Provenance-Site Interaction in Mangium (*Acacia mangium* Willd.) in the Philippines[1]

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Abstract

Interaction of nine provenances of *Acacia mangium* Willd. were studied at three sites of the Philippines such as Lubuagan, Vintar in Ilocos Norte (Region - 1), Mapuyo, Mobo in Masbate (Region-5) and Lantapan Malaybalay in Bukidnon (Region-10). The sites were climatically, edaphically and topographically different from each other. The provenances studied were 13233 (Walsh's Pyramid, Qld.), 13235 (Mourilyn Bay, Qld.), 13236 (Kurrimine, Qld.), 13238 (Tully Mission Beach, Qld.), 13240 (Ellerbeck Rd. Cardwell, Qld.), 13241 (Broken Pole Creek, Qld.), 13242 (Abergowrie SF, Qld.), 13460 (Oriomo River, Qld.), 13621 (Piru Ceram, Indonesia).

Analysis of variance for diameter and height showed significant variations due to provenance, site, and provenance-site interactions. All the provenances except one (13621) showed the best growth at Bukidnon site due to main effect. The significant provenance-site interaction was found at Masbate site which was mostly due to the remarkably different growth behaviour of the provenance 13621.

সারসংক্ষেপ

ফিলিপাইনের তিনটি সাইট যথা - লুবুয়াগান, ভিন্তার, ইলোকোস নর্তে (রিজিওন-১), ম্যাপুও, মোবো, মাসবাতে (রিজিওন-৫) এবং লান্তাপান, মালাইবালাই, বুকিডনন (রিজিওন-১০)-এ ম্যানজিয়াম (*Acacia mangium* Willd.) প্রজাতির নয়টি 'প্রভেন্যান্সের' 'ইন্টার‍্যাকশন' এর উপর একটি পরীক্ষা করা হয়। পরীক্ষার সাইটগুলি জলবায়ু, মাটি ও উচ্চতার বিভিন্ন বিষয়ে পার্থক্য রয়েছে। পরীক্ষিত প্রভেন্যান্সগুলি হচ্ছে - ১৩২৩৩ (ওয়ালেসেস পিরামিড, কুইন্সল্যাণ্ড), ১৩২৩৫ (মোরিলেন বে, কুইন্সল্যাণ্ড), ১৩২৩৬ (কুরিমাইন, কুইন্সল্যাণ্ড), ১৩২৩৮ (টালিমিশন বীচ, কুইন্সল্যাণ্ড), ১৩২৪০ (এলরবেক রোড কার্ডওয়েল, কুইন্সল্যাণ্ড), ১৩২৪১ (ব্রোকেনপোল ক্রীক, কুইন্সল্যাণ্ড), ১৩২৪২ (এ্যাবোর গোবি এস এফ, কুইন্সল্যাণ্ড) এবং ১৩৬২১ (পিরুসিরাম, ইন্দোনেশিয়া)।

গাছের ব্যাসার্ধ ও উচ্চতার 'এ্যানোভা' করে 'প্রভেন্যান্স', 'সাইট' ও 'প্রভেন্যান্স-সাইটের ইন্টার‍্যাকশন'-এর জন্য প্রভেন্যান্সের বৃদ্ধির যথেষ্ট অমিল দেখা যায়। 'মেইন ইফেক্ট' এর জন্য একটি মাত্র প্রভেন্যান্স (১৩৬২১) ছাড়া পরীক্ষিত সবগুলি প্রভেন্যান্সের বুকিডনন সাইটে সবচেয়ে ভাল বৃদ্ধি দেখা যায়, কিন্তু প্রভেন্যান্স-সাইট-এর 'ইন্টার‍্যাকশন' এর কারণে মাসবাত সাইটে ১৩৬২১ প্রভেন্যান্সের সবচেয়ে ভালবৃদ্ধি দেখা যায়।

Key words : *Acacia mangium*, Philippines, site interaction

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Introduction

Mangium (*Acacia mangium* Willd.) is native to Australia, Indonesia and Papua New Guinea (Nicholson 1981). It occurs at lower elevations in all soil types in its natural habitat where there is a high rainfall of even distribution (Teitzel and Bruce 1971). It is a leguminous tree species with multiple uses and can be easily cultivated on the poor sites of the tropics (Kaplan 1979). It grows faster than many reforestation species which are used now a days in many countries of the world (NAS 1983, Yap 1986, Moran 1992). Significant variations in growth, survival and resistance to pests and diseases of different provenances of the species have been reported under different environmental conditions (Pettersson and Havmoller 1984; Faizuddin and Dalmacio 1992). Eighteen provenances of the species were established in three different edaphic, climatic and physiographic conditions of the Philippines in 1984. The present paper reports significant provenance-site interaction for growth traits, height and diameter.

Materials and methods

Study sites

The study was conducted in three sites of the country such as Lubuagan, Vintar in Ilocos Norte (Region 1), Mapuyo, Mobo in Masbate (Region 5) and Lantapan, Malaybalay in Bukidnon (Region 10) as shown in Figure 1.

