Water Status and Radiation Environment in Rubber (*Hevea brasiliensis*) Systems:
A comparison between monoculture and mixed rubber-Acacia mangium plots

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

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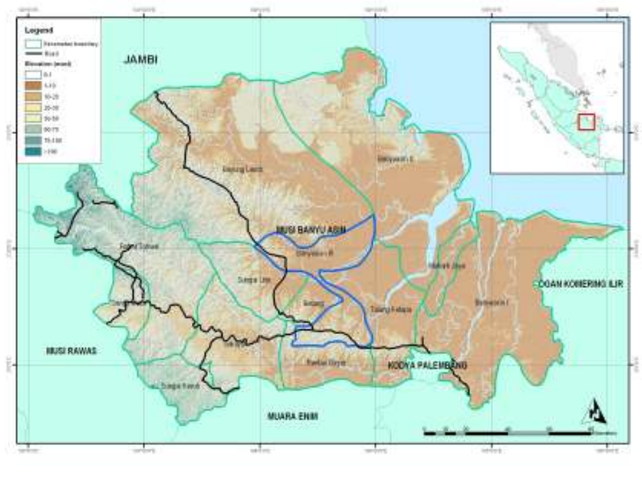
INTRODUCTION

Indonesia is the second biggest natural rubber producer in the world with 84% of the total production area constituted by smallholder rubber. Rubber smallholdings tend to have lower productivity and quality than estate plantations. Interplanting of A.mangium within rubber plots may be an attractive option for smallholder rubber farmers in the tropics to increase their land productivity.
However,
Because A. mangium is a very fast growing tree species, careful timing of planting and spacing arrangements of A. mangium is probably required to reduce light and water competition with rubber trees. Competition for water use between trees species in periods of low rainfall may be another constraint to growth of the rubber tree.

OBJECTIVES AND METHODS

The study was focused on assessing the relative contribution of water deficit and light deficit in the depressing effect of A. mangium on rubber growth (comparing monoculture of rubber (6 x 3.3 m and 6 x 2 x 14 m), rubber associated with A. mangium (3 x 3 x 17 m) and A. mangium monoculture (3 x 3 m)) in the fifth year after plot establishment.

The light intercepted by the canopy was calculated by measuring PAR simultaneously in the open and below the canopy and leaf area index. Allometric equations as a function of tree diameter were used to estimate above ground biomass. Tree diameter was recorded at 130 cm height bi-monthly using meter tape. The ratio of aboveground biomass growth and light interception by the canopy was expressed as Light Use Efficiency (LUE).
Leaf water potential was measured before dawn every week during the dry season and bi-weekly during the rainy season.




