FERTILISER EFFECTS ON THE TREE GROWTH AND SOME WOOD PROPERTIES OF *PARASERIANTHES FALCATARIA* ON DURIAN SERIES SOIL

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WAN RASIDAH ABDUL KADIR & ANI SULAIMAN. 1992. Fertiliser effects on the tree growth and some wood properties of *Paraserianthes falcataria* on Durian series soil. Nitrogen and phosphorus combinations were applied on young seedlings of *Paraserianthes falcataria* (three months after transplanting) at six-monthly intervals until the seedlings were 21 months old. Diameter growth, total height increment, mortality rate and heartwood to sapwood (HS) ratio were found to be insignificant at all levels of treatment. Specific gravity was found to be highly significant between fertiliser treatment and between discs. N2P1 was significantly different from the rest of the treatment, whereas N2P0 was only significantly different from N1P1. Nitrogen application in combination with P appeared to have some effects in increasing the specific gravity in comparison with nitrogen in the absence of P. There was a significant difference in specific gravity between the three discs where the highest value was 0.39 and the lowest was 0.27. No significant interaction was observed between portions of disc and fertiliser treatment.

Keywords: *Paraserianthes falcataria* - fertiliser - tree growth - timber properties

Introduction

Forest plantations were developed partly as a result of growing demand for timber, wood pulp and firewood (Evans 1982). Intensive agricultural practice has proved that productivity could be increased by three to five times. Through proper systems of silvicultural management, the productivity of forest plantations can be increased by reducing the maturity period. However, there is no substantial information on the effect of such management system on wood yield and properties. According to Bevege (1984), properties that are likely to be affected by, for example, fertilisation are fibre characteristics, density and juvenile corewood.

After three years of growth, favourable increment in height and diameter has been observed in the response of *Paraserianthes falcataria* to phosphorus and nitrogen fertilisation on Durian series ((Typic Plinthudult) soil (Wan Rasidah *et al.* 1988). This study deals with the effect of fertiliser application on tree growth and some timber properties of 6-y-old *P. falcataria.* The parameters assessed were mortality rate, growth rate, specific gravity and proportion of heartwood to sapwood present.

Materials and methods

The trial was carried out at Kemasul Forest Reserve in 1983 with newly planted 6-month-old *P. falcataria* seedlings. A total of six plots with four replications were established. Each plot consisted of 49 trees with the central 25 as recording trees. The spacing among the trees was 3×3 *m*. The first fertiliser application was applied three months after transplanting and continued at six-monthly intervals until the trees were 21 months old. Three levels of nitrogen (0, 25 and 50 *g* of fertiliser per tree) and two levels of phosphorus (0 and 60 *g* of fertiliser per tree) were tested: nitrogen in the form of ammonium sulphate (AS) and phosphorus in the form of a mixture of triple superphosphate (TSP) and Christmas Island Rock Phosphate (CIRP). All P treated plots were given an equal amount of TSP and CIRP. The fertiliser treatments are described in Table 1. Early enumerations were based on height and diameter increment at breast height (dbh).

Table 1. Fertiliser treatments at different levels of application

Abbreviation	Description
N0P0	No N and P fertiliser (control)
N0P1	No N but 60 *g* of P fertiliser added
N1P0	25 *g* of N and no P fertilisers added
N1P1	25 *g* of N and 60 *g* of P fertilisers added
N2P0	50 *g* of N and no P fertilisers added
N2P1	50 *g* of N and 60 *g* of P fertilisers added

The diameter growth increment and clear bole height were measured on all 6-*y*-old *P. falcataria* stem selected before wood sampling was carried out. Prior to wood sampling, each selected tree was felled and cut into 2.5 *cm* discs from the lower portion (A) at 0.15 *m* height, middle portion (B) at 3.5 *m* height and upper portion (C) at 6 *m* height of the clear bole. The discs were brought back to the sawmill for further cutting into small samples. From each disc, two strips of about 50 *mm* wide were cut across the diameter and arbitrarily marked as N, S, E and W to indicate the four different radii of each disc. From each radius, three block samples of $50 \times 50 \times 25$ *mm* were taken radially from the pith outwards for determination of specific gravity based on green volume of timber and its oven dry weight.

