

# PROVENANCE VARIATIONS OF MANGIUM (*ACACIA MANGIUM* Willd.) IN SURVIVAL AND RESISTANCE TO PESTS AND DISEASES IN THE PHILIPPINES

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## ABSTRACT

Variations of different provenances of mangium (*Acacia mangium* Willd.) in survival and resistance to pests and diseases under Ilocos Norte, Masbate and Bukidnon conditions of the Philippines were studied. The survival at one and a half years and the resistance to pests and diseases at five years after planting were determined. The results show highly significant variations in per cent survival among provenances under Masbate and Bukidnon conditions and in resistance to pests and diseases under Ilocos Norte and Bukidnon conditions.

The survival was the highest in the provenances 13622 (Sidei, Indonesia) in Masbate and 13232 (Cowley Beach Road, Qld) in Bukidnon. The best provenances resistant to pests and diseases were 13229 (Claudie River, Qld) in Ilocos Norte and 13236 (Kurrimine, Qld) in Bukidnon.

## সারসংক্ষেপ

ফিলিপাইনের ইলোকোস নর্থে, মাসবাতে এবং বুকিডনন এলাকার বিভিন্ন মাটি ও আবহাওয়ায় ম্যানজিয়াম এর বিভিন্ন প্রভেন্যান্স এর বাঁচার হার এবং রোগ বালাই এর আক্রান্ত থেকে নিজেকে রক্ষার ক্ষমতা নির্ণয় করা হয়। দেড় বছর বয়সে বাঁচার হার এবং গাছের পাঁচ বছর বয়সে রোগ বালাই এর আক্রান্ত থেকে রক্ষার ক্ষমতা নির্ণয় করা হয়। বাঁচার হার মাসবাতে এবং বুকিডননে তাৎপর্যপূর্ণভাবে পার্থক্য পরিলক্ষিত হয়। ইলোকোস নর্থে এবং বুকিডননে এদের রোগ বালাই থেকে রক্ষা পাওয়ার ক্ষমতাও তাৎপর্যপূর্ণভাবে পার্থক্য পরিলক্ষিত হয়।

সবচেয়ে ভাল বাঁচার হার দেখা যায় মাসবাতে ১৩৬২২ (সাইডি, ইন্দোনেশিয়া) প্রভেন্যান্সে এবং বুকিডননে ১৩২৩২ (কাউলি বীচ রোড, কুইন্সল্যান্ড) প্রভেন্যান্সে এবং রোগ বালাই থেকে বাঁচার ক্ষমতা দেখা যায় ইলোকোস নর্থে ১৩২২৯ (ক্লাডি রিভার, কুইন্সল্যান্ড) প্রভেন্যান্সে এবং বুকিডননে ১৩২৩৬ (কুরিমাইন, কুইন্সল্যান্ড) প্রভেন্যান্সে।

## INTRODUCTION

Individuals of a plant species differ from each other in their genotypes and consequently in

their phenotypes. These variations in the genotypes of the species are generally reflected

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in variations in respect of survival, growth, tree quality and resistance to pests and diseases.

The well adapted individuals survive and grow successfully in the environment in which they are adapted. But if these individuals are not adapted, they are susceptible to unfavourable environmental conditions and a higher percentage of the population are killed due to fluctuation in weather condition.

Mangium (*Acacia mangium* Willd.) is a fast-growing leguminous tree species. It can grow very well in the adversed sites in the tropics (Kaplan, 1979). It has been widely used for many purposes such as pulp, fuelwood, veneer, furniture, particle board, charcoal and ornamentals (NAS 1979, Applegate and Nicholson, 1986, Logan, 1986). It can compete with *Imperata cylindrica* grass (Tham, 1976). It ranks high in species trials in many tropical countries of the world.

Kimmins (1987) reported that a population of wide variation in genotypes is less successful in survival and growth under stable environmental conditions and only a small population becomes well adapted at any time and is able to survive. According to Kiellander (1960), a uniformly distributed rainfall throughout the year is essential for high survival. Studies conducted on many exotics reveal that tree species/provenances differ greatly in their abilities to withstand pests and diseases (Zobel and Talbert, 1984). In most cases, the exotics, when grown under stress condition of a new environment, are susceptible to pests and diseases, which results in failure in many forestation programs in several regions of the world. This is due to variations in their genotype

to withstand pests and diseases (Kinloch and Zoerb, 1971; Zobel *et al.* 1956).

