Carbon content in various parts of 5 para rubber clones (*Hevea brasiliensis*)

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ABSTRACT: This work aims to provide information about carbon content in various parts (root, trunk, branch and leaf) of 5 para rubber clones (RRIT 251, PB 260, RRIM 600, RRIT 408 and BPM 24). The 5x4 factorial in randomized complete block design was used. The experiment was done at NongKhai Rubber Research Station between June to September 2017. The trees were cut then measured trunk height and gird at 150 cm. The carbon analysis was done by the Carbon/Nitrogen Determinator Analyzer. Analysis of variance was used to determine different between clones and carbon content in different parts. The result found thatno difference in carbon content between clones (P>0.05). The average carbon content for all clones was 44.01%. The carbon content difference between parts (P<0.01) was found. The leaf was found highest carbon content, followed by trunk and branch. The root was found lowest carbon. The partition of carbon to trunk, root, branch and leafwas 44.03%, 28.05%, 17.41% and 10.51% respectively. The interaction between clone and parts in carbon content was not found.This informationis useful for the one who like to find carbon stock in para rubber tree which can be calculate from biomass using result from this experiment.
Keywords: para rubber, carbon content, carbon partition

Introduction

The Para rubber tree *(Hevea brasilliensis*) is one of the most important industrial crops, especially for Thailand, Indonesia and Malaysia. The Para rubber tree has high biomass, high growth rate and strong potential of carbon storage (Charoenjit, 2015; Bangjan and Yingjajaval, 2006; Saengruksawong, 2013). Latex yield harvested from Para rubber tree is mostly used in the tire industrial. Rubber estate owners, managers, rubber tree breeders and researchers need basic data of not only rubber yield but also tree growth, biomass production and carbon partitioning. The information is essential for them to understand the mechanics of the rubber yield, to develop new agricultural technologies and breed tree with increased yield (Sone et al. 2014). The Para rubber tree absorb CO2 by the photosynthesis process then turn it in to biomass. The rubber plantation could play an important role in carbon budget and thus be part of the Clean Development Mechanism (CDM) of the Kyoto Protocol (Charoenjit, 2015). Carbon stock in rubber tree is important for growth and production also for carbon credit.

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Carbon stock can be estimate at plantation level using remote sensing data (Charoenjit et al., 2013).At tree scale, it can be estimated from biomass. Because it lacks information about carbon content at tree scale, especially Ain different parts of rubber tree and the different in carbon content in different clones. Researcher usually assumed the carbon content in the biomass e.g. 50% of biomass (Sone et al., 2014). This work aims to provide information about carbon content in various part of the rubber and the different in the clone. This information is useful for the one who like to find carbon stock in para rubber tree which can be calculate from biomass using result from this experiment.

Materials and Methods

The experiment was done on 5-year-old para rubber treesplanted in the NongKhai Rubber Research Center (NRRC), Rattanawapee district, NongKhai province, Thailand (18°09' N, 103°10' E; 178 m AMSL; Soil Type: Sandy loam) between June to July 2017. The 5x4 factorial in randomized complete block design was used. The first factor was the clones. (i.e. RRIT 251, PB 260, RRIM 600, RRIT 408 and BPM 24). The second factor was the plant part (i.e. root, trunk, branch and leaf). The three different size (i.e. large medium and small) of rubber trees per clone were used as block.

The trees were cut then the trunk height and girth were measured. The various components of rubber clones were separated into 4 parts, including roots, trunk, branches and leaves. The roots were divided into 3 levels diameter, i.e.<1 cm, 1-5 cm and >5 cm. The roots were clean and desiccate at room temperature. The trunk was cut for every 100 centimeters. The branches were divided into levels, i.e. 1st, 2nd, 3rd, 4th and 5th branches, respectively. The leaves were separated in to level form the 1st, 2nd, 3rd, 4th and 5th branches. The roots, trunk and branches were cut into small pieces less than 5 cm. The sawdust was kept after cut into pieces separated for each part for carbon analysis. All biomass (root, trunk, branches and leaves) were dried in a hot air oven at 70 °C until unchanging for dry weight. The biomass of each part (root, trunk, branch or leaf) were samples from its levels by proportion of dry weight, mixed and then crushed to have diameter size less than 0.2 millimeters for carbon analysis. The carbon analysis was done by the CN 628 Series, Carbon/Nitrogen Determinator Analyzer (LECO Instruments (Thailand) Ltd.).