The climatic, edaphic and topographic features of these sites differ from each other and a summarized information is given in Table 1.

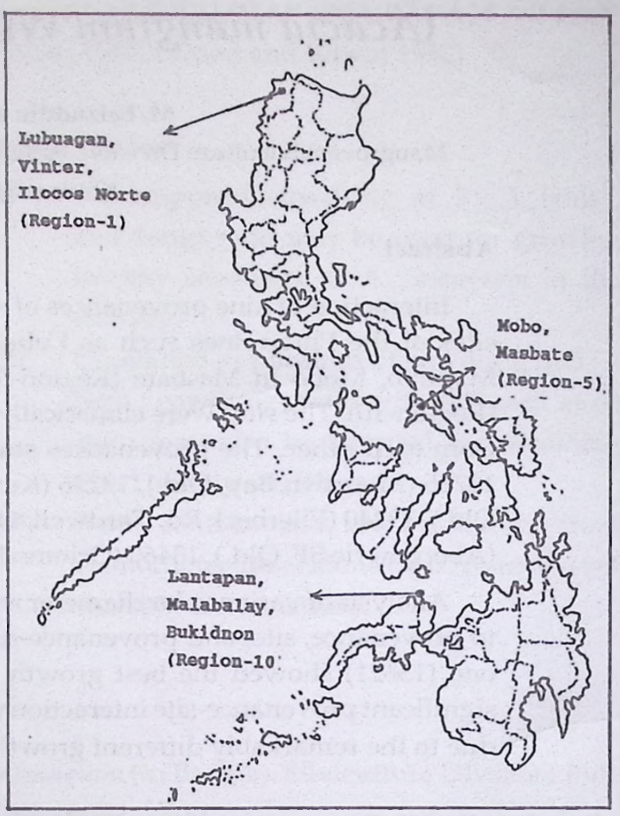


Figure 1. Map of the Philippines showing three study sites.

Provenances

The provenances were not the same in all the three study sites due to lack of seedlings during the plantation time or occurrence of fires in the plantation areas. So, nine provenances, common in all study sites, out of 18 provenances tried were taken into consideration to determine the interaction between sites and provenances. A list of all these provenances with their origin, latitude, altitude, etc., is given in Table 2.

Table 1. Climatic, edaphic and topographic features of study sites in Ilocos Norte, Masbate and Bukidnon.

Feature	Ilocos Norte (Region 1)	Masbaste (Region 5)	Bukidnon (Region 10)
Altitude (m)	291.0	295.0	985.0
Longitude	120°45´E	123°38´E	124°56´E
Latitude	18°2´N	$12^{0}14´$N	$8^{0}3´$N
Temperature			
Average maximum monthly (°C)	31.7	31.6	28.7
Average minimum monthly (°C)	22.2	24.3	18.5
Rainfall			
Average annual (mm)	1927.2	1941.9	2543.5
Annual rainy days (no.)	96.0	170.0	221.0
Relative humidity (%)	76.0	82.0	82.0
Typhoon (yearly average)	16 times	4 times	0
Fires	0	Common (from March-May)	Very common
Soil			
pH	5.85	5.85	4.63
Soil depth (cm)	60	100	55
Soil textural class	Sandy clay	Sandy clay	Sandy loam
Organic matter (%)	1.084	2.400	4.560
P (ppm)	6.35	14.20	4.00
K (ppm)	328.50	249.0	96.0
Total nitrogen (%)	0.025	0.16	0.43
Topography :			
Slope (%)	28.0	6.0	30.0
Aspect	NW	SE	NW

Source : PAGASA, Soil Report - 21 & 23 of Soil Survey of the Republic of the Philippines, field observation.

Experimental design and layout

At each site, the plantations were established using a Randomized Complete Block Design at a planting distance of 3 m x 3 m with only two blocks due to inadequate number of seedlings. The provenances were established at each block with one plot for every provenance. In total, there were 49 trees of each provenance in each plot, of which 25 sequentially numbered trees were in the centre and 24 trees in the peripheral buffer zones.

Data collection and analysis

Data on diameter and height growth were collected during the dry season from the middle of December, 1989 till the end of March, 1990. The plantation at the time of data collection was five and a half years old.

Data were statistically analyzed by analysis of variance to determine the extent of variation among provenances.

Results and discussion

The results show highly significant ($P < 0.01$) interactions between sites and provenances (Table-3). The interaction effects of nine common provenances among three sites in diameter and height growth are shown graphically in Figures 2 and 3 respectively. The results indicate significant interaction effects between a specific provenance and the three sites. All the provenances except 13621 (Piru, Ceram, Indonesia) performed the best at Bukidnon site (Region-10). Across all the pr venances, the poorest performance was observed at Ilocos Norte site (Region-10) and the Masbate site took the intermediate position in respect of growth performance of the provenances. Among the provenances, the best diameter growth was observed in the provenance 13240 (Ellerbeck Rd. Cardwell, Qld.) and the best height growth in the provenance 13233 (Walsh's Pyramid, Qld.) So, the different provenances responded differently in the growth traits at different sites due to differences in site conditions. The provenance 13621 (Piru, Ceram, Indonesia) showed a significant interaction with site factors. The significant interaction was mostly due to higher growth of the provenance at Masbate site and poorer growth at Bukidnon site.

