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Optimum potassium fertilizer rate for growth, biomass yield, and fuel properties of Leucaena (*Leucaena leucocephala*) cv. Tarramba in sandy soil

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Abstract The results showed that the 187.5, 375 and 750 kg ha^{-1} application rates increased plant height and stem diameter, while the control (0 kg ha^{-1}) showed a potassium deficit, resulting in stem dieback. High leaf, branch, and stem yield were found at application rates greater than 93.75 kg ha^{-1}, while plant height, stem diameter and biomass yield were slightly further increased in the 187.5, 375 and 750 kg ha^{-1} treatments. Regarding fuel properties, the potassium application rate did not affect the heating value and ash content but decreased the N and S contents. The potassium content tended to increase with increased potassium application rate. However, the leucaena wood under all the treatments had suitable fuel properties for use as a fuel crop.

Keywords: Leucaena, Potassium fertilizer, Biomass yield, Fuel properties, Sandy soil

Introduction

The feedstock demand of biomass power plants in Thailand is high, particularly biomass from wood. Currently, the quantity of feedstock available fluctuates according to the material source area and is often inadequate to meet biomass power plant demand. Using areas that are limited for growing economic crops (e.g., sandy soil) to grow fuel crops is one way to increase the quantity of feedstock and reduce competition for areas where economic crops are planted. Sandy soil is particularly widespread in the northeast region of Thailand (approximately 44.4 million ha) (Wongkrachang and Rattaneetu, 2013). Leucaena (*Leucaena leucocephala* [Lam.] de Wit) is currently grown as an energy crop by farmers as an alternative source of income. Leucaena belongs to the Fabaceae family. It is a fast-growing tree with a deep root system, drought-

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tolerant and regrows rapidly after harvest (Piggin and Nulik, 2005; Dalzell *et al*., 2006). Cultivating leucaena as a fuel crop has many benefits as it increases not only the efficiency of land use but also soil fertility (Dalzell *et al*., 2006). In the northeast region, the sandy soil has low water holding capacity, low fertility, low amounts of organic matter, low cation exchanging capacity, low total nitrogen, and very low phosphorus and exchangeable potassium (Kheoruenrommne, 1999). Other studies have shown deficiencies of P, S, K and some trace elements (Shelton *et al*., 1979). The application of chemical fertilizer is required to grow leucaena in sandy soil, especially potassium fertilizer (Tudsri, 2004). Jones and Carter (1989) reported that potassium affects the growth of leucaena at the seedling stage. Therefore, provided other deficiencies are corrected, the application of potassium fertilizer is required to improve the growth and biomass of leucaena for use as a fuel crop. The present study aimed to investigate the appropriate potassium fertilizer application rate to achieve optimum growth and biomass yield and optimum fuel properties of leucaena grown in a sandy soil in northeast Thailand.

Materials and methods

An experiment was performed at Buriram Livestock Research and Testing Station, Pakham district, Buriram Province, Thailand in 2011-2015. Soil analyses of the 0-30 cm depth indicated a sandy soil with low organic matter (0.43%), 5.38 pH, very low phosphorus (2.1 ppm), and low potassium (8.9 ppm). The experimental design was a randomized complete block design (RCBD) with four replications. The treatments consisted of five potassium fertilizer (0-0-60) application rates; 0 (control), 93.75, 187.5, 375 and 750 kg ha^{-1} $year^{-1}$.

Plant materials

Leucaena (*L. leucocephala* cv. Tarramba) seeds were scarified and then sown in seedling bags (size 2×6 inches). The seedlings were grown in a nursery for 2 months after planting and transplanted to a field experiment in March 2011. Seedlings were planted at 1×0.5 m. spacing and plot size was 5 × 5 m. Phosphorus fertilizer (0-46-0) and gypsum ($CaSO_4$) were applied at 375 and 250 kg ha^{-1} $year^{-1}$ and were re-applied the same rate after each harvesting. The weeds were regularly controlled, and the leucaena was irrigated once a week during the dry season (March to May 2011).

