Research Note

MINERAL CONCENTRATION IN ARRACACHA PLANT PARTS[1,2]

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Recently Del Valle et al. (1995) reported that the tuber yield of arracacha (*Arracacia xanthorrhiza* Banc.) responds to levels of nitrogen fertilization. They also indicated a lack of response to phosphorus and potassium. Analysis of mineral concentration in plant tissue is often used as an aid for practical fertilization recommendations. Information regarding the effect of nitrogen fertilization on the mineral concentration of arracacha plant parts is scarce. The objective of this study was to determine the mineral concentration in arracacha tissues when plants were subjected to increasing levels of nitrogen fertilization. Details of the field materials and methods have been previously reported by Del Valle et al. (1995). The experiment was established in a Humatas series soil (Typic Tropohumults) with a pH of 5.5. Cultivar Criolla was used. The experimental design was a randomized complete block. A 5 × 3 × 2 factorial arrangement of level of nitrogen fertilization, plant part and sampling date was used. Treatment combinations were replicated four times. Nitrogen was supplied as ammonium sulphate at rates of 0, 90, 135, 179 and 224 kg/ha. All plots received the equivalent of 39.3 kg/ha of P, 74.7 kg/ha of K and 56 kg/ha of Mg. At 126 and 224 days after planting (DAP), two plants per plot were pulled from the soil, washed and divided in leaf laminas, leaf petioles and corms. Parts were oven-dried at 65°C to a constant weight, then ground.

For nitrogen and phosphorus determinations, samples were prepared by the wet ashing procedure (Campbell and Plank, 1992). After this procedure was completed, determinations were made colorimetrically using a continuous-flow segmented-stream autoanalyzer system.[6,7] Samples for potassium, calcium and magnesium were prepared by dry ashing and determined by spectrophotometry[7,8] (Campbell and Plank, 1992). Potassium was determined by the flame emission process, whereas calcium and magnesium were determined by atomic absorption. Mineral concentration was expressed as a percentage of the tissue dry weight.

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[6]Technicon™ AutoAnalyzer II. Technicon Industrial System, Tarrytown, NY.

[7]Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of materials or equipment by the University of Puerto Rico, nor is this mention a statement of preference over other materials or equipment.

[8]Perkin-Elmer 2380 Atomic Absorption Spectrophotometer, Perkin-Elmer, Norwalk, CN.

TABLE 1.—*Nutrient concentration in arracacha plant parts in increasing levels of N fertilization.*

	Plant Part						
	Leaf			Leaf			
N Level	Lamina	Petiole	Corm	Lamina	Petiole	Corm	
	% of dry weight						
kg/ha	N			P			Mg[1]
0	3.64	1.23	0.54	0.53	0.59	0.23	0.19
90	3.84	1.21	0.66	0.44	0.39	0.22	0.20
135	4.08	1.24	0.66	0.43	0.31	0.20	0.22
179	4.20	1.34	0.72	0.43	0.32	0.18	0.23
224	4.26	1.36	0.76	0.46	0.36	0.21	0.23
$LSD_{0.05}$		0.18			0.05		0.03
	K			Ca			
0	2.82	3.53	2.17	1.96	0.94	0.57	—
90	2.55	2.93	2.34	1.71	0.75	0.59	—
135	2.50	2.41	1.93	1.67	0.78	0.54	—
179	2.52	2.16	1.98	1.95	0.73	0.43	—
224	2.41	2.59	1.97	1.85	1.06	0.44	—
$LSD_{0.05}$		0.42			0.23		

[1]Interaction Plant Part X Level of N fertilization was non significant for Mg concentration.

