

SECTION 1

COST DATA – Nitrogen, Phosphorous, and Potassium Uptake by Plants

Table 1: Crop uptake and general nutrient recommendations for crops grown in the Caribbean Area										
Crop	Crop uptake				Nutrient recommendation ¹					
	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
Horticultural										
Tomatoes ²	180	21	280		155	41, 67	66		35000	N applied via drip irrigation. Apply low P or high P levels if soil test P is in high or lower soil test categories, respectively. Apply K level if soil level is in medium or lower test categories.
					103					Apply this N amount pre-plant, and sidedress at flowering.
Peppers ²	140	12	140		155	41, 67	25,30		25000	N applied via drip irrigation. Apply low P and K or high P and K levels if soil test is in high or lower soil test categories, respectively.
					103					Apply this N amount pre-plant, and sidedress at flowering.
Cucumber	45	36	71	26710	155, 206	23	43		24750	N: Apply this amount by fertigation. Apply low or high N levels if soil total N test is in high or lower test categories, respectively. 50 lbs. of N can be applied pre-plant. P and K, apply this amount pre-plant if soil test P and K are medium or low.

Crop	Crop uptake				Nutrient recommendation					
	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
EGGPLANT					103	21, 103	21, 129		25000	Apply this N amount pre-plant, and sidedress at flowering. Apply low P and K or high P and K levels if soil test P and K are in high or lower test categories, respectively.
Sweet Pepper					103	44	68		8750	Apply this amount split in 6 applications via drip irrigation at 2-week intervals.
					50	22	33			Apply this amount as pre-plant. Not fertigated field applies this amount as sidedress at flowering and harvesting.
Beans ³	90	16	179	890	21-31	0-4; 9-13; 15-25	0-18; 30-47; 64-94		2100	N: apply this amount pre-plant and at flowering. P and K: Apply these amounts when P and K levels are in the high, medium, and low categories, respectively.
Coffee ⁴	228	17	205	2000					2000	
Coffee year					91 - 137	39 - 59	38 - 57	17 - 25 Mg		Total amount split into 4 applications using complete fertilizer mixture when soils is in low N, P, and K categories. High density (1815 pl./acre).
Coffee year 1					56 - 82	24 - 35	23 - 34	10 - 14 Mg		Total amount split into 4 applications using complete fertilizer mixture when soils is in low N, P, and K categories. Low density (1089 pl./acre).

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	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
Coffee year 2					182 - 228	78 - 98	121 - 149	33-41 Mg		Total amount split into 4 applications using complete fertilizer mixture when soils is in low N, P, and K categories. High density (1815 pl./acre).
COFFEE YEAR 2					109 - 137	47 - 59	73 - 91	20-25 Mg		Total amount split into 4 applications using complete fertilizer mixture when soils is in low N, P, and K categories. Low density (1089 pl./acre).
Coffee year 3					307 - 409	44 - 59	254 - 336	37-49 Mg		Total amount split into 3 applications using complete fertilizer mixture when soils is in low N, P, and K categories. High density (1815 pl./acre).
Coffee year 3					184 - 245	27 - 35	154 - 204	23-30 Mg		Total amount split into 3 applications using complete fertilizer mixture when soils is in low N, P, and K categories. Low density (1089 pl./acre)
Coffee year 4					409 - 819	59 - 117	336 - 680	47-98 Mg		Total amount split into 3 applications using complete fertilizer mixture when soils is in low N, P, and K categories. High density (1815 pl./acre).
Coffee year 4					245 - 491	35 - 70	204 - 408	30-59 Mg		Total amount split into 3 applications using complete fertilizer mixture when soils is in low N, P, and K categories. Low density (1089 pl./acre).
Cabbage	90	13	100	30000 ⁵	103-155	43	66		35000	Split apply this amount (post-plant and during head cabbage formation) if soil N level is under high test category. Apply P and K amount if soils test level is not in high categories.
	268	27	205	62000 ⁴						
Pigeon Peas										Crop does not respond to fertilizer application in most fertile soils.