Data collection and statistical analysis

In the first year, plant height and stem diameter were measured at 12 months after transplanting in the field whereas the 2nd, 3rd and 4th measurements were done at 12 months after harvesting in 2013, 2014, and 2015 respectively. Plant height was measured from the ground to the shoot apex of the leucaena by meter stick, stem diameter was measured at breast height (130 cm above ground level) by a vernier caliper. The number of shoots was measured at 12 months after each harvesting on the main stump by direct counting (Chotchutima *et al*., 2016). Eighteen randomly selected plants per plot were cut at 50 cm above ground level. Each plant was separated into leaf (including the green stem), branch and woody stem and then fresh weight was recorded immediately by an electronic balance. Dry weight of leaf, branch and woody stem were measured after placing them into a hot air oven at 80ºC for 72 hours. To prepare the wood samples to evaluate fuel properties, the dry woody stems were ground by grinding machine with a 1 mm sieve. Leucaena wood were analyzed for carbon (C), hydrogen (H), oxygen (O), nitrogen (N) and S content (ultimate analysis) by an elemental analyzer (LECO, 2003). The phosphorus and potassium contents were measured by an atomic absorption spectrophotometer. Ash content was analyzed following the Association of Official Analytical Chemists (AOAC, 1980) method, and the calorific value was determined by a bomb calorimeter (AOAC, 1980). ANOVA and Duncan's multiple range test were used to analyze variance and compare the means, respectively.

Results

Rainfall

The average rainfall throughout the 5-year planting period. There was no rainfall after the leucaena were transplanted in March 2011; therefore, the leucaena was irrigated from March 2011 to June 2011. While there was a little rainfall in July 2011 and continuous rainfall from August 2011 to October 2011, the average maximum rainfall was recorded as 633 mm. In 2012, 2013, 2014 and 2015 (Jan-April), the average rainfall was 1.179, 1.458, 1.227 and 84 mm, respectively. In 2013, the average rainfall was higher than in 2011, 2012, 2014, while optimum rainfall distribution occurred in 2013 and 2015. The monthly average rainfall from May to October was 100 mm, and the highest average rainfall in September was 331 and 306 mm in 2013 and 2014, respectively. In 2015, rainfall was low but sufficient for leucaena. However, rainfall was heavy in March 2015 during the harvest (Figure 1).

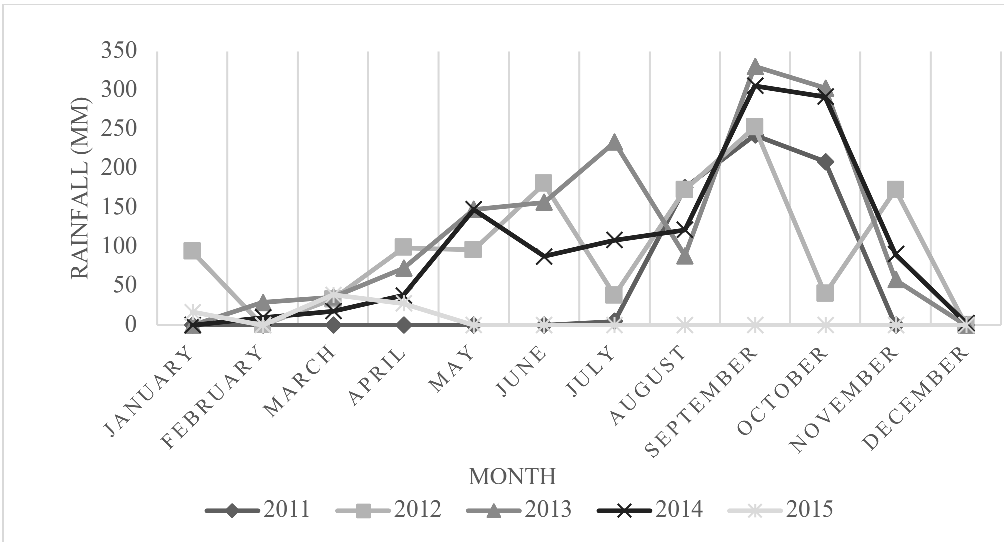

Figure 1. Average monthly rainfall from March 2011 to April 2015 at the Buriram Livestock Research and Testing Station, Pakham district, Buriram Province, Thailand