In a provenance trial of mangium in Mindoro and Mindanao in the Philippines, a 30% better survival was observed in Mindanao than in Mindoro (Havmoller, 1989). Provenance trials of mangium in Bangladesh indicated significant differences among different provenances in survival 18 months after planting (Zashimuddin *et al.*, 1983). Provenance trials of *Abies nordmanniana* in Denmark indicated significant differences in terms of resistance to pests and diseases among different provenances (Larsen and Nielsen, 1982).

A provenance trial of mangium was established by BFD (Bureau of Forest Development) in 1984 on different sites of the Philippines. Best seed sources of the species in terms of survival and resistance to pests and diseases are yet to be determined.

The objective of this study was, therefore, to determine the variations of the different provenances of mangium in respect of survival and resistance to pests and diseases under the different climatic conditions of the country.

## MATERIALS AND METHODS

### Study sites

This study was conducted in 3 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). The summarised data of these 3 sites are given in Table 1.

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

Feature	Ilocos Norte (Region 1)	Masbate (Region 5)	Bukidnon (Region 10)
<b>Climate</b>			
<b>Temperature</b>			
Average maximum monthly (°C)	31.7	31.6	28.7
Average minimum monthly (°C)	22.2	24.3	18.5
<b>Rainfall</b>			
Average annual (mm)	1927.2	1941.9	2543.5
Annual rainy days (no.)	96	170	221
Relative humidity (%)	76.0	82.0	82.0
<b>Typhoon</b>			
(yearly average)	16 times	4 times	0
<b>Fires</b>			
	0	Common from March-May	Very common
<b>Soil</b>			
pH	5.85	5.85	4.63
Soil depth (cm)	60	100	55
Soil textural class	Sandy clay loam	Sandy clay loam	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 (%)	0.25	0.16	0.43
<b>Topography</b>			
Slope (%)	28.0	6.0	30.0
Aspect	N W	S E	N W
Altitude (m)	291.0	295.0	985.0
Longitude	120°45'E	123°38' E	124°56' E
Latitude	18°2' N	12°14' N	8°3' N

SOURCE : PAGASA, Soil Report = 21 & 23 of soil Survey of the Republic of the Philippines, field observation.

### Provenances

The provenance trial of *A. mangium* was established in August, 1984 by the Bureau of Forest Development (BFD), now renamed as Forest Management Bureau (FMB). There were 18 provenances collected from the natural habitat

of Queensland in Australia, Papua New Guinea and Indonesia. The description of the provenances with their original location, altitude, longitude, etc. are given in Table 2.

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

Seed lot no.	No. of parent tree	Quantity		Origin						
		Kg	G	Locality	Latitude		Longitude		Alt M	Viable seeds/10 g
					Deg	Min	Deg	Min		
13230	10	0	40	Mission Beach, Qld	17	53	146	6	0	300
13231	5	0	40	Nw of Silkwood, Qld	17	42	145	57	40	230
13232	10	0	40	Cowley Beach Road, Qld	17	41	146	5	5	410
13233	10	0	40	Walsh's Pyramid, Qld	17	6	145	48	20	670
13234	10	0	40	Trinity Inlet, Qld	17	2	145	48	20	500
13235	5	0	40	Mourilyn Bay, Qld	17	35	146	5	10	400
13236	5	0	40	Kurrimine, Qld	17	46	146	5	10	80
13237	10	0	40	El Arish, Qld	17	50	146	1	20	230
13238	10	0	40	Tully Mission Bch. Rd., Qld	17	50	146	2	70	420
13239	10	0	40	Syndicate Rd. Tully, Qld	17	55	145	52	50	400
13240	5	0	40	Ellerbeck Rd. Cardwell, Qld	18	14	145	58	60	550
13241	5	0	40	Broken Pole Creek, Qld	18	21	146	3	50	640
13242	10	0	40	Abergowrie Sf, Qld	18	26	146	1	60	600
13229	6	0	40	Claudie River, Qld	12	44	143	13	60	500
13260	18	0	40	Oriomo River, Png	8	50	143	8	10	415
13621	9	0	40	Piru Ceram, Indsia	3	4	128	12	50	160
13622	15	0	40	Sidei, Indsia	0	46	133	34	30	860
13846	75	0	50	7km Sse of Mossman, Qld	16	31	145	24	60	640

Source : Bureau of Forest Department, Nov. 17, 1983

### Experimental design

The plantation was established in a Randomized Complete Block Design (RCBD) with the spacing of 3m x 3m in each site. There were two blocks in each site due to shortage of seedlings. There were 25 sequentially numbered trees in the center and 24 trees in the peripheral

buffer zones in each block.