Crop	Crop uptake				Nutrient recommendation						Comments
	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)		
	lbs./acre/year				lbs./acre/year						
Watermelon	40	5	54	10000 ⁵	88-103	24, 44, 67	85, 129, 171		24000	N: Split apply this amount pre-plant, and 1 month after transplanting. N, P and K: apply this amount when soil test is in high, medium or low category, respectively.	
	64	9	96	16000 ⁴							
Pumkin ⁵	96	11	93	24000	103 - 155	44	66		24000	Apply this N amount pre-plant, and during the first 1.5 months after transplant. Apply P and K amounts if soil test P and K are in the low category.	
Sweet Corn ²	155	20	105	8000							
Lettuce ²	107	13	191	36000							
Onion					155, 206	23	43		24750	N: Apply this amount by fertigation; Apply low or high N levels if soil total N test is in high or lower test categories, respectively. 50 lbs. of N can be applied pre-plant. P and K, apply this amount pre-plant.	

Crop	Crop uptake				Nutrient recommendation					
	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
Fruits										
Mango ⁶	93	11	88	14256						
Mango 6 months					3-7	1-2	2-4			Apply low and high level amount in low (41 pl./acre) and high density (109 pl./acre), respectively.
Mango year 1					13-20	3-4	9-14			Apply low level early in the year and high level six months later. High density (109 pl./acre).
Mango year 1					5-7	1-2	3-5			Apply low level early in the year and high level six months later. Low density (41 pl./acre).
Mango year 2					26-33	6-7	18-23			Apply low level early in the year and high level six months later. High density (109 pl./acre).
Mango year 2					10-12	2-3	7-9			Apply low level early in the year and high level six months later. Low density (41 pl./acre).

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	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
MANGO YEAR 3					39-46	9-10	27-32			Apply low level early in the year and high level six months later. High density (109 pl./acre).
Mango year 3					15-17	3-4	10-12			Apply low level early in the year and high level six months later. Low density (41 pl./acre).
Mango year 4					52-59	12-13	36-41			Apply low level early in the year and high level six months later. High density (109 pl./acre).
Mango year 4					20-22	4-5	14-15			Apply low level early in the year and high level six months later early. Low density (41 pl./acre).
Mango year 5					65-72	15-16	45-50			Apply low level early in the year and high level six months later. High density (109 pl./acre).
Mango year 5					25-27	5-6	17-18			Apply low level early in the year and high level six months later. Low density (41 pl./acre).
Mango + 8 years					25-75	5-15	17-51			Total amount applies using a complete fertilizer mixture. High density (109 pl./acre). Amount level applies increases with production.

Crop	Crop uptake				Nutrient recommendation					
	N	P	P	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
Mango + 8 years					65-195	15-45	45-135			Total amount applies using a complete fertilizer mixture. Low density (41 pl./acre). Amount level applies increases with production.
PAPAYA ⁷	156	18	187	80000	23	10	19		121,500	Apply this amount after transplant.
					34,45,56	15,19,24	28,37,46			Apply this amount 1, 2 and 3 months after transplant, respectively.
					90	39	75			Apply monthly this amount from 4 - 14 months after transplant.
ORANGES ⁸	38	4	56	48000 var. Valencia						
Citrus year 1					34-19	15-8	23-12			Total amount split into 3 applications using complete fertilizer mixture. Apply high and low level to high density (222 pl./acre) and low density (121-pl./acre) density, respectively.
Citrus year 2-3					103-56	18-10	57-31			Total amount split into 2 applications using complete fertilizer mixture. Apply high and low level to high density (222 pl./acre) and low density (121-pl./acre) density, respectively.
Citrus year 4					206-274	35-47	114-152			Total amount split into 2 applications using complete fertilizer mixture. High density (222 pl./acre).