Stem diameter

In the 1st and 2nd year, the potassium applications of 375 and 750 kg ha^{-1} produced significantly larger stems than the 187.5 kg ha^{-1} ($P \leq 0.01$), and the stem diameter in all the treatments was greater than in the control. For the 3rd year, the 750 and 375 kg ha^{-1} rates had larger stem diameters (2.8 and 2.7 cm) than the control ($P \leq 0.01$). The control also had the smallest stem diameter in the 4th year (Table 1).

Plant height

The plant height of the leucaena in the 1st and 2nd years showed that the potassium application of 375 and 750 kg ha^{-1} produced significantly taller plants than the 187.5 kg ha^{-1} and control ($P \leq 0.01$). In the 3rd year, the 750 kg ha^{-1} plants were significantly taller (671 cm) than the 93.75 kg ha^{-1} and control plants. The control remained the shortest plants (364 cm) in the 4th year (Table 1).

Table 1. Stem diameter and plant height of *Leucaena leucocephala* cv. Tarramba under different potassium fertilizer application rates in 2012–2015

Potassium rate kg ha^{-1}	Stem diameter (cm)				Plant height (cm)			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
0	0.7 c	1.0 c	1.5 b	1.8 c	148 c	224 c	310 c	364 b
93.75	1.4 b	2.2 b	2.2 ab	2.3 b	250 b	474 b	472 bc	551 a
187.5	1.8 a	2.7 a	2.4 ab	2.8 a	342 a	566 a	542 ab	602 a
375	1.9 a	2.9 a	2.7 a	2.7 ab	351 a	597 a	622 ab	676 a
750	1.9 a	2.9 a	2.8 a	2.7 ab	345 a	635 a	671 a	719 a
F-test	**	**	**	**	**	**	**	**

Means of the same column followed by the same letter were not significantly different at the 0.05 level using Duncan's multiple range test. ** = significantly different at 99%

Number of shoots

There was a statistically significant difference in the number of shoots in the 2nd year. At 6 months, the number of shoots in the 375 and 750 kg ha^{-1} treatments was less than the control, while the number of shoots was not influenced by the different treatments at 12 months. In the 3rd year, the 187.5 kg ha^{-1} rate had the maximum number of shoots (6 shoots/stump) at 6 months, which was significantly different than the others, except the 375 kg ha^{-1} rate. Moreover, the 187.5 kg ha^{-1} rate had more shoots than the 750 kg ha^{-1} rate and the control (Table 2) at 12 months. In the 4th year, the 750 kg ha^{-1} rate provided 2 shoots/stump at 6 months, which was significantly less than the 93.75, 187.5, and 375 kg ha^{-1} rates. A statistically significant difference in the number of shoots was observed at 12 months. The 750 kg ha^{-1} rate still showed a lower number of shoots (2 shoots/stump) than the control, 93.75 and 187.5 kg ha^{-1} rates (4–5 shoots/stump).

Table 2. Shoot numbers of *Leucaena leucocephala* cv. Tarramba under different potassium fertilizer application rates in 2012–2015

Potassium rate (kg ha^{-1})	**1st**		**2nd**		**3rd**		**4th**	
	6 months	12 months	6 months	12 months	6 months	12 months	6 months	12 months
0	-	-	6 a	4	4 c	4 bc	4 bc	4 ab
93.75	-	-	5 ab	3	4 bc	4 ab	6 a	5 a
187.5	-	-	5 ab	4	6 a	5 a	4 ab	4 ab
375	-	-	4 bc	3	6 ab	4 abc	4 b	4 bc
750	-	-	3 c	2	4 bc	3 c	2 c	2 c
F-test	-	-	*	ns	**	**	**	**

