Plantain *(Musa accuminata x M. balbislana [AAB group])*

French: Plantain; Spanish: Plátano; German: Plantane, Kochbanane

Under Tropical/Subtropical Conditions

Crop data

Plantains (cooking banana) are closely related to the familiar dessert banana. In some respects they are more important than dessert banana because they are a staple diet in Southeast Asia, the Pacific Islands, Tropical America and Tropical Africa. The Cameroons, for example, produce taro, cassava and banana (including plantain) in approximately equal quantities, about 600 000 t each per year.

In some respects plantain seems to differ in nutrient requirements from dessert banana. The two crops also seem to differ in the way they respond to intensive management; and dessert bananas are often more productive through many successive crops, whereas successive yields of intensively managed plantains often decline rapidly.

Nutrient demand/uptake/removal

The following table is based on very limited data.

Nutrient uptake/removal - Macronutrients						
Production level	**kg/ha**					
	N	**P2O5**	**K2O**	**MgO**	**CaO**	**S**
Near maximum	250	46	702	100	252	24
Intermediate (75 %)	148	30	420	66	154	14
Low (50 %)	73	16	180	33	91	7
Source: Vicente-Chandler & Figurella, 1962; Del Valle et al., 1978; Fox et al., 1979						

Further data on contents of nutrients are given with "Fertilizer recommendations".

Plant analysis data

Plant analysis data - Macronutrients						
Production level	**% of dry matter (No. 3 leaf)**					
	N	**P**	**K**	**Mg**	**Ca**	**S**
Near maximum	3.4	0.19	3.5	0.25	0.7	0.26
Intermediate (75 %)	2.7	0.16	2.8	0.21	0.6	0.20
Low (50 %)	2.0	0.14	1.8	0.15	0.5	0.10
Source: Vicente-Chandler & Figurella, 1962; Del Valle et al., 1978; Fox et al., 1979						

Further "plant analysis data" is given with "Fertilizer recommendations".

Fertilizer recommendations

Plant nutrition problems may stem from a superficial and restricted root system - a problem of banana generally. However, reports frequently specify that the soil should be deep and fertile. Perhaps shallow rooting is as much a function of soil properties as it is of plant characteristics.

Fertilizer recommendations should be based on crop requirements for a particular expected yield, corrected for the ability of the environment to meet those requirements. But two

nutrients, N and K, are deficient for plantain growing in most soils. The quantity of N a soil can deliver to plantain can be estimated from the N taken up in a similar situation by a crop such as continuously-grown, minimum-till maize. N uptake by plantain is approx. 8 kg/t of fruit produced. Thus a yield of 30 t represents 250 kg of N removed (table nutrient uptake/removal) The deficit, uptake minus soil N delivered, should be supplied as fertilizer or manure, with allowance made for the inefficiency of the fertilizer and/or manure application.

The efficiency of N in the tropics is often approx. 50 %. In Hawaii (clay soil) estimates of N recovery in banana at harvest, in relation to N applied, were about 65 %. Probably much of the N was lost as volatilized ammonia resulting from spreading the fertilizer (urea) on dry ground and trash.

Dessert bananas, and probably plantain too, develop an effective mycorrhiza. The fungus-root association decreased the required concentration of P in soil solution from 0.1 mg/l to 0.05 mg/l. This is less than the required concentration for many vegetable crops and perhaps more than the requirement for maize. Such dilute solutions do not necessarily indicate low fertilizer requirements. Highly weathered, fine-textured soils of the tropics will typically require 100 to > 200 mg/kg P in soil to attain a sufficient P level for plantain. Such rates of phosphate are seldom used even in experiments. Thus reported fertilizer requirements are frequently low.

P percentage in plantain fruit is low and so also is the quantity of P contained in the fruit. P fertilizer required is more a matter of soil reactions with P than it is of crop need. Estimates of fertilizer requirements on a global scale demonstrate that Acrisols, Ferralsols and Andosols - important soils in the tropics - are high P-sorbing soils; the weighted mean P sorption is 900 kg/ha P_2O_5 to attain 0.02 mg P/l in solution. This is a little low for maximum plantain production.

Plantain is rich in K; a 30 t crop contains approx. 720 kg/ha K_2O of which 240 kg is removed in the fruit. Much of the remaining 480 kg should be available for a ratoon crop.

The requirement for S in plantain is approx. 7 % of the N requirement. However, S is taken up more sluggishly than N, and therefore should be supplied at approx. 10 % of the amount of N.

The following table is an example of estimated fertilizer requirements for plantain (plant crop) and the type of information needed to make reasonable estimates for specific locations. This example assumes yields of approximately 35 t/ha, typical fertilizer efficiencies for weathered soils, and low soil fertility. The table can be modified to suit local conditions and yield expectations by substituting more appropriate values for soil-supplied nutrients and fertilizer efficiencies. Such modifications depend on the amount of leaching reltive to expectation (based on rainfall-evaporation data, probability of N loss by NH_3 volatilization and denitrification, P and K sorption by the soil, S accretion via rainfall, etc.) The estimated N and K requirements are similar to the average fertilizer rates used in experiments that produced acceptable yields (average 34 t fruits/ha).

Estimated fertilizer requirements					
Plant crop	**N**	**P2O5**	**K2O**	**MgO**	**S**
Effective amounts from soil and rainfall (kg/ha)	60*	18**	216***	20	10
Total uptake by crop yielding 35 t/ha (kg/ha)	250	46	702	100	24
Balance to be obtained from fertilizer (kg/ha)	190	28	702	80	14
Assumed fertilizer use efficiency (%)	50	10	75	75	75
Amount to be provided in fertilizer (kg/ha)	380	280	648	107	19
Remark: Based on reasonable expectations of nutrient supplying power of wheathered soils, fertilizer efficiencies associated with moderate leaching, and plant uptake of nutrients associated with acceptable production of 35 t/ha of fruit.					
* Assume 0.15 % N, 4 % mineralization rate and 50 % efficiency.					
** Assume 10 t dry matter that is 0.1 % P and that this can be produced with no P fertilizer.					
*** Assume 0.15 meq exchangeable K/100 g soil which is 75 % available.					

Predicting fertilizer requirements for a ratoon crop is more uncertain than for a plant crop because of residual fertilizer effects and the efficiency of nutrient recovery from plant crop residues, which are difficult to evaluate. Soil contributions will usually decrease with time and residual fertilizer effects will increase if fertilizer is added in excess of crop removal. An evaluation of these residual effects requires estimates of nutrients removed in the fruit and long-term (residual) efficiencies of fertilizers. The first can be calculated from yield and composition data; the second is more in the realm of speculation, or at best, an educated guess. Such uncertainities notwithstanding, predicted requirements for a ratoon crop producing 35 t/ha of fruit are about 165 kg/ha N, 115 kg/ha P2O5, 288 kg/ha K2O, 40 kg/ha MgO and 25 kg/ha S.

These predictions are low in comparison with annual requirements (7-year average) for banana in Hawaii, but suitable data for ratoon plantain were not available for comparison. In the absence of specific data, local recommendations for dessert banana will be helpful.

Fertilizer requirements based on soil analysis have not been worked out for plantain as far, reference should be made to such worked out for banana.

Further reading

FOX, R.L.: Banana. In: PLUCKNETT, D.L.; SPRAGUE, H.B.(eds.): Detecting mineral nutrient deficiencies in tropical and temperate crops. Westview, Boulder, CO, USA (1989)

IRIZARRY, H.F. et al.: Nutrient uptake of intensively managed plantain as related to stage of growth at two locations. J. Agric. Univ. Puerto Rico 65, 331-345 (1981)