The differences between rubber clones for each plant part were tested by analysis of the variance (ANOVA) and the significance was represented by the p-value. The least significant difference (LSD) was used to compare the mean (significant for p-value < 0.05). The means and standard errors were computed.All statistical analysis was performed by SAS University Edition.

Results and Discussion

The girth at 150 cm height, trunk height and total dry weight of all sample trees were shown in **Table 1**. The trunk height of the tree was ranged between 420 to 863 cm. The girth ranged between 14.6 to 29.5 cm. Total dry weight ranged between 11.5 to 40.57 Kg.

The gird of RRIM600in this experiment was close to 4-year-old rubber grown in Northeast of Thailand reported by Bangjan and Yingjajaval (2006). The tree seems to be 1 year smaller than what it should be. This may case by the planting space smaller (4x4m) compare to 7x3m in commercial farm.

Table 1 The girth at 150 cm height, trunk height and total dry weight of 5 para rubber clones (5-year-old)

Clones	Replication	Trunk height (cm.)	Girth at 150 cm height (cm.)	Total dry weight (kg)
RRIM600	1	863	28.4	40.57
RRIM600	2	693	25.5	29.95
RRIM600	3	580	21.0	15.88
RRIT251	1	800	29.5	35.89
RRIT251	2	690	26.3	27.16
RRIT251	3	689	23.3	24.89
RRIT408	1	640	17.6	11.61
RRIT408	2	487	15.5	11.50
RRIT408	3	530	15.5	8.39
BPM24	1	630	17.5	21.21
BPM24	2	420	14.6	11.53
BPM24	3	490	17.3	11.51
PB260	1	636	20.6	18.04
PB260	2	610	17.2	12.66
PB260	3	663	20.8	12.40
Average		628.07	20.71	19.55

Carbon content in various part of 5 para rubber clones RRIM600, RRIT251, RRIT408, BPM24 and PB260 was shown in **Table 2**. It was found to have ranged between 37.22 to 47.46%. The difference between clones was not significant (P=0.8839). The average carbon content for all clones was 44.01%. The difference between parts was significant (P<0.01). The leaf was found to have highest carbon content 46.72%, followed by trunk and branch 44.74 and 44.09% respectively. The root was found to have lowest carbon content 40.49% (**Table 2**). The average carbon content found in this experiment was lower than value 50% which was used by Sone et al. (2014) to calculate carbon content from biomass.

Table 2 The carbon content (%±SEM) in various part of 5 Para rubber clones

Rubber Clones	Carbon content (%)					
	Root	Trunk	Branch	Leaf	Average	P-value
RRIM600	40.43±0.42	44.13±0.17	44.54±0.21	46.81±0.22	43.98	0.8839
RRIT251	37.22±0.80	45.92±0.49	44.42±0.36	47.46±0.16	43.75	
RRIT408	41.87±0.42	45.05±0.38	43.95±0.27	46.40±0.15	44.31	
BPM24	41.40±0.27	44.29±0.11	44.00±0.15	47.06±0.26	44.19	
PB260	41.51±0.30	44.34±0.19	43.53±0.27	45.84±0.19	43.80	
Average	40.49[c]	44.74[b]	44.09[b]	46.72[a]	44.01	
P-value	<0.01*					

[a-c] Means followed by different letters were significantly different (P<0.01)

The carbon in various part of 5 para rubber clones was ranged between 1.43 to 3.51 kg for root. The trunk ranged between 2.04 to 5.71 Kg/tree. The branch and leaf ranged between 0.69 to 2.97 kg and 0.45 to 1.12 Kg/tree, respectively. The average total carbon for all clones was 8.44 kg/tree. (**Table 3**)