Means of the same column followed by the same letter were not significantly different at the 0.05 level using Duncan's multiple range test.
ns = non-significant, * = significantly different at 95%, ** = significantly different at 99%

Fresh weight yield

In the 1st year, the potassium application rate of 187.5, 375, and 750 kg ha^{-1} produced a fresh leaf yield of over 4-ton ha^{-1}. Fresh branch yield of the control was 4-ton ha^{-1} compared to the others (1.01-1.73 ton ha^{-1}). The 375 kg ha^{-1} had significantly higher fresh woody stem and total fresh biomass yield than the 93.75 kg ha^{-1} and control ($P \leq 0.01$). It is evident that the application of potassium fertilizer provided higher fresh weight yields than the non-application of potassium fertilizer, particularly the application rate of ≥187.5 kg ha^{-1}. In the 2nd year, the weight of the fresh biomass yield was higher than the previous year, and the response of each treatment was similar to the 1st year. The potassium application rate of 187.5 and 750 kg ha^{-1} produced more fresh leaf yield than the 93.75 kg ha^{-1} and control ($P \leq 0.01$). The control still produced low fresh branch yield. The 187.5, 375, and 750 kg ha^{-1} produced higher fresh woody stem yield than the control. The control and 93.75 kg ha^{-1} produced lower total fresh biomass yield (5.38 and 27.19 ton ha^{-1}) than the 187.5, 375, and 750 kg ha^{-1}. In the 3rd year, the 750, 375, and 187.5 kg ha^{-1} produced higher fresh leaf yields (9.14, 8.39 and 8.87 ton ha^{-1}) than the control (3.31 ton ha^{-1}). The 187.5 kg ha^{-1} produced higher fresh branch yield than the control ($P \leq 0.01$). The 750 kg ha^{-1} produced higher fresh woody stem yield (54.23 ton ha^{-1}) than for the 93.75 kg ha^{-1} and control. The 750 kg ha^{-1} also had higher total fresh biomass yield than the 93.75 kg ha^{-1} and control. In the 4th year, the 187.5, 375, and 750 kg ha^{-1} had higher fresh leaf yield than control. The control was the lowest fresh branch yield (1.79 ton ha^{-1}). The 750 kg ha^{-1} produced higher fresh woody stem than the control and showed higher total fresh biomass yield than the 93.75 kg ha^{-1} and control (Table 3).

Dry weight yield

In the 1st year, all potassium application rates of ≥187.5 kg ha^{-1} produced higher dry leaf yield than the control ($P \leq 0.01$). However, the dry branch yield was not influenced by the different treatments. The 375 and 750 kg ha^{-1} rates produced higher dry woody stem yields than the 93.75 kg ha^{-1} and control treatments. In the 2nd year, all potassium fertilizer rates produced higher dry leaf and branch yield than the control, while the 187.5 kg ha^{-1} rate produced higher dry branch yield than the 750 kg ha^{-1} and control ($P \leq 0.01$). The 187.5, 375, and 750 kg ha^{-1} produced higher dry stem and total dry biomass yield than the 93.75 kg ha^{-1} and control treatments ($P \leq 0.01$). In the 3rd year, there was a statistically significant difference in the dry leaf and branch yield between the 93.75, 187.5, 375, and 750 kg ha^{-1} and the control treatments. The 750 kg ha^{-1} rate produced significantly higher dry stem and total biomass yield than the 93.75 kg ha^{-1} and control treatments ($P \leq 0.01$). In the 4th year, potassium application rate of ≥187.5 kg ha^{-1} had higher dry leaf yield than the control ($P \leq 0.01$). Moreover, it was observed that the 187.5, 375, and 750 kg ha^{-1} rates provided higher dry branch yields than the control ($P \leq 0.01$). The potassium application rate of ≥93.75 kg ha^{-1} had higher dry woody stem yield than the control. The 750 kg ha^{-1} rate produced higher total dry biomass yield than the 93.75 kg ha^{-1} and the control ($P \leq 0.01$) (Table 3).

