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NUTRIENT CONTENT IN DURIAN (*DURIO ZIBETHINUS* L.) BRANCH BARK

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Abstract: Durian (*Durio zibethinus* L.) fruit form on the bark of branches. The aim of our research was to assess whether branches bearing different number of fruits have different nutrient contents in their bark. We determined the nitrogen (N), phosphorous (P), potassium (K), and carbon (C) content in branch bark 30 days after fruit set using branches bearing different number of fruits per panicle (0, 1, 2 or >2) of two varieties ('Otong' and 'Kani'). Bark was cut into 0.03 m long and 0.005 m wide segments with an average thickness of 0.00085 m. The bark of branches bearing a different number of fruits had the same N, P, K, and C content but different ratios of C/N, C/P, C/K, N/K, and P/K. The bark of 'Otong' branches had a higher N content but a lower C/N ratio than 'Kani' bark.

Keywords: durian, bark, nutrient, 'Otong', 'Kani'.

Introduction

Durian (*Durio zibethinus* L.) flowers are not terminal but form directly on the bark of branches. Consequently, to assess the link between nutrient content and fruiting quality, this study aimed to assess the content of key nutrients in the bark of durian branches. SAKHIDIN (2008) noted that the N and C content in the bark of durian branches, rather than leaves, influenced flower induction.

'Otong' and 'Kani' are two of the most important durian varieties in Central Java, Indonesia [DIRECTORATE OF FRUIT CROPS, 2008]. Flowering induction, fruit set, and fruit growth need a certain content of nutrients. VEMMOS (1995) stated that the carbon to nitrogen ratio (C/N) affects flowering and fruiting. A low carbohydrate concentration in trees caused by shading reduced flower number in *Lantana camara* L. [MATSOUKIS & al. 2003]. WU & al. (2013) stated that a high starch concentration in branches before flower formation and a high soluble sugar concentration during flower bud formation might benefit flower bud formation in carambola (*Averrhoa carambola* L.), which yields star fruit.

An insufficient supply of assimilates causes fruit abscission [BANGERTH, 2000]. In durian leaves and the bark of branches, nutrient content is relevant for the identification of nutritional deficiencies, imbalances or excesses. In durian, the highest C/N ratio was observed in a treatment that induced off-season flowering [SAKHIDIN, 2008].

Materials and methods

This research was conducted in a durian orchard that belongs to a farmer located in Pageralang Village, Kemranjen District, Banyumas Regency, Central Java, Indonesia from 15 September until 15 December 2013, at 45 m above sea level. The research

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materials were 12-year-old durian trees of two varieties, namely ‘Otong’ and ‘Kani’. The study was conducted as a completely randomized design in which the first factor was variety while the second factor was the number of fruits per panicle (0, 1, 2, and >2). There were eight treatment combinations with four replications, so a total of 32 durian trees.

To analyze the N, P, K, and C content, branch bark was removed from the 32 trees when the fruits were 30 days old after fruit set. Analysis of N content was conducted by the KJELDAHL (1983) method. P and K content were determined by spectrophotometry, P content with a UV mini-1240 UV-Vis spectrophotometer at λ = 430 nm (Shimadzu, Kyoto, Japan), and K content with a Polarized Zeeman Automatic Absorption spectrophotometer at λ = 768 nm (Hitachi, Tokyo, Japan). C content was determined by the WALKLEY & BLACK (1934) method with a UV mini-1240 UV-Vis spectrophotometer at λ = 560 nm.

Bark at the bottom of each horizontal branch located between fruit and the leaf, at about 1 m from the main trunk and about 3 m above ground level, was cut into a segment 0.03 m long and 0.005 m wide (average thickness was 0.00085 m). Bark was dried at 60°C for 48 h in an oven. Data were analyzed using analysis of variance (ANOVA) with the statistical program SAS version 9. Following ANOVA, means were separated using Duncan’s multiple range test and the *t*-test at $p<0.05$.

Results and discussion

The N, P, K, and C content in the bark of branches was statistically similar for all of the number of fruits per panicle (Tab. 1). Both varieties showed variation in N content in the bark, but no variation in P, K, and C content. Table 2 indicates that the branches bearing different numbers of fruit per panicle showed variation in the C/N, C/P, C/K, N/K, and P/K ratios, but not the N/P ratio. The C/N ratio of both varieties was significantly different (Tab. 2).

N, P, K, and C content

Table 1 shows that branches bearing different number of fruits per panicle had the same N, P, K, and C content in the bark. This result is in contrast with a claim made by HUETT (2000) that the productivity of horticultural crops is dependent on an adequate N status because photosynthetic capacity is dependent on leaf N content per unit area. URBAN & al. (2004) reported that fruit set was associated with a decrease in leaf carbohydrate concentration, probably as a consequence of an increased demand for both N and energy of the developing fruits.

