

Nutrient Removal by Papaya Fruits¹

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Abstract. Nutrient analysis of harvested papaya fruits from trees grown at Waimanalo, Oahu, Hawaii and at Malama-Ki, Puna, Hawaii showed the following descending order of removal: K, N, Ca, Mg, P. Quantities of N and K removed by Malama-Ki fruits represented 38 and 56%, respectively, of the amounts applied as fertilizer.

The nutrients in harvested fruits represent an important portion of that applied to a crop as fertilizer. Nutrients also occur in the vegetative parts of fruit crops but those removed by the harvested fruits represent a net loss from the plant-soil system. Loss of applied N and K may occur by leaching under heavy rainfall conditions or loss of N may result from volatilization during dry weather. Because it represents part of the nutrient balance sheet for a crop, a study of fruit nutrient removal yields information which, when combined with leaf analytical data, aids in the development of a fertilizer program. In the present study the quantities and proportions of 5 major nutrients, removed by harvested papaya fruits, were determined and the quantities of N and K recovered from the harvested fruits relative to the fertilizer applied, were estimated.

Seven papaya (*Carica papaya* L. cv. 'Solo') trees at the Hawaii Agricultural Experiment Station farms at Malama-Ki, Puna, Hawaii and 8 trees at Waimanalo, Oahu, Hawaii supplied the fruits for this study. Trees grew at Puna on an aa lava soil, an unweathered rocky soil belonging to the Lithosols group, which possesses excellent aeration but low cation exchange and buffering capacities, while those at Waimanalo grew on a silty clay soil, whose clay content is a mixture of hydrated halloysite and montmorillonite, and which possesses moderately high cation exchange and buffering capacities. Trees at Puna received a total of 8.667 lb. of 10-4-8 fertilizer (actual N, P, K analysis) applied at 6-week intervals, while those at Waimanalo received adequate fertilizer at 3-month intervals but the amount was not known precisely. Both plantings appeared normal and healthy.

Fruits at the mature-green stage were harvested from trees at Waimanalo and Malama-Ki on March 15, 1966, and April 26, 1966, respectively. A fruit from each tree served as a sample. A fruit was sliced into 8 longitudinal

pieces, and a piece was taken for chemical analysis. The flesh was separated from the seeds, the former was diced then both tissues were dried in a draft oven at about 70 C. The dry tissues were ground in a Wiley Mill and chemical determinations were then made on the ground material separately for each slice of fruit and each tissue. Results are expressed on the fresh weight basis.

Potassium concentration was higher in Waimanalo fruits, while N was higher in Malama-Ki fruits (Table 1). Table 1 also shows that all nutrient concentrations and particularly N and P, were higher in the seeds than in the flesh.

Harvested fruits from Malama-Ki and Waimanalo removed 0.3323 lb. and 0.2570 lb. of N, and 0.4057 lb. and 0.3815 lb. of K per tree, respectively, (Table 2). This means that harvested fruits removed N equivalent to 3.323 lb. and 2.570 lb., and K equivalent to 5.071 lb. and 4.769 lb. of 10-4-8 fertilizer per tree at Malama-Ki and Waimanalo, respectively.

When the ratios of the amount of each nutrient removed relative to the amount of nitrogen removed (Table 2) were ranked in descending order, the following result was obtained: K, N, Ca,

Mg, P. These ratios for papaya were in general agreement with some found for oranges (3, 4). They differed for those reported for apples (1, 5), peaches (5), plums (5), and pineapples (2), in which the P ratio ranked third after K and N ratios.

When the quantities of nutrients removed by Malama-Ki fruits were compared with the quantities applied in mixed fertilizer (8.667 lb. of 10-4-8 fertilizer), 38% of the N and 56% of the K were accounted for by the fruits. The N efficiency percentage of papaya was within the range reported for Florida citrus (20-40%) by Smith (4), but the K efficiency percentage found here was substantially lower than that (80%) reported by Smith (4). Leaching of the K-ion from the porous, rocky soil under conditions of heavy rainfall at Malama-Ki may have been the chief factor responsible for this difference.

Literature Cited

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Table 1. Moisture and nutrient composition of papaya seeds and flesh.

Locality	Part of fruit	Weight		% Fresh weight				
		(g)		Moisture	N	P	K	Ca
Malama-Ki	Seeds	50.1±	6.3	81.6±0.6	.84±.12	.105±.003	.37±.01	.20±.01
	Flesh	517.4±52.7		86.2±0.5	.12±.01	.017±.001	.21±.01	.03±.0
Waimanalo	Seeds	56.0±	4.3	82.6±0.4	.76±.07	.094±.002	.42±.01	.18±.02
	Flesh	457.4±11.4		88.5±0.6	.11±.01	.017±.002	.25±.01	.06±.01

Table 2. Quantities of nutrients removed by harvested papaya fruits from a tree in a year and the ratios of each nutrient when N is 1.00.

Locality	Nutrients	Lb./tree ^x per year	Ratio, N=1.00
Malama-Ki	N	.3323	1.00
	P	.0448	0.13
	K	.4057	1.22
	Ca	.0815	0.24
	Mg	.0474	0.14
Waimanalo	N	.2570	1.00
	P	.0361	0.14
	K	.3815	1.48
	Ca	.1038	0.40
	Mg	.0361	0.14

^xYield Malama-Ki - - 181 lb./tree per year.
Waimanalo - - 142 lb./tree per year.

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