Table 3. Fresh and dry weight yield of *Leucaena leucocephala* cv. Tarramba under different potassium fertilizer application rates in 2012–2015

Potassium rate (kg ha^{-1})	Fresh weight yield (ton ha^{-1})				Dry weight yield (ton ha^{-1})			
	Leaf	Branch	Woody stem	Total	Leaf	Branch	Woody stem	Total
1st (2012)								
0	1.05 c	0.51	0.37 c	1.93 b	0.42 c	0.27	0.19 c	0.88 b
93.75	3.72 b	1.01	2.69 bc	7.43 b	1.32 b	0.45	1.43 bc	3.20 ab
187.5	5.58 a	1.73	7.01 ab	14.31 a	2.12 a	0.80	3.69 ab	6.61 a
375	4.93 ab	1.48	8.13 a	14.53 a	1.68 ab	0.67	4.40 a	6.75 a
750	4.93 ab	1.16	8.08 a	14.18 ab	1.83 ab	0.50	4.12 a	6.44 a
F-test	**	ns	**	**	**	ns	*	*
2nd (2013)								
0	1.71 c	1.25 c	2.42 c	5.38 c	0.71 c	0.78 c	1.28 c	2.77 c
93.75	5.50 b	3.69 ab	18.00 b	27.19 b	2.18 b	2.13 ab	10.09 b	14.39 b
187.5	8.14 a	4.97 a	34.10 a	47.21 a	3.24 a	2.76 a	19.64 a	25.64 a
375	6.78 ab	4.07 ab	37.22 a	48.06 a	2.65 ab	2.11 ab	21.09 a	25.85 a
750	7.36 a	3.51 b	44.23 a	55.10 a	2.96 a	1.88 b	24.89 a	29.73 a
F-test	**	**	**	**	**	**	**	**
3rd (2014)								
0	3.31 b	1.84 b	15.48 c	20.63 b	1.49 b	1.09 b	9.76 b	12.34 b
93.75	5.39 ab	3.11ab	19.92 bc	28.42 b	2.16 a	1.69 a	11.06 b	14.91 b
187.5	9.14 a	4.93 a	38.97 abc	53.03 ab	3.82 a	2.62 a	23.31 ab	29.75 ab
375	8.39 a	3.70 ab	42.80 ab	54.89 ab	3.59 a	2.03 a	24.83 ab	30.45 ab
750	8.87 a	3.29 ab	54.23 a	66.39 a	3.77 a	1.53 a	31.05 a	36.34 a
F-test	*	*	**	*	*	*	*	*
4th (2015)								
0	3.70 b	1.79 b	16.01 b	21.50 c	1.59 c	0.79 b	10.15 b	12.53 c
93.75	7.98 ab	4.38 a	32.59 a	44.95 bc	3.43 bc	1.93 ab	20.33 a	25.69 bc
187.5	11.96 a	6.05 a	49.54 a	67.55 ab	5.14 ab	2.66 a	31.58 a	39.38 ab
375	10.69 a	4.58 a	56.30 a	71.58 ab	4.60 ab	2.01 a	36.06 a	42.68 ab
750	10.58 a	4.36 a	69.23 a	84.16 a	4.55 a	1.92 a	44.59 a	51.05 a
F-test	**	**	**	**	**	**	**	**

Means of the same column followed by the same letter were not significantly different at the 0.05 level using Duncan's multiple range test.
ns = non-significant, * = significantly different at 95%, ** = significantly different at 99%

Table 4. Heating value and ash content of *Leucaena leucocephala* cv. Tarramba under different potassium fertilizer application rates