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	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
Citrus year 4					112-150	19-26	62-83			Total amount split into 2 applications using complete fertilizer mixture. Low density (121 pl./acre).
Citrus year 5					229-343	49-59	190-380			Total amount split into 2 applications using complete fertilizer mixture. High density (222 pl./acre).
Citrus year 5					125-187	27-32	103-207			Total amount split into 2 applications using complete fertilizer mixture. Low density (121 pl./acre).
Citrus year 6					274-412	59-71	228-456			Total amount applies using a complete fertilizer mixture. High density (222 pl./acre).
Citrus year 6					150-224	32-38	124-248			Total amount split into 2 applications using complete fertilizer mixture. Low density (121 pl/acre)
Citrus year 7					320-481	69-83	266-532			Total amount applies using a complete fertilizer mixture. High density (222 pl./acre).
Citrus year 7					175-261	37-44	145-290			Total amount split into 2 applications using complete fertilizer mixture. Low density (121 pl/acre).
Citrus year 8					366-553	79-95	303-607			Total amount applies using a complete fertilizer mixture. High density (222 pl./acre).
Citrus year 8					200-299	43-51	166-331			Total amount split into 2 applications using complete fertilizer mixture. Low density (121 pl./acre).

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	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
Citrus year 9					412-662	89-106	342-683			Total amount applies using a complete fertilizer mixture. High density (222 pl./acre).
Citrus year 9					225-335	48-58	186-372			Total amount split into 2 applications using complete fertilizer mixture. Low density (121 pl./acre).
Citrus year 10					457-731 (572-858)	98-118 (123-147)	380-759 (475-949)			Total amount applies using a complete fertilizer mixture. High density (222 pl./acre). Maximum level amounts reached after 10 years are in parenthesis.
Citrus year 10					249-374 (312-467)	54-64 (67-80)	207-413 (259-517)			Total amount split into 2 applications using complete fertilizer mixture. Low density (121 pl./acre). Maximum levels amount reached after 10 years are in parenthesis.
Pineapple ⁹	182	22	290	49005	300-399 (173)	21-32 (50)	207-248 (144)		48000	These nutrients are provided from complete fertilizer mixture recommended. Total amount split into 3 applications (1-2 months, 4-5 months and 8-9 months post-plant). The Land Authority producers in the north part of Puerto Rico use N, P, and K levels in parenthesis.
Avocado¹⁰	36	9	44	28800						

Crop	Crop uptake				Nutrient recommendation					
	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
Avocado year 1					13-9	3-2	7-5			Total amount split into 3 applications using a complete fertilizer mixture. Apply high and low level to high (70 pl./acre) and low (48 pl./acre) density, respectively.
Avocado year 2					17-25	4-6	9-14			Total amount split into 2 applications using a complete fertilizer mixture. High density (70 pl./acre).
Avocado year 2					12-17	2-4	6-10			Total amount split into 2 applications using a complete fertilizer mixture. Low density (48 pl./acre).
Avocado year 3					21-42	5-9	35-70			Total amount split into 2 applications using a complete fertilizer mixture. High density (70 pl./acre).
Avocado year 3					19-29	4-6	32-48			Total amount split into 2 applications using a complete fertilizer mixture. Low density (48 pl./acre).
Avocado year 4					42-56	9-12	70-93			Total amount split into 2 applications using a complete fertilizer mixture. High density (70 pl./acre).
Avocado year 4					29-38	6-8	48-64			Total amount split into 2 applications using a complete fertilizer mixture. Low density (48 pl./acre).
Avocado year 5					56-70	12-15	93-116			Total amount split into 2 applications using a complete fertilizer mixture. High density (70 pl./acre).

Crop	Crop uptake				Nutrient recommendation					
	N	P	K	Yield (Fresh weight)	N	P	K	Other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
Avocado year 5					38-48	8-10	64-80			Total amount split into 2 applications using a complete fertilizer mixture. Low density (48 pl./acre)
Avocado year 6					84-140	18-30	193-232			Total amount split into 2 applications using a complete fertilizer mixture. High density (70 pl./acre).
Avocado year 6					58-96	12-21	95-156			Total amount split into 2 applications using a complete fertilizer mixture. Low density (48 pl./acre).
Avocado + 10 years					140	30	232			Total amount split into 2 applications using a complete fertilizer mixture. High density (70 pl./acre).
Avocado + 10 years					96	21	156			Total amount split into 2 applications using a complete fertilizer mixture. Low density (48 pl./acre)
Agronomic										
Sorghum ⁴ (grain)	247	39	164	8000						
TOBACCO⁴	125	11	211	3000						
Rice ¹¹	110	22	116	5000	120	11	54		5000	Total amount split into two applications in soils with N, P and K low test categories.

