The effect of potassium application on tissue and soil K, and their relationship to yield of bananas (CV 'Dwarf cavendish').

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EFFET D'APPORTS POTASSIQUES SUR LES TENEURS EN K DES TISSUS ET DU SOL ET LEURS RELATIONS AVEC LE RENDEMENT DU BANANIER (cv. 'Dwarf Cavendish').
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RESUME - Dans une expérience à 7 niveaux de N et de K combinés en «fonction continue» (3 répétitions, 4 plants par parcelle), K a fortement augmenté le rendement sur 2 cycles tandis que N était inefficace. Aux deux cycles, échantillonnés après floraison, la teneur en K du limbe est mieux corrélée avec le rendement que celle de la nervure centrale. Cependant la nervure, ainsi que le sol, montrent au 1er cycle une relation quadratique rendant mieux compte de la courbe de réponse, qui se stabilise au-delà d'un certain maximum : le limbe ne révèle pas cette consommation de luxe. Au 2ème cycle, la teneur en K de la nervure a été considérablement abaissée par un stress hydrique, cas à éviter car source d'erreur dans l'interprétation des analyses. Celles-ci montrent que le niveau de K dans la nervure considéré comme satisfaisant serait peut-être 3,5 à 4,0 p. 100 au lieu de 3,0 à 3,5 p. 100. La corrélation entre K du sol et rendement est acceptable, bien qu'un léger effet dépressif se soit manifesté à partir de 200 ppm.

INTRODUCTION

As a result of the large variability in tissue sampling techniques for bananas as used by different research workers (MARTIN-PREVEL, 1977), it was decided to determine the effect of nitrogen and potassium on production of bananas, and to compare the midrib and lamina tissue sampled after flowering.

In order to obtain a reliable indication of the importance of these two elements for banana production as well as the optimum norms required in a particular tissue sample, a relatively large number of levels of both these elements had to be used.

MATERIALS AND METHODS

The experimental design used was the continuous function technique described by WARNER, FOX and PRASOMSOOK (1974). Seven levels each of N and K were used with four plants per plot and three replicates.

The tissue samples were taken from the middle portion

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of the midrib and the corresponding inner halves of the lamina. These were sampled from the third youngest leaf after flowering when the first two male hands were visible.

The soil on which this experiment was planted was a virgin red clay loam with a very low exchangeable potassium content. As the soil was cleared from indigenous bush before planting, it was reasonably high in organic material. Owing to this fact, no significant response to nitrogen was obtained. Therefore, only the potassium reaction will be discussed.

Experimental yields represented the total bunch mass including stalk. On average, it could be estimated that 85 to 88% of this mass were marketable fingers. Yields were taken for the plant and first ratoon crops.

During the development of the ratoon crop a severe drought was encountered and irrigation water was very limited. This could have had a marked effect on the yield as well as on the absorption and translocation of potassium.

RESULTS

The main effects of the seven levels of potassium on bunch mass are given in Table 1 for both the plant and first ratoon crops. Each value represents the mean of 21 plots.

Potassium applications had a considerable effect on yield as represented by bunch mass up to the K3 (600 g KCl/mat) for plant crop and K_4 (800 g KCl/mat) for the first ratoon crop.

The effect of the potassium treatments on the K-content of the various tissue samples and the exchangeable K in the soil are presented in Table 2.

TABLE 1 - The effects of increased K applications on yield.

(Bunch mass in kg)

K level (g KCl/mat/year)	Plant crop	First ratoon	P + R1 (mean)
K0 0	15,3 c	21,9 c	18,6
K1 200	19,1 b	23,3 c	21,2
K2 400	18,8 b	26,7 b	22,8
K3 600	22,2 a	28,6 b	25,4
K4 800	22,3 a	30,4 ab	26,4
K5 1 000	22,8 a	30,9 a	26,8
K6 1 200	22,3 a	31,7 a	27,0
Mean	20,4	27,6	24,0
L.S.D. (P = 0,05)	1,9	2,5	
(P = 0,01)	2,5	3,3	
CV (%)	15,4	14,9	

TABLE 2 - The effect of increased K applications on tissue and soil analysis.