Potassium rate (kg ha^{-1})	Heating value (kcal $^{-1}$)	Ash content (% dry matter)
0	4.39	1.79
93.75	4.35	1.49
187.5	4.36	1.24
375	4.35	1.23
750	4.33	1.54
F-test	ns	ns

Means of the same column followed by the same letter were not significantly different at the 0.05 level using Duncan's multiple range test.
ns = non-significant

Fuel properties of Leucaena wood

The heating values and ash contents of the leucaena were not significantly influenced by the different application rates of potassium fertilizer (Table 4), and the applications of potassium fertilizer did not affect the carbon and hydrogen contents. Increasing rates of applied potassium fertilizer tended to reduce the nitrogen and sulfur content except for the 750 kg ha^{-1} treatment. The phosphorus content tended to decrease with increasing rate of applied potassium fertilizer, but there was no statistically significant difference. Likewise, increasing the potassium fertilizer application rate tended to enhance the potassium content of the leucaena wood, but there was no statistically significant difference (Table 5).

Table 5. Carbon, hydrogen, nitrogen, sulfur, phosphorus, and potassium content of woody stems of *Leucaena leucocephala* cv. Tarramba under different potassium fertilizer application rates

Potassium rate	Elemental content (% dry matter)					
(kg ha^{-1})	C	H	N	S	P	K
0	45.00	6.93	1.05a	0.14 a	0.11	0.12
93.75	45.13	7.20	0.95 ab	0.09 b	0.09	0.16
187.5	45.00	7.17	0.81 bc	0.08 bc	0.06	0.17
375	44.93	7.22	0.73 c	0.07 c	0.05	0.19
750	44.80	7.21	0.80 bc	0.08 bc	0.07	0.27
F-test	ns	ns	*	**	ns	ns

Means of the same column followed by the same letter were not significantly different at the 0.05 level using Duncan's multiple range test.
ns = non-significant, * = significantly different at 95%, ** = significantly different at 99%

Discussion

The results of the experiment suggested that there was insufficient potassium in the soil to support plant growth in terms of height, stem diameter, and biomass yield components for use as a fuel crop. The soil analysis data before starting the experiment, demonstrated that there was low potassium content compared to plant demand. According to Tudsri (2004) leucaena requires at least 60 ppm of potassium in the soil. The current study found that the leucaena showed symptoms of a potassium deficiency such as chlorosis, leaf burn at margins and dieback of shoots. This indicated that without the application of potassium fertilizer (the control), the leucaena could not produce sufficient yield. Likewise, the 93.75 kg ha^{-1} also showed potassium deficiency symptoms, but these were only found on the leaves and branches. However, woody stem yield of the 93.75 kg ha^{-1} rate was close to that achieved in the 187.5 and 375 kg ha^{-1} treatments in the 3rd and 4th year.

The potassium deficiency symptoms decreased with increasing application rate of potassium fertilizer from 187.5 to 375 kg ha^{-1}, and symptoms were not observed at 750 kg ha^{-1}. Therefore, the results suggested that during the 1st year of a plantation, 375 - 750 kg ha^{-1} of potassium fertilizer should be applied because the root system is not yet completely developed. However, leucaena has the ability to regrow after the 1st year, and all the application rates in the 2nd year produced higher yields than the control due to shoot number increasing the biomass production.

During the 1st and 2nd years, the leucaena responded to the application of 187.5 kg ha^{-1} potassium fertilizer. Higher application rates resulted in slight increases in yield that were not statistically significant. In the 3rd and 4th years, branch and stem yields tended to increase, particularly the stem and total biomass yields. However, the leucaena produced similar stem and total biomass yields for the 187.5 to 750 kg ha^{-1} application rates. In the 4th year, the amount of shoot dieback was less in the 93.75 kg ha^{-1} compared to the control and there was no shoot dieback at higher rates.

