

Extraction of Potassium and Phosphorus by Mexican Yam Bean

By J.Z. Castellanos, V. Badillo and A. Sosa

A tuberous legume crop with high nitrogen (N) fixing capacity, Mexican yam bean (also called jícama) has great potential as a high protein food crop. It contributes N for subsequent crops, provided adequate phosphorus (P) and potassium (K) are supplied.

The Mexican yam bean (*Pachyrhizus ahipa* and *Pachyrhizus erosus*) is a tuberous legume crop cultivated in South America and Mexico. It has high yield potential (Heredia-Garcia, 1994), high nutritional value (Evans et al, 1977), as well as low N fertilizer requirement (Tamez, 1987) and pesticide requirements (Clausen, 1944). It has worldwide potential as a cultivated crop (Sorensen, 1994).

One significant advantage of these two crop species is their ability to produce high biomass through biological N fixation, thereby negating the need for N fertilizer applications (Kjaer, 1992). However, no studies have been conducted to measure N₂ fixation or the uptake of K and P. Our first objective was to measure both the percent N derived from the atmosphere (Ndfa) and the actual amount of N that was fixed by each species. The second objective was to measure the amount of K and P uptake by each species.

The plants were flower-pruned, as is normally practiced in Latin America. Harvesting was done 180 to 200 days after planting. Tuber fresh weight and moisture content and the dry (continued on page 4)

Nodulation is compared in two species of Mexican yam bean at 122 days after planting.



More About Our Cover Photo

The scene on our cover is in Tanah Datar, West Sumatra, Indonesia. Stover and pods of freshly harvested peanuts have been brought from the field to the house, where shelling takes place. The plant material will probably not be returned to the field.

The traditional fallow system is often not practiced in the region, so soils have become depleted of phosphorus (P). Farming is on steep slopes so erosion control, using simple contour strips, is part of the P capitalization approach.

PPI/PPIC programs are encouraging recapitalization of P in acid upland soils of Southeast Asia and other regions. Phosphorus fertilization is usually required before any response to potassium (K) is noted in these conditions. The article beginning on page 14 of this issue tells more about work with soil fertility in tropical uplands. BCI



weight of straw were determined after harvest. Samples of both roots and shoots were analyzed for total P and K content.

Tuber Yield and Nitrogen Fixation Capability of Mexican Yam Bean

Percent of Ndfa ranged from 55 to 70 for the *P. ahipa* cultivars and from 70 to 77 for the *P. erosus* cultivars (Table 1). The percentage Ndfa for the latter equals the best N₂ fixation capability of cultivated grain legumes (Peoples and Craswell, 1992; Castellanos et al,

Table 1. Tuber yield, nitrogen fixation and partitioning by yam bean cultivars.

Species/Cultivar	Tuber yield, t/ha	Nitrogen yield, kg/ha	Nitrogen fixed, kg/ha	N in crop residue, kg/ha	N content in crop residue, %	Net N ¹ balance, kg/ha
<i>P. ahipa</i> /cv AC-102	38	137	95	55	3.24	18
<i>P. ahipa</i> /cv AC-521	41	133	74	63	3.49	12
<i>P. erosus</i> /cv San Miguelito	103	247	175	150	3.45	73
<i>P. erosus</i> /cv San Juan	101	248	190	130	3.51	81
LSD (0.05)	11	37	30	21	NS	16
CV	10	12	14	13	9	22

¹Net N balance = N fixed minus N exported in the tuber.

Nitrogen content in the crop residue ranged from 130 to 150 kg/ha in *P. erosus* cultivars, more than twice that found in both *P. ahipa* cultivars. The concentration of N in the residue was very high, ranging from 3.24 to 3.51 percent N. High quality residue is a unique feature of Mexican yam bean, contributing significant quantities to the N nutrition of subsequent crops. The amounts of N fixed ranged from 74 to 95 kg N/ha and from 175 to 190 kg N/ha for *P. ahipa* and *P. erosus*, respectively. Positive net N balances ranged from 12 to 18 kg N/ha for *P. ahipa* and 73 to 81 kg N/ha for *P. erosus*...higher than those values found for most legume crops (Peoples and Craswell, 1992).

Potassium Removal by Mexican Yam Bean

The K content of tubers was 50 percent higher in *P. erosus* than in *P. ahipa*, a proportional difference similar to that for N between the two species. Potassium uptake ranged from 125 to 266 kg/ha and is high compared to other field crops, including potatoes (Table 2).

Table 2. Potassium content and uptake by yam bean.

Species/Cultivar	Tuber ¹ yield, t/ha	K content, % ²		K uptake, kg K ₂ O/ha		
		Tuber	Straw	Tuber	Straw	Total
<i>P. ahipa</i> /cv AC-102	38	0.96	1.54	94	31	125
<i>P. ahipa</i> /cv AC-521	41	0.99	1.56	92	34	126
<i>P. erosus</i> /cv San Miguelito	103	1.55	1.59	180	86	266
<i>P. erosus</i> /cv San Juan	101	1.56	1.80	161	80	241

¹Fresh weight.

²Dry weight basis.

Since farmers do not traditionally apply K to the yam bean crop, it is important to study the crop's response to fertilizer K inputs.

Phosphorus Removal by Mexican Yam Bean

The amounts of P in the tuber and straw components were relatively low, although P content was much higher in the above ground portion of the plant. The total P_2O_5 uptake by *P. erosus* was approximately 40 kg/ha, indicating a high demand for P (Table 3).



Mexican yam bean has potential as a cultivated crop in many areas of the world.

Table 3. Phosphorus content and uptake by yam bean.

Species/Cultivar	Tuber ¹ yield, t/ha	P content, % ²		P uptake, kg P_2O_5 /ha		
		Tuber	Straw	Tuber	Straw	Total
<i>P. ahipa</i> /cv AC-102	38	0.09	0.20	22	7	29
<i>P. ahipa</i> /cv AC-521	41	0.09	0.17	16	7	23
<i>P. erosus</i> /cv San Miguelito	103	0.11	0.16	23	16	39
<i>P. erosus</i> /cv San Juan	101	0.13	0.20	25	16	41

¹Fresh weight.

²Dry weight basis.

The results of this study indicate that these tuberous legume species have excellent potential as a high protein food crop and supplier of N to subsequent crops for agricultural systems used in tropical and semitropical regions, provided adequate P and K are supplied. **BCI**

Dr. Castellanos is Research Specialist (Investigador Especialista) in soils and vegetable nutrition with INIFAP in Mexico. Vicente Badillo and Anacleto Sosa are associated researchers in the program.

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