After the specific gravity test, the same samples were prepared for nutrient analysis. The samples were ground to powder form, dried at 105 $^{\circ}C$ for 2 *h* and extracted for N using Kjeldahl digestion (Eastin 1978) and P using dry ashing methods (Walinga *et al.* 1989). Both elements were determined colorimetrically using autoanalyser.

Statistical treatment

In comparing the control (treatment without fertiliser) with each of the five fertiliser combinations on various parameters, analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) techniques were employed and the data set was analysed using Statistical Analysis System (SAS) package.

Results and discussion

Tree growth

For the mortality rate (Pr > F = 0.751), total height (Pr > F = 0.594) and diameter (Pr > F = 0.747) increment, no significant difference was observed in the five fertiliser treatments compared with the control.

Mortality rate, total height and diameter increment were observed to be highest in N1P1 treatment. The reason for the high mortality rate observed was not ascertained. The branches were found broken and sometimes fell on the adjacent tree. The affected trees were thus more prone to termite and other insect attacks and died after some time. This left more space for the remaining trees to accelerate their growth and thus resulted in increased height and diameter (Table 2). Seibt (1966) observed that the influence of fertilisers on growth and yield of different species of trees is not correlated with that on the increments in height and diameter. He pointed out that the increase in diameter is more suitable for assessing the effects of fertiliser treatment than the increase in height. The lowest value for mortality rate was found in treatment with N2P1, height with N2P0 and diameter with N1P1.

Table 2. Mortality rate and comparison between mean increment in total height and diameter with the control

Treatment	Total height (*m*)	Clear bole height (*m*)	Diameter (dbh) (*cm*)	Mortality rate (%)
N0P0 (control)	15.01a	8.03a	63.63a	30a
N0P1	14.48a	6.84a	69.75a	34a
N1P0	13.67a	7.37a	64.35a	28a
N1P1	17.02a	7.08a	71.75a	38a
N2P0	14.70a	6.13a	63.30a	34a
N2P1	15.46a	5.41a	65.58a	28a

Means in columns having the same letter are not significantly different at 5% level (diameter was measured at breast height)

From Table 2, the clear bole height was not significantly different among treatments, but showed a considerable difference between the lowest and highest values. All trees with fertiliser treatments were observed to be low branching.

Wood properties

Specific gravity had no interaction effect between different fertiliser treatments and discs (Table 3). However, there was a significant difference between the fertiliser treatment and the control, and between different discs and the control. The highest specific gravity was obtained with treatment N2P1 and was significantly different from the rest of the treatments (Table 4). The specific gravity was found

to be highest at the lower bole (A) compared to the middle (B) or top (C) parts of the bole (Table 5). The sprecific gravity values are also significantly different from one to the other. Earlier findings on non-fertilised wood of 15-y-old *P. falcataria* showed a specific gravity of 0.43 (Laurie 1966).

Table 3. ANOVA Results for specific gravity and heartwood to sapwood (HS) ratio

Source	Pr >F	
	Specific gravity	HS Ratio
Fertiliser	0.0157 **	0.4059 ns
Disc	0.0001 **	0.3189 ns
Fertiliser × Disc	0.9608 ns	0.3019 ns

** = highly significant at 1 % level; ns - not significant

Table 4. DMRT based on specific gravity and heartwood to sapwood ratio for each treatment

Parameter	Treatment					
	N0P0	N0P1	N1P0	N1P1	N2P0	N2P1
SG	0.32 bc	0.33 bc	0.32 bc	0.31 c	0.36 ab	0.38 a
HS Ratio	5.23 a	5.43 a	5.66 a	5.76 a	4.64 a	5.88 a

Means in rows having the same letter are not significantly different at 5 % level; HS ratio = heartwood to sapwood ratio; SG= specific gravity (Abbreviations similar for Table 5)