The provenances of the species were established in each plantation site with one plot for every provenance. So, the number of plots were corresponding to the number of provenances in each block.

## Data collection

**Survival :** Data on survival were recorded after 15 months of planting in all the sites by the Research Section of the Reforestation Division, FMB, DENR, Diliman, Quezon City.

**Scoring of health :** Data on health condition were collected at the age of five and half years. Three categories of health conditions were considered for this purpose. The tree scorings are as follows :

Characteristics	Scorings
Infestation by both insects and fungi.	1
Infestation only either by insects or fungi	2
No infestation	3

The extent of variation among provenances were explored by analysis of variance and difference between means by Duncan's multiple range test.

## RESULTS AND DISCUSSION

### Variations in per cent survival

Data on variations in per cent survival are shown in table 3. Highly significant variation ( $P < 0.01$ ) in per cent survival among provenances was observed in 2 sites, Masbate and Bukidnon.

In Masbate, the highest per cent survival (100%) was observed in the provenances 13622 (Sidei, Indonesia), 13846 (7 km SSE of Mossman, Qld.) 13460 (Oriomo River, PNG), 13240 (Ellerbeck Rd., Qld.), 13241 (Broken Pole Creek, Qld.), 13242 (Abergowrie SF, Qld.), whereas the lowest per cent survival (18%) was observed in the provenance 13237 (El Aris, Qld.).

In Bukidnon, the highest per cent survival (100%) was observed in the provenance 13232 (Cowley Beach Road, Qld.) followed by 13460, Oriomo River, Qld (98%) ; 13242, Abergowrie SF, Qld. (98%) 13241, Broken Pole Creek, Qld. (96%); 13234, Trinity Inlet, Qld (96%) ; 13235, Mourilyn Bay, Qld. (96%) ; 13621, Piru Ceram, Indonesia (96%) ; 13240, Ellerbeck Rd., Qld (94%). The provenance 13237, El. Arish, Qld. also showed the lowest percent survival (44%) in this site.

The provenance 13622 (Sidei, Indonesia) gave a good survival only in the Masbate site. The provenances with very good survival were 13241 (Ellerbeck Rd., Qld), 13460 (Oriomo River, Qld), 13242 (Abergowrie SF, Qld), 13241 (Broken Pole Creek, Qld), in both Masbate and Bukidnon sites. The lowest per cent survival was in the provenance 13237 (El Arish, Qld.) in both the sites. This means that this provenance has a very narrow range of adaptation and it is not suitable to both Masbate and Bukidnon. The high survival of the other provenances both in Masbate and Bukidnon indicates that they have a very wide range of adaptation to the sites.

Earlier investigations on survival confirm the findings of this study. A significant difference on survival was also observed among different provenances of *Acacia mangium* in Bangladesh (Zashimuddin *et al.*, 1983). In the present study, the best survival was observed under Bukidnon condition. Havmoller (1989) also reported a 30% better survival of mangium provenances in Mindanao than in Mindoro in the country. Zobel *et al.* (1956) and Kiellander (1960) mentioned that uniform rainfall and less fluctuated weather are essential for a high survival. So, very few provenances survived in the Ilocos Norte site which might be due to very scarce and uneven rainfall and large fluctuations in environmental conditions.

Table 3. Per cent survival of different provenances of *A. mangium* under 3 site conditions.