Table 2: Different provenances of *Acacia mangium* with their respective origin and site characteristics.

Seed lot No. (provenances)	No. of parent tree	Locality	Origin Latitude	Origin Longitude	Alt. (M)	Viable seed/10g
13233	10	Walsh's Pyramid, Qld.	17°6′	145°48′	20	670
13235	5	Mourilyn Bay, Qld	17°35′	146°5′	10	400
13236	5	Kurrimine, Qld.	17°46′	146°5	10	80
13238	10	Tully Mission Bch Rd., Qld.	17°50′	146°2′	70	420
13240	5	Ellerbeck Rd. Cardwell, Qld.	18°14′	145°58	60	550
13241	5	Broken Pole Creek, Qld	18°21′	146°3′	50	640
13242	10	Abergowrie Sf, Qld	18°26′	146°1′	60	600
13460	18	Oriomo River, PNG	8°50′	143°8′	10	415
13621	9	Piru, Ceram, Indonesia	3°4′	128°12′	50	160

Source : Forest Management Bureau, Philippines, 1988.

Havmoller (1989) reported 30% better growth of *Acacia mangium* provenances in Mindanao than in Mindoro. Awang and Taylor (1993) also reported significant site-provenance interaction in mangium provenances and they mentioned that PNG provenances showed better height and diameter growth. But in the present study, Queens land provenances showed better growth at Bukidnon site and one Indonesian Provenance (13621) showed better growth at Masbate.

Conclusion

This study shows that all the provenances except 13621 (Piru Ceram, Indonesia) showed the best diameter and height growth at Bukidnon site whereas the best provenance 13621 was observed at Masbate site. The increased diameter and height growth of all the provenances except the provenance 13621 at Bukidnon site was mostly the result of main effects. The significant provenance-site interaction was mostly due to different growth behaviour of the provenance 13621.

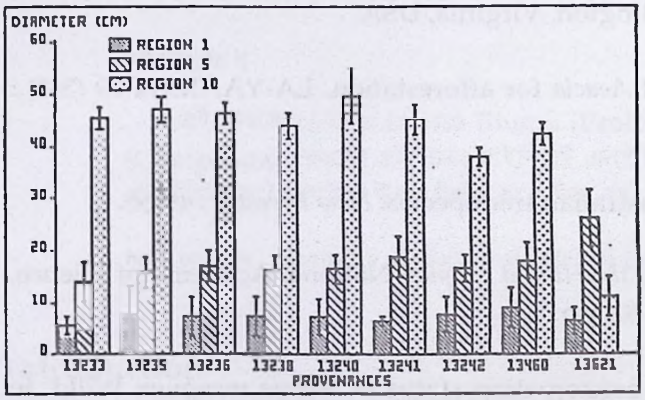
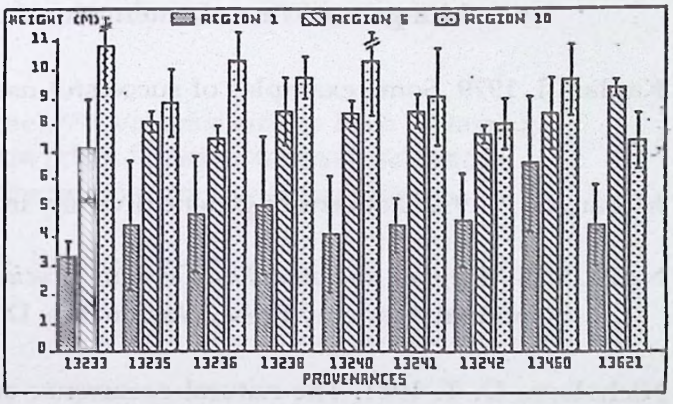


Figure 2 .The effects of planting sites and provenances on diameters of nine common provenances of *Acacia mangium*.



Fiugre 3 . The effects of planting sites and provenances on plant height of nine common provenances of *Acacia mangium*.

Table 3: Analysis of variance for diameter and height of *Acacia mangium* provenances under Ilocos Norte, Masbate and Bukidnon site conditions.

Source of variation	Df	Diameter		Height	
		MSS	F-value	MSS	F-value
Block	1	237.86	3.08ns	11.840	5.39*
Site (S)	2	73788.54	956.60**	1044.37	475.15*
Provenances (P)	8	2162.45	28.04**	30.402	13.83**
SxP	16	1189.31	15.42**	22.767	10.36**
Error	26	77.13	2.197		
Total	53				

Note : ns - not significant; * significant at 5% level and ** significant at 1% level, MSS - mean sum squares; F value - value of F.

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