar trees. The colour of oleoresin culminates into black with age (Fig. 6). In the case of 1 cm x 1 cm and 2 cm x 2 cm nailing densities it requires about 20 or 22 kg iron nails for nailing an agar tree at the age of 6- 7 years. As a result, the physical growth of the treated agar trees is hampered and about 10% agar trees die if nailed during the winter season. The results of the present experiment agree with findings of Rahman *et al.* (1984).

The present study revealed that the agar formation increases with the age of treated agar trees. It is concluded that 4 cm x 4 cm nailing distance was found to be the best density of nailing for maximum agar formation and 10-15 years old trees give the highest production of agar.

Table 2. Nature and colour of oleoresin produced at different nailing treatment.

Experimental sites	Age of tree (year)	Nailing distance (cm x cm)	Nature of oleoresin formed			Colour of oleoresin		
			Vertical	Spiral	Partial	White	Brown	Dark brown
Location-1 (Boroduara in Chittagong and Fashiakhali in Cox's Bazar)	8	1x1	+	-	-	6	2	2
		2x2	++	-	+	4	1	5
		3x3	++	+	+	1	4	5
		4x4	+++	+	-	0	4	6
		5x5	+++	++	-	1	4	5
Location-2 (Bagaihat in Rangamati)	10	1x1	+	-	-	5	5	0
		2x1	++	+	+	4	2	4
		3x3	++	+	+	1	4	5
		4x4	+++	+	+	0	1	9
		5x5	+++	++	-	0	7	3
Location-3 (Bagmara and Lathitila in Moulvibazar)	15	1x1	++	+	+	4	4	2
		2x2	++	+	+	0	7	3
		3x3	+++	++	+	0	2	8
		4x4	+++	+	++	1	3	6
		5x5	+++	+	-	3	3	4

Nil = (-), Minimum = (+) , Medium = (+ +), Maximum (+++)

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