K level	% K in lamina		% K in midrib		mg K/kg soil	
	Plant crop	First ratoon	Plant crop	First ratoon	Plant crop	First ratoon
K0	1,61 e	1,57 c	0,81 e	0,84 d	73	61
K1	2,12 d	1,81 c	0,96 e	0,94 d	100	79
K2	2,53 c	2,17 b	1,62 d.	1,33 c	102	105
K3	3,40 b	2,56 a	2,26 c	1,49 c	107	156
K4	3,91 a	2,59 a	2,79 b	1,85 b	114	138
K5	4,29 a	2,76 a	3,74 a	2,15 a	130	168
K6	4,10 a	2,76 a	3,51 a	1,89 b	139	203
Mean	3,17	2,32	2,24	1,50	109	130
L.S.D. (P = 0,05)	0,48	0,30	0,37	0,23		
(P = 0,01)	0,63	0,40	0,49	0,31		
CV (%)	25,1	23,6	27,5	25,9		

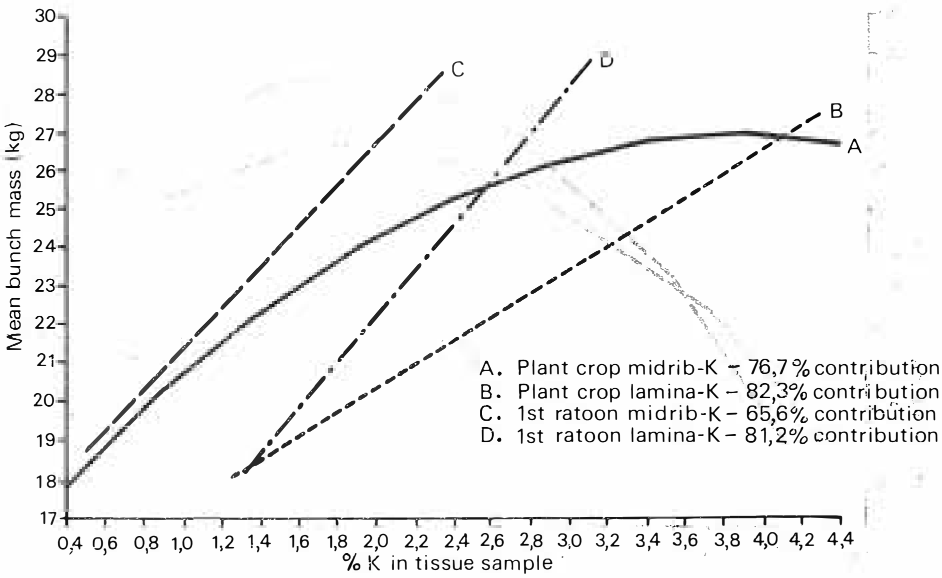

Figure 1 • THE EFFECT OF TISSUE K ON BUNCH MASS.

The variation between plots was reasonably high, resulting in fairly high CVs. Although the CVs were slightly higher in the case of the midrib samples, the increases due to treatments were larger. However, the drought during the development of the ratoon crop had a larger effect in reducing the midrib K than the lamina K.

The treatment effects on the soil K were quite marked especially in the ratoon crop analysis.

The main purpose of this experiment was to determine the relationships between tissue analysis and production. For this purpose the plot means were used and polynomial regressions determined. These are given in Figure 1.

As the drought had a very marked effect on the K content of the ratoon crop more attention should be given to the results of the plant crop (A and B in Fig. 1).