Although the 750 kg ha^{-1} had the tallest shoots, their number was restricted by intense competition for carbohydrate reserves among coppiced shoots and the development of competitive dominance (Vanderneer *et al.*, 1996), which resulted in the natural thinning of shoots. The larger, more dominant, and vigorous shoots had better survival than the smaller shoots (Lévesque *et al.*, 2011). This resulted in only a few shoots/stamps in the 750 kg ha^{-1} at 12 months after cutting. Although the 750 kg ha^{-1} treatment had the lowest number of shoots, it had the highest stem diameters, resulting in a high woody stem yield.

The results of 4-years experiment revealed that the optimal application of potassium fertilizer was at least 187.5 kg ha^{-1} for a plantation of leucaena in the sandy soil conditions of Buriram. Although higher application rates were applied, the increase in biomass yield was not statistically significantly different but increased the cost of potassium fertilizer. An increase in the application rate of potassium fertilizer increased the stem diameter and enabled the growth of leucaena in a sandy soil condition with lower fertility in the long term, but the high rate of potassium fertilizer should be divided into two or more applications to enhance nutrient efficiency. This method would allow for the effective assimilation of potassium fertilizer by leucaena and avoid fertilizer loss due to leaching in sandy soil conditions.

In terms of fuel properties, the results of the five treatments provided calorific values between 4.33 and 4.39 kcal g^{-1}, which is close to sawdust (heating value of 4.77 kcal g^{-1}) (Wangkhamchan and Thitima, 2018). The results of this experiment suggested that the ash content of leucaena wood was not affected by the application of different rates of potassium fertilizer and was less than the ash content of rice husk, rice straw, sugarcane leaf, and bagasse (Energy for Environment Foundation, 2006). Ash content is an important component of biomass related to burning ability and calorific value, and affects thermal chemical processes (Obernberger *et al*., 2006). High ash contents can reduce calorific values (Lewandowski and Kicherer, 1997; Bakker and Elbersen, 2005), and high ash content can also affect equipment efficiency and production costs (Kocourkova *et al*., 2006). The leucaena wood had a carbon content of between 44.8% and 45.1%, less than rice husk (37.5%) and rice straw (38.2%) (Energy for Environment Foundation, 2006).

The hydrogen content of the leucaena ranged from 6.9% to 7.2%, which was higher than other biomasses, such as rice husk and rice straw (<5.1%) (Energy for Environment Foundation, 2006). The application of potassium fertilizer tended to decrease the nitrogen content of the leucaena wood. However, the nitrogen contents were 0.52% to 0.75% higher than those reported for leucaena by Rengsirilkul *et al*. (2011), and nitrogen contents exceeding 0.6% create toxic nitrous oxide (Obernberger *et al*., 2006). The application of potassium fertilizer reduced the sulfur content of the leucaena biomass. Fuelwood with high sulfur contents is not appropriate feedstock for biomass power plant because of the sulfur dioxide they emit during burning and their reduced heating value. The leucaena wood in the present study had low sulfur content of <2% compared to The Department of Industrial Work (2011). The application of potassium fertilizer did not increase the phosphorus content of the leucaena wood above the standard (1%) (Obernberger *et al*., 2006). A phosphorus content exceeding this affects the quality of combustion and causes a decrease in the melting point temperature of ash content (Steenari *et al*., 2009). The results of the present study indicate that the potassium content of leucaena wood showed a non-significant increase with increased rates of potassium fertilizer application. However, all the application rates in this study resulted in potassium contents lower than the guideline value of ≤7% (Obernberger and Thek, 2004). If the biomass contains >7% potassium, the melting point of ash increases in adherence to the combustion system and boiler requirements (Obernberger and Thek, 2004). In general, the fuel properties of leucaena wood grown following the application of potassium fertilizer are appropriate for use as a fuel crop.

An application rate of 187.5 kg ha^{-1} potassium fertilizer was found to be the optimum for the growth, biomass yield, and fuel properties of the leucaena. Increasing the application rate to 375 and 750 kg ha^{-1} slightly increased the growth rate and biomass yield compared to the application rate of 187.5 kg ha^{-1}, but this was not a significant difference.

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