Table 3 The carbon partition (Kg/tree±SEM) in various parts of 5 para rubber clones

Rubber Clone	Carbon partition (kg/tree)				
	Root	Trunk	Branch	Leaf	Total
RRIM600	2.79±0.31	5.66±0.56	2.97±0.38	1.12±0.29	12.54±0.78
RRIT251	3.51±0.40	5.71±0.37	2.63±0.20	0.75±0.07	12.61±0.56
RRIT408	1.43±0.22	2.04±0.18	0.69±0.16	0.45±0.07	4.62±0.31
BPM24	1.84±0.25	2.58±0.38	0.90±0.20	0.92±0.22	6.25±0.49
PB260	1.84±0.20	2.74±0.28	0.80±0.22	0.82±0.17	6.20±0.38
Average	2.28±0.07	3.75±0.10	1.60±0.07	0.81±0.04	8.44±0.14

The interaction between clone and parts in carbon content was not found. This mean that the carbon content proportion in different clones are in the same proportion. The partition of carbon into various parts of 5 clones para rubber tree was found to have highest carbon partition to trunk, followed by root, branch and leaf, respectively. The carbon partition was 44.03%, 28.05%, 17.41% and 10.51% for trunk, root, branch and leaf, respectively. (**Figure 1**) The trunk has highest carbon partition according to high biomass partition to the trunk (Banjan and Yingjajaval, 2006).

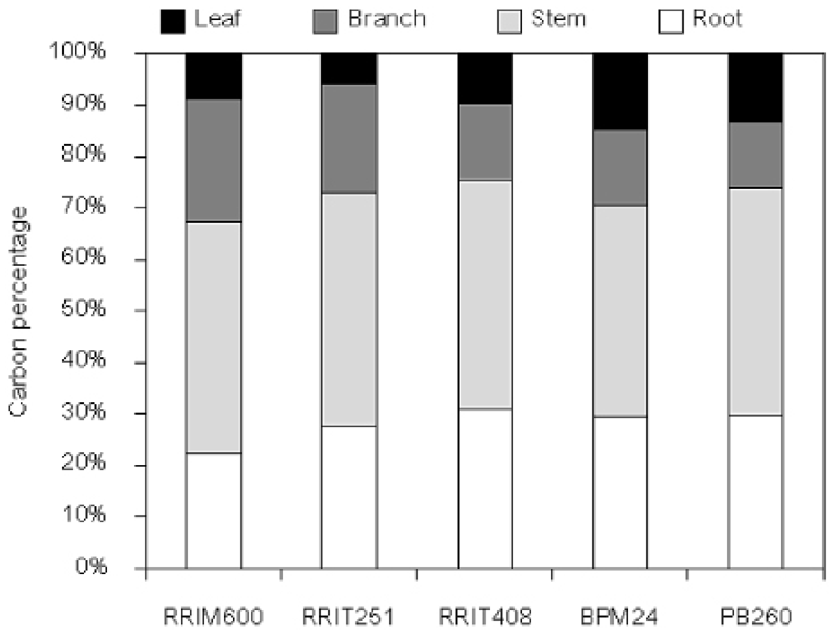

Figure 1 Partition of carbon into various parts of 5 clones para rubber clones

Conclusions

This work aims provide information about carbon content in various part of the rubber and the different in the clone. The 5 para rubber clones were RRIM600, RRIT251, RRIT408, BPM24 and PB260. The difference in percent carbon content between clones was not significant. The average percent carbon content for all clones was 44.01%. The difference between parts was found. The leaf was found to have highest carbon content 46.7%, followed by trunk and branch 44.74 and 44.09% respectively. The root was found to have lowest carbon content 40.49%.The partition of carbon to various parts was 44.03%, 28.05%, 17.41% and 10.51% for trunk, root, branch and leaf, respectively.

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