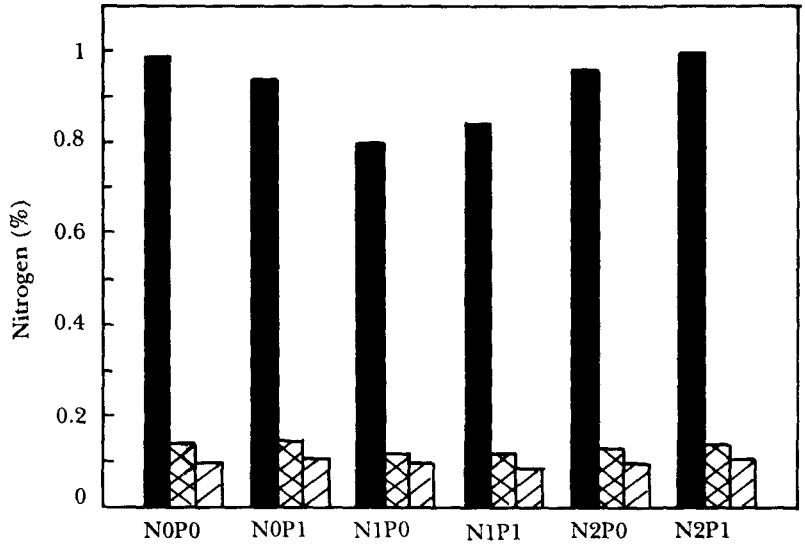
Table 5. DMRT based on different discs for specific gravity and heartwood to sapwood ratio

Parameter	Disc A	Disc B	Disc C
SG	0.389 a	0.348 b	0.273 c
HS Ratio	5.76 a	5.46 a	5.08 a

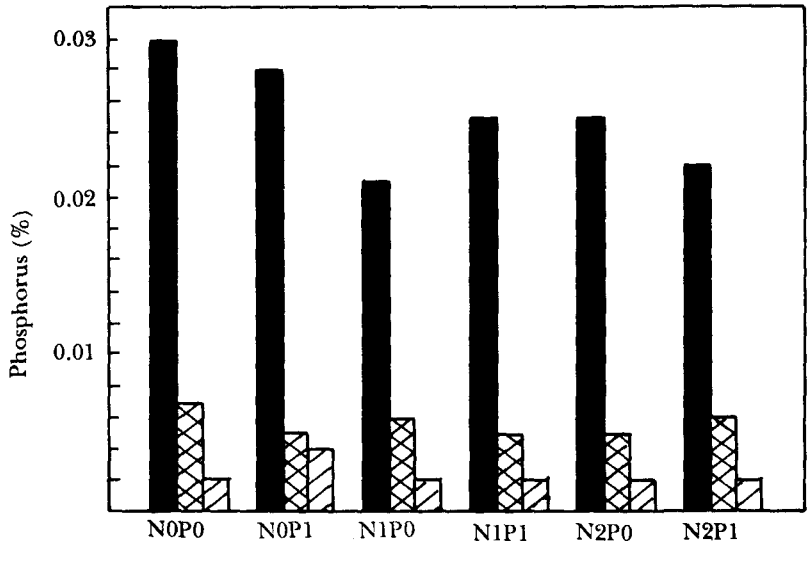
The difference in the values could be due to age difference, locality and silvicultural treatment. However, according to Seibt (1966), the density of wood decreases somewhat after fertiliser treatment probably due to alteration of the structure of the wood. von Pechmann and Wutz (1960) likewise found a slight reduction in specific gravity after application of fertiliser.

Heartwood to sapwood (HS) ratio was found to be highest in N2P1 and lowest in N2P0. However, it is not significantly different. As expected, disc A showed the highest HS ratio, followed by disc B and C (Table 5).

From Figure 1, there appears to be no appreciable difference in the nitrogen and phosphorus contents between control and treated samples. Even though there is some numerical difference, it can be assumed to be due to the dilution effect of tree growth. This is true for all sections of the bark, sapwood and heartwood. In general, most of the nutrients are accumulated in the bark followed by sapwood and heartwood.