There were significant plant part X level of nitrogen fertilization and plant part X sampling date interactions for nitrogen, phosphorus, potassium and calcium concentration. Only the main effects were significant for the concentration of magnesium. Within nitrogen levels, concentration of nitrogen, phosphorus, potassium and calcium in the corm was significantly lower than in the lamina (Table 1). Differences in mineral concentration among plant parts is usually attributed to organ function (Kowalenko, 1994; Fraizier et al., 1967). For nitrogen fertilization of 90 kg/ha or more, concentration of nitrogen, phosphorus and calcium in laminas was higher than in petioles. Magnesium concentration was higher in laminas (0.37%) and decreased significantly in petioles (0.16%) and corms (0.12%). Increasing the level of nitrogen fertilization above 90 kg/ha had no effect on the concentration of nitrogen, potassium and calcium in corms (Table 1). Nitrogen fertilization above 135 kg/ha had no effect on phosphorus or magnesium concentrations in any plant part. Fertilization with increasing nitrogen levels had no effect on nitrogen concentration in petioles nor on potassium concentration in laminas. In contrast, nitrogen concentration in laminas increased as level of nitrogen fertilization increased.

Except for calcium, there were no differences in the concentrations of minerals when the corm was sampled at 126 or at 224 DAP (Table 2). Concentrations of phosphorus and

TABLE 2.—*Nutrient concentration in arracacha plant parts at 126 and 224 days after planting.*

	Plant Part						
	Leaf			Leaf			
DAP[1]	Lamina	Petiole	Corm	Lamina	Petiole	Corm	
	% of dry weight						
	N			P			Mg[2]
126	4.13	1.50	0.71	0.41	0.35	0.22	0.20
224	3.90	1.10	0.62	0.51	0.44	0.19	0.24
$LSD_{0.05}$		0.11			0.03		0.02
	K			Ca			
126	1.40	1.98	1.97	1.84	0.69	0.85	—
224	3.60	3.47	2.19	1.80	1.02	0.17	—
$LSD_{0.05}$		0.26			0.15		

[1]DAP = days after planting.
[2]Interaction Plant Part X DAP was non significant for Mg concentration.

potassium in laminas and petioles were significantly higher at 224 than at 126 DAP. Magnesium concentration was also higher at 224 DAP irrespective of the plant part. These results indicated accumulation of P, K and Mg as the plant developed. In contrast to phosphorus and potassium, nitrogen was more concentrated at 126 than at 224 DAP in both laminas and petioles. Nitrogen is highly mobile in the plant; thus, concentration usually decreases in older leaves.

For the whole plant, mineral concentrations tended to be positively correlated (Table 3). The exception was potassium concentration, which was not correlated to nitrogen or calcium concentrations. However, many of the positive relationships became non significant in the individual plant parts, thus indicating less association when the parts are considered alone.

Many practical fertilization recommendations use the mineral composition of a plant part to assess the nutritional status of the crop at a given time (Kowalenko, 1994; Fraizier et al., 1967). Results of the present study suggest that leaf tissue, especially the lamina, has better potential than the corm as a plant part to be chosen for further studies in plant analyses as a guide for fertilization. Leaf lamina had higher concentration of minerals and was easy to sample. The mineral concentration in the leaf lamina of arracacha exhibits the same pattern as that reported for tanier by Goenaga (1994). Nitrogen and potassium concentration in the lamina tend to be higher than phosphorus and magnesium whereas concentration of calcium is intermediate among these groups. Since arracacha leaves grow and senesce sequentially, leaf position and age are variables that must be taken into account in further studies.

TABLE 3.—*Pearson correlation coefficients among nutrient concentration in the whole arracacha plant and within plant parts.*

Plant part	Concentration	Concentration			
		P	K	Ca	Mg
Whole Plant	N	0.61**	NS	0.84**	0.91**
	P		0.53**	0.60**	0.55**
	K			NS	0.20**
	Ca				0.81**
Leaf Lamina	N	NS	NS	NS	NS
	P		0.68**	NS	NS
	K			NS	0.41*
	Ca				NS
Leaf Petiole	N	0.32*	0.54**	0.45**	0.50**
	P		0.57**	NS	NS
	K			0.41**	NS
	Ca				0.43**
Corm	N	NS	NS	NS	0.39*
	P		NS	0.47**	NS
	K			NS	NS
	Ca				NS

*, **Significant at $P \leq 0.05$ and $P \leq 0.01$, respectively.

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