The K content of the lamina sample (B) contributed 82,3% to the increase in yield (R = 0,9072) while the midrib K contributed 76,7% (R = 0,8758). The fact that the lamina sample shows a linear effect is contradictory to the yield results which clearly have reached a peak. This would then mean that the lamina sample does not reflect excess K (luxury consumption) but is extremely suitable for deficiency conditions.

The relationship between the midrib K and yield on the other hand clearly shows that peak production is reached at approximately 3,4% K after which it levels off. This result is in good agreement with the previous norm of 3,0 to 3,5 established by LANGENEGGER and DU PLESSIS (1977) when using an entirely different technique.

The relationship between soil K, as affected by the treatments, and yield are presented in Fig. 2.

The contribution of soil K to the increase in yield for the plant crop was 56,1% and increased to 73,2% for the ratoon crop. This is a reasonable relationship for a soil analysis with a fairly consistent curve for plant and ratoon crops, reaching a peak in both cases at 170 mg K/kg soil. Under the conditions of the experiment, higher K in the soil resulted in a slight reduction in yield.

DISCUSSION

These results clearly show the importance of potassium applications to bananas on soils with insufficient reserves of this element. Increase in yields of more than 40% could be expected. Under more favourable climatic conditions, much higher yields could have been expected for the ratoon crop at the optimum levels of potassium application.

The problem with banana fertilisation is to know when and how much potassium to apply. The results of this experiment confirm the effectiveness of soil and leaf analysis, especially when used in conjunction with each other, for this purpose. Although they cannot clearly determine the correct amount to apply, preplant soil analyses can give a good indication. Leaf or midrib analysis could then be used to verify the correctness of the preplant applications of K and could be implemented annually to monitor the K status of the plantation. According to these and previous results, a value of approximately 3,5% K in the midrib, after flowering, would ensure a reasonable crop provided other nutritional and irrigation requirements were met. Too low or too high K values in the soil or midrib sample could result in reduction in yield in addition to wasting money by using excessive applications of potash.

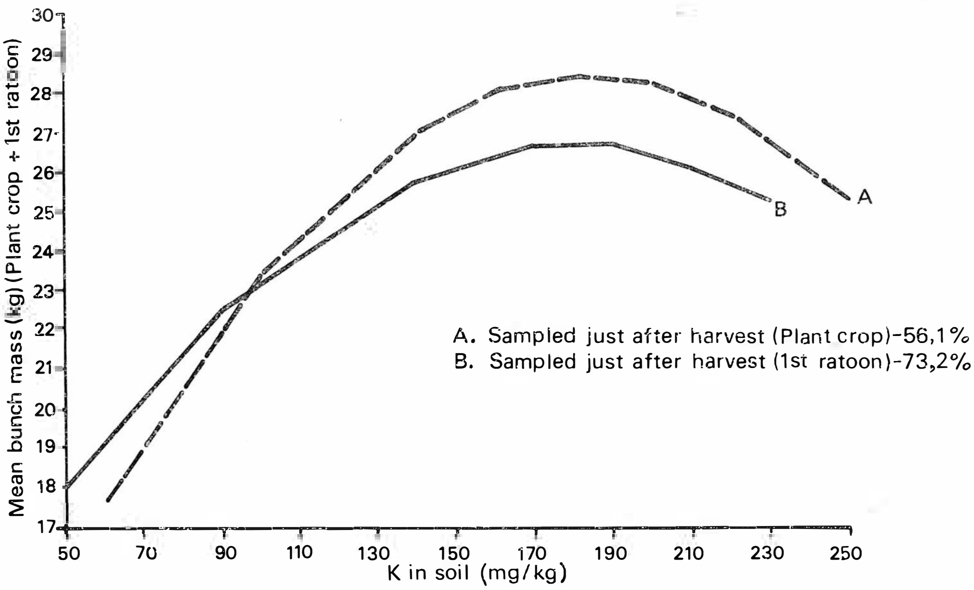

Figure 2 • THE EFFECT OF SOIL K ON BUNCH MASS.

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