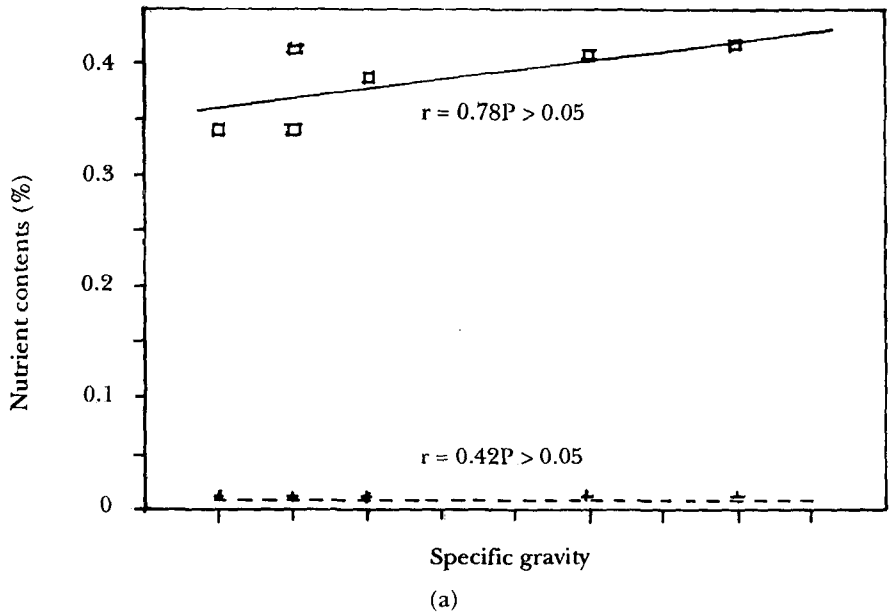
(a)



(b)

Figure 1. Nutrient contents in bark, sapwood and heartwood

Both N and P are weakly correlated with the two wood properties tested (Figure 2). The relatively higher correlation coefficient (r) shown by the relationship between N contents in the stem and specific gravity (Figure 2a) corresponds to Table 4 where the increment in specific gravity for N application is significantly higher.



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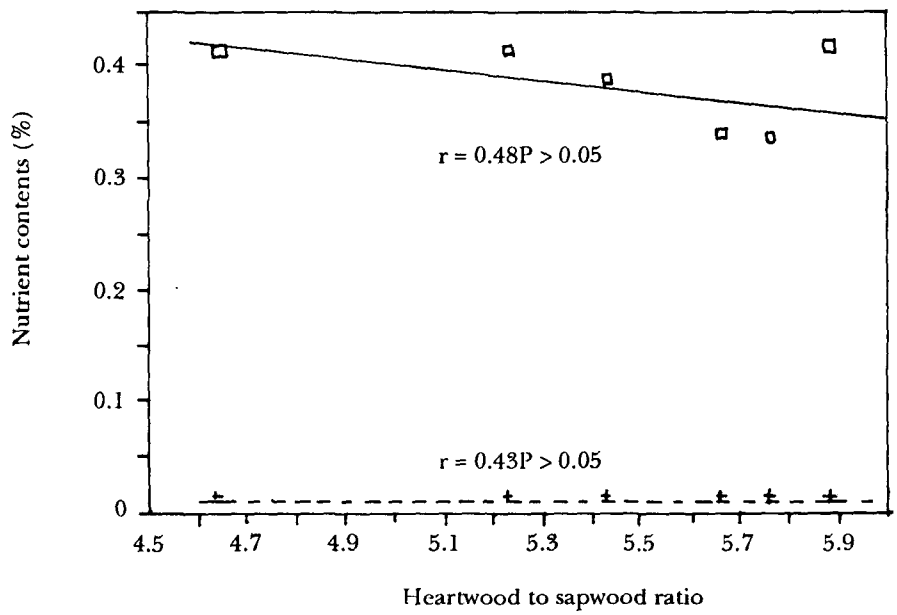

(b)

Figure 2. Relationship of nutrient contents with (a) specific gravity and (b) heartwood to sapwood ratio

van den Driessche (1984) speculated that during the heartwood formation, some proportions of sapwood nutrients of N, P and K would be redistributed from the sapwood that is being converted. This may be true for the relationship between nitrogen and HS ratio (Figure 2b) whereby the higher the heartwood proportion the lower is the N content. However, no important difference was observed with P probably due to low initial P contents.

Conclusion

Fertiliser application appeared to increase the specific gravity of wood but had no effect on heartwood to sapwood ratio in *P. falcataria.* No effect was also observed on the tree growth. However, there was an indication based on the growth parameter (clear bole height) that fertilisation could lead to short merchantable logs.

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