rubber monoculture double spacing

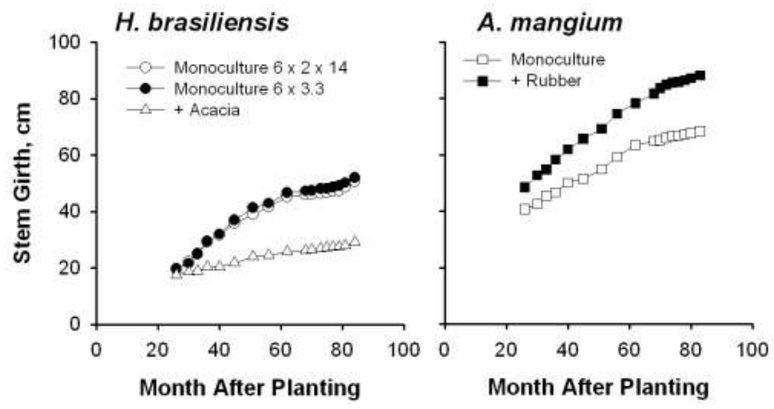

intercropping of rubber and *Acacia mangium*


rubber monoculture normal spacing

RESULTS AND DISCUSSION

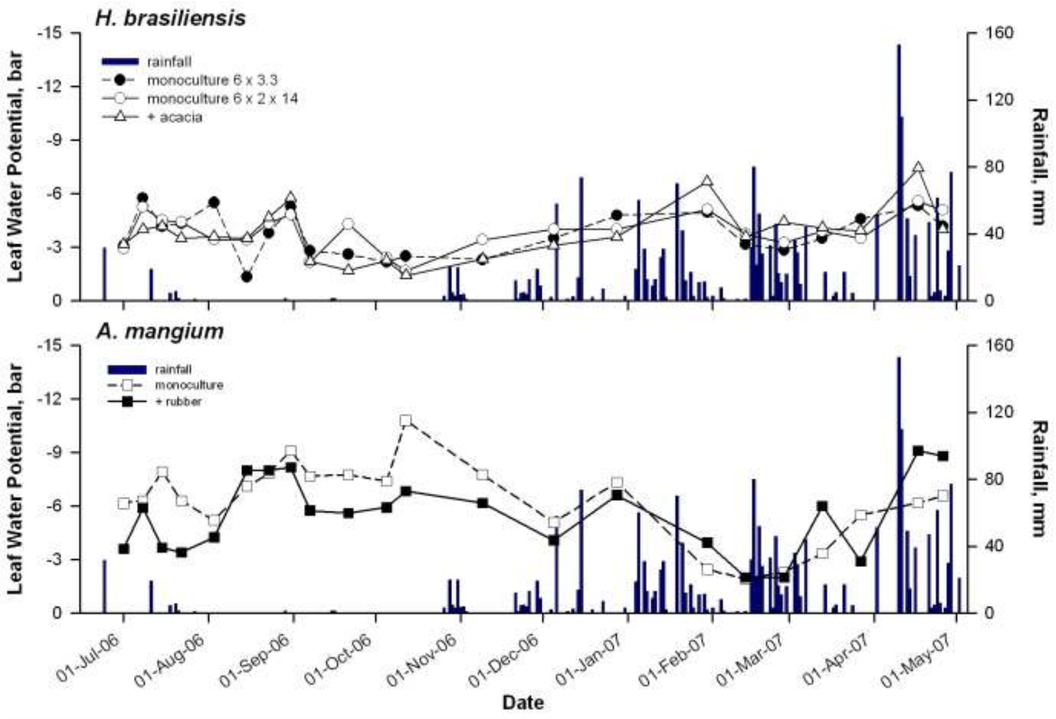
Season	Trees	System	Growth increment (mm/month)
Dry	*H. brasiliensis*	Monoculture 6 x 2 x 14	1.41 b
		Monoculture 6 x 3.3	0.89 a
		+ *A. mangium*	0.79 a
	A. mangium	Monoculture	1.74 a
		+ *H. brasiliensis*	2.05 a
Rainy	*H. brasiliensis*	Monoculture 6 x 2 x 14	6.76 d
		Monoculture 6 x 3.3	6.33 d
		+ *A. mangium*	2.97 c
	A. mangium	Monoculture	2.56 ab
		+ *H. brasiliensis*	3.53 b

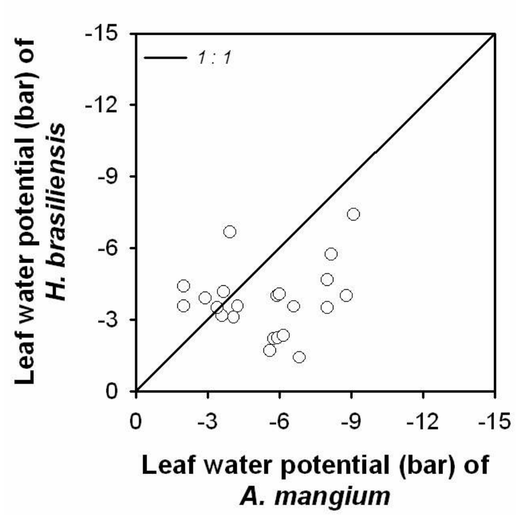
Value followed by the same letters are not significantly different (P = 0.05).
dry (2 May – 11 September 2006) and rainy (16 November 2006 – 28 March 2007) season at year six after planting



The growth rate of rubber in a mixture with A. mangium was significantly smaller than in monoculture. Conversely altering spacing pattern while maintaining the number of stem per ha in monoculture did not affect the growth of rubber.Twenty-six months after planting the development of A. mangium is much greater when interplanted with rubber than when grown in monoculture.

Growth rate at year six after planting however is no longer significantly lower in pure stands





Leaf water potentials (LWP) of rubber and A. mangium show significant differences between rainy and dry season. LWP of rubber under different systems studied does not show any consistent difference. Leaf water potential of A.magium was more negative than that of rubber in the mixed system, but not as negative as that in a monoculture of A. Mangium

Light use efficiency (LUE) of H. brasiliensis associated with A. mangium only shows significantly lower than monoculture during rainy season.

However, the amount of biomass and light intercepted by H. brasiliensis associated with A. mangium is significantly lower than that of H. brasiliensis in monoculture. Thus, the net effect of A. mangium on depressing rubber growth, however, is likely to be primarily caused by shading. Intercepted of light of A. mangium under different systems study almost the same, however, LUE of A. mangium monoculture during rainy season is significantly higher than A. mangium associated with H. Brasiliensis.

Season	Tree	System	AGB*) (g m-2)		PAR (MJ m-2)		LUE (g MJ-1)	
Dry	*H. brasiliensis*	Monoculture 6 x 2 x 14	238.0	c	778.1	b	0.31	b
		Monoculture 6 x 3.3	143.4	b	799.9	b	0.18	a
		+ *A. mangium*	46.9	a	162.1	a	0.29	ab
	A. mangium	Monoculture	893.9	bc	871.5	c	1.03	ab
		+ *H. brasiliensis*	274.5	a	722.6	ab	0.38	a
Rainy	*H. brasiliensis*	Monoculture 6 x 2 x 14	1168.5	d	817.5	bc	1.43	d
		Monoculture 6 x 3.3	1127.0	d	855.9	c	1.32	d
		+ *A. mangium*	189.9	bc	180.3	a	1.05	c
	A. mangium	Monoculture	1381.4	c	786.2	b	1.75	b
		+ *H. brasiliensis*	487.0	ab	664.2	a	0.74	a

CONCLUSION

Monitoring of growth, light interception and leaf water potential in various planting systems suggested that the depressing effect of acacia on rubber in mixed plots was primarily caused by light competition. Without any management such as pruning or careful timing of planting of acacia, planting acacia and rubber on the same plot would be disadvantageous.