TAHIR & HAMID (2012) showed the highest content of N, P, and K (1.67%) in the leaves of guava (*Psidium guajava* L.) plants when all fruits were removed, i.e., fully thinned. UPRETI & al. (2013) and DAVENPORT (2009) stated that a high C/N ratio was required for floral initiation in mango. As reproductive growth is a developmental event that requires high energy, flowering requires a large supply of carbohydrates [SANDIP & al. 2015]. In mango, the accumulation of carbohydrates and N in leaves is positively associated with flower bud initiation and differentiation [KUMAR & al. 2013].

Ratio of C/N, C/P, C/K, N/P, N/K and P/K

Table 2 shows that the highest C/N ratio (60.18) was achieved when there was one fruit per panicle, but this ratio was not significantly different to the C/N ratio when there were no fruits or more than two fruits per panicle, which shows that C in the bark of branches is needed for fruit development. A lower – but insignificant – C content in branch bark was due to the absence of fruits or the presence of too many fruits. The highest C/P ratio was achieved when there were >2 fruits per panicle, but this was not significantly different to the C/P ratio when there were no or one fruit per panicle. ELKHISHEN (2015) reported that an increase in the C/N ratio led to improved fruit retention.

THAMRIN & al. (2009) showed that increasing C/N ratio by bark strangulation increased fruit set of pummelo (*Citrus grandis* (L.) Osbeck). A high C/N ratio in durian bark can increase fruit set in response to water stress in off-season production [SAKHIDIN, 2008]. The highest C/K, N/K, and P/K ratios occurred when there were no fruits on the panicle (Tab. 2). This implies that there was a relatively lower K content in the bark of branches without fruit and a relatively higher C, N, and P content than other fruit densities, although differences were not significant (Tab. 1). LOVATT & al. (1988) also proposed that in citrus, N and carbohydrates serve as substrates for the synthesis of key metabolites that act alone or work with plant hormones to initiate the flowering process.

'Otong' showed a higher N content and lower C/N ratio in the bark of branches than 'Kani', leading to a 5.50% and 11.94% fruit set, respectively (Tab. 1). A higher C/N ratio in 'Kani' was attributed to higher fruit set [PEBRIYANTI, 2014]. HIMAWAN (2014) showed that these two durian varieties show differences in fruit drop, 66.67% in 'Kani' but 70.89% in 'Otong', possibly as a result of this difference in the C/N ratio of the branch bark. SANDIP & al. (2015) and KUMAR & al. (2013) showed that the C/N ratio differed during shoot growth in mango varieties, which reveals its dependence on environmental conditions and prevailing metabolic balance.

Tab. 1. N, P, K, and C content (%) in bark of branches with different numbers of fruit per panicle of two durian varieties

		N	P	K	C
Number of fruits per panicle*	0	0.763 a	0.908 a	0.704 a	40.437 a
	1	0.729 a	0.874 a	0.818 a	41.240 a
	2	0.891 a	0.987 a	1.044 a	38.752 a
	>2	0.720 a	0.806 a	1.016 a	37.370 a
Varieties**	'Otong'	0.879 a	0.878 a	0.927 a	40.405 a
	'Kani'	0.672 b	0.910 a	0.864 a	38.494 a

*Means followed the same letter within each treatment are not significantly different (DMRT; 5%)
** Means followed the same letter within each treatment and variety are not significantly different (*t*-test; 5%)

Tab. 2. Ratio of C/N, C/P, C/K, N/P, N/K and P/K in bark of branches with different numbers of fruit per panicle of two durian varieties

		C/N	C/P	C/K	N/P	N/K	P/K
Number of fruits per panicle*	0	54.62 ab	49.19 ab	80.37 a	0.89 a	1.50 a	1.64 a
	1	60.18 a	49.94 ab	62.02 b	0.86 a	1.07 b	1.19 b
	2	49.37 b	41.72 b	43.84 c	0.89 a	0.89 b	1.07 b
	>2	54.19 ab	51.40 a	40.42 c	0.95 a	0.76 b	0.84 b
Varieties**	'Otong'	49.51 b	50.72 a	57.24 a	1.03 a	1.15 a	1.12 a
	'Kani'	59.68 a	45.41 a	56.09 a	0.76 a	0.96 a	1.25 a

Explanations as for Tab. 1.

Conclusions

The durian (*Durio zibethinus* L.) tree is unique in that it forms fruit directly on the bark of branches. This study found that there were no differences in the N, P, K, and C content of bark when there was no fruit, or even when more than two fruits per panicle, although C/N, C/P, C/K, N/K, and P/K ratios differed. Two varieties of durian were tested, and 'Otong' bark had more N than 'Kani' bark. The ability to develop fruit in durian might not depend on the levels of N, P, K, and C content, but rather on other factors.

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