Crop	Crop uptake				Nutrient recommendation						Comments
	N	P	K	Yield (Fresh weight)	N	P	K	other	Average Yield (Fresh weight)		
	lbs./acre/year				lbs./acre/year						
Sugarcane	105	23	185 ¹²		185-120	77-20	216-50			New seedlings; apply low or high levels if soil test are in high or lower test categories, respectively.	
	75	22	149 ⁵	100000	124 -144	0-66	0 –171			Suckers; apply low or high levels if soil test are in high or lower test categories, respectively.	
Grass ¹³				(Dry matter)							
GUINEA	288	44	362	22962	330-300	48-44	189-171			These nutrients are provided from complete fertilizer mixture recommended. Total amount split into 4 applications. Apply high level to hay green shop and low level to forage grazing. N, P, and K level are for low soil test categories. N level applies in hay and green shop may increase up to 600 lb./acre and P level up to 60 lb./acre.	
Napier	301	64	502	25908							
Pangola	298	47	356	23585							
Malojillo	306	43	382	23941							
CONGO	304	49	401	29815							
Star	345	58	418	25187							
Sorghum ⁴	196	29	235	14400							
Farinaceous											
Plantains ¹⁴	215	19	521		288	25	598	52 Mg		These nutrients are provided from complete fertilizer mixture recommended. Split this amount into four applications in soils with N, P and K low-test categories.	

Crop	Crop uptake				Nutrient recommendation					
	N	P	K	Yield (Fresh weight)	N	P	K	other	Average Yield (Fresh weight)	Comments
	lbs./acre/year				lbs./acre/year					
Bananas ¹⁴	247	20	633		264-432	19-31	548-896	52 Mg	26000-52000	
Yam	169	22	191	45924 ¹⁵ var. Florido	147-218	63-94	198-294		20000	These nutrients are provided from a complete fertilizer mixture recommended. Apply this amount in soils with N, P and K low-test categories, one month after seed sprout. Apply low N, P and K levels in low density (7260 pl./acre) and the high levels in high density (10890 pl./acre).
	105	106	142	28256 ¹⁶ var. Florido						
	190	17	199	52300 ¹⁷ var. Guinea						
Cassava ¹⁸	182	5	164	19808	30-40	13-17	50-66		30000	These nutrients are provided from a complete fertilizer mixture recommended. Split total amount in two applications (first and third month after after planted) in soils with N, P and K low test categories. Apply low N, P and K levels in low density (2723 pl./acre) and the high levels in high density (4840 pl./acre).

Crop	Crop uptake				Nutrient recommendation						Comments
	N	P	K	Yield (Fresh weight)	N	P	K	other	Average Yield (Fresh weight)		
	lbs./acre/year				lbs./acre/year						
Tanier	273	74	371	20827 ¹⁹ var. Blanca	88-138	19-30	110-171	16-25	8000	These nutrients are provided from a complete fertilizer mixture recommended. Apply this amount in soils with N, P and K low-test categories. Apply low N, P and K levels in low density (7000 pl./acre) and the high levels in high density (11000 pl./acre).	
	129	36	196	10071 ¹⁹ var. Kelly							
	111	13	139	var. Morada							
Sweet Potato					48-60	21-26	80-100		25000	These nutrients are provided from a complete fertilizer mixture recommended. Apply this amount in soils with N, P and K low-test categories.	
Caladium (Malanga)					80	34	108		16000	These nutrients are provided from a complete fertilizer mixture recommended. Apply this amount in soils with N, P and K low-test categories.	

SOURCES

- ¹ Data summarized from “Conjuntos Tecnológicos, University of Puerto Rico, Agricultural Experiment Station by Agronomist José A. Castro, USDA, NRCS and Dr. David Sotomayor, College of Agricultural Science, UPR, Mayagüez Campus.
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- ⁸ Tucker et al., 1995.
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- ²⁰ Vicente Chandler et al., 1982.