Ilocos Norte			Masbate			Bukidnon		
P	M	D	P	M	D	P	M	D
13231	62.50	a	13622	100	a	13232	100	a
13239	44.85	a	13846	100	a	13460	98	ab
13238	43.01	a	13460	100	a	13242	98	ab
13242	41.18	a	13240	100	a	13241	96	ab
13241	40.07	a	13241	100	a	13234	96	ab
13234	39.52	a	13242	100	a	13235	96	ab
13621	36.58	a	13229	64	b	13621	96	ab
13232	33.82	a	13621	64	b	13240	94	ab
13235	29.41	a	13232	64	b	13233	92	ab
13229	26.29	a	13233	50	bc	13229	92	ab
13237	25.00	a	13231	36	cd	13238	92	ab
13240	22.79	a	13238	36	cd	13231	84	abc
13460	21.32	a	13235	36	cd	13239	80	bc
13622	20.04	a	13234	36	cd	13236	68	c
13846	18.57	a	13236	36	cd	13237	44	d
13236	17.65	a	13230	36	cd			
13233	17.65	a	13239	24	d			
13230	17.65	a	13237	18	d			

P = Provenance ; M=Mean ; D=Duncan's grouping ; means followed by the same letter are not significantly different at 5% level (ANOVA and Duncan's multiple range test)

#### Variations in health condition

Variations in health condition are shown in Table 4. There was no significant variation in health condition among provenances in the Masbate. But the provenances in Ilocos Norte and Bukidnon showed significant variations ( $P < 0.01$ ) in health condition.

The best provenances resistant to pest and diseases in Ilocos Norte were 13229 (Claudie River, Qld), 13230 (Mission Beach, Qld), 13241

(Broken Pole Creek, Qld), 13236 (Kurrimine, Qld), 13235 (Mourilyn Bay, Qld).

In Bukidnon, the best provenances apparently free from pests and diseases were 13236 (Kurrimine, Qld), 13242 (Abergowrie SF, Qld) 13239 (Syndicate Road Tully, Qld), 13621 (Piru Ceram, Indonesia). Provenance 13231 (N. W. of Silkwood, Qld) was the most susceptible to pests and diseases. It was attacked by small black insects nesting on the stem and branches. As

a result, the plants became yellow and were low in vigor.

The results on health conditions also confirm the claims of Kinloch and Zoerb (1971), Zobel

and Talbert (1984) and Larsen and Nielsen (1982) that based on several studies, many exotics differed significantly in their ability to withstand pests and diseases.

**Table 4. Plant health of different provenances of *A. mangium* under Ilocos Norte, Masbate, and Bukidnon conditions.**

Ilocos Norte			Masbate			Bukidnon		
Prove-nance	Mean		Prove-nance	Mean		Prove-nance	Mean	
13229	3.000	a	13229	3.0000	a	13236	3.0000	a
13230	3.000	a	13230	3.0000	a	13242	3.0000	a
13241	3.000	a	13460	3.0000	a	13239	3.0000	a
13236	3.000	a	13235	3.0000	a	13621	3.0000	a
13237	3.000	a	13236	3.0000	a	13233	2.9565	a
13460	2.933	a	13237	3.0000	a	13241	2.9500	a
13234	2.857	a	13238	3.0000	a	13234	2.8750	ab
13233	2.778	ab	13240	3.0000	a	13235	2.8667	ab
13232	2.773	ab	13241	3.0000	a	13238	2.8571	ab
13239	2.733	abc	13242	3.0000	a	13249	2.8333	ab
13242	2.667	abc	13621	3.0000	a	13460	2.8182	ab
13240	2.615	abc	13233	2.9231	a	13231	2.6667	b
13621	2.615	abc						
13238	2.611	abc						
13231	2.500	abc						
13846	2.500	abc						
13622	2.235	bc						
13235	2.143	c						

## CONCLUSIONS

The study shows significant differences in survival and resistance to pests and diseases among different provenances. The highest survival was observed in Masbate and Bukidnon conditions. Maximum number of provenances also

had better survival in these two sites because of higher and evenly distributed rainfall throughout the year.

All the provenances regarding resistance to pests and diseases are very much well adapted

under Masbate conditions but in other two sites, only a few provenances are found resistant to pests and diseases.

The different provenances performed differently in survival and resistance to pests and diseases under different site conditions. The best provenance regarding survival and resistance to pests and diseases is 13460 (Oriomo River, PNC) for all 3 site conditions in the Philippines.

The follow up study is recommended at a later stage, may be at 10 years age after planting, to see the incidence of pests and diseases.

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