Effect of Potassium Fertilizer on the Yield of Plantain-Melon Intercropped on an Oxic Paleustalf in south Western Nigeria

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Abstract

An on-farm experiment was conducted on an Oxic Paleustalf in south western Nigeria in the 1993 and 1995 cropping seasons with the aim of determining optimum K fertilizer for plantain and melon crops when intercropped, and also to determine the most economic fertilizer rate to be applied. The experimental design was a randomised complete block with four replications. Potassium fertilizer was applied at rates of 120, 240, 360 and 480 kg K ha^{-1} and a control. Economic analysis was carried out to assess the profitability of this intercrop at different K rates using a partial budgeting method. Results showed that this soil is deficient in K and intercropped plantain-melon responded to the application of the fertilizer. The following parameters responded significantly ($p<0.05$) to K fertilizer application: number of hands and fingers $bunch^{-1}$, mean length of plantain bunch as well as mean bunch and total bunch weight.Maximum yield was obtained at 360 kg K ha^{-1} in both cropping seasons. Optimum K fertilizer for melon was 240 kg K ha^{-1}. Results of the partial budgeting method for the intercrop at different K fertilizer applied were ₦10, 000.00 (or $384.60) in 1993 and ₦ 6, 700.00 ($ 257.69) in 1995 cropping seasons. In conclusion, the optimum K fertilizer that will give the best marginal rate of return was estimated to be 360 kg K ha^{-1}.

Media summary

An experiment was carried out to determine the effect of K fertilizer as well as optimum quantity to apply on the yield of plantain intercropped with melon on Oxic paleustalf .

Key words

Africa, melon, Nigeria, Oxic PaleUstalf, plantain, potassium

Introduction

Plantain (Musa AAB) often plays a dominant role in farming systems of the forest zone of West Africa as well as in many other African nations. Production remains largely in the hands of small-scale farmers who over the years have ingeniously integrated it into various cropping systems like bush fallow, homestead farms and taungya systems (Wilson 1987). In bush fallow rotations, plantain can either be the first or last crop in the sequence. Farmers often intercropped on these soils without adequate knowledge of the right quantity of fertilizers to be applied. There is sparse literature on the effect of various rates of potassium fertilizer on plantain-melon intercrop on Oxic PaleUstalfs in the southern western part of Nigeria. Therefore, an experiment was conducted in 1993 and 1995 cropping seasons to evaluate the effect of four different levels of K fertilizer on the yield and yield components of these crops in intercrop.

Methods

The trial was conducted at the on-farm research site at Ayepe located at $7^{0}15^{l}$ N latitude for both the 1993 and 1995 cropping seasons. Soils at the site were collected and analysed as outlined in Akinyemi et al. (2003). Suckers of plantain (Musa AAB) cv Agbagba were planted at a spacing of 3 x 2m and were intercropped with melon (*Clocynthis citrullus*). These crops were established in the alleys of plantain at populations of 20,000, 53,000 and 5,000 plants/ha. Seeds of melon were planted at the rate of three

seeds/hole and later thinned to two. The suckers of plantain were treated with furadan 3 G to control incidence of plantain weevil (*Cosmopolites sordidus*). The experimental treatments consisted of four levels of potassium (120, 240, 360 and 480 kg K/ha) and a control. The experimental design was a randomised complete block with four replications, which were farmers' fields. A plot size of 13 x 10m was adopted al all locations. Nitrogen and phosphorus were applied at the rate of 100 kgN/ha and 60 kg P/ha, respectively. Potassium fertilizer was applied in two equal amounts 2 and 4 months after planting (MAP). Plots were hand weeded regularly throughout the trial. The following data were collected: plant height, stem girth, number of functional leaves/plant, number of days to shooting, number of suckers/stools at harvest, height of oldest sucker at harvest, number of hands/bunch; number of fingers/bunch and bunch weight for plantain. Plantain was harvested as they matured. Melon fruits were collected at maturity, weighed and softened by beating with a piece of wood and allow to rot to facilitate seed removal. Seeds were washed and air-dried for 3d. The following data were collected: fruit weight, seed weight of fruit, seed number/frit and total seed yield. Data were subjected to analysis of variance using the general linear model procedure of the statistical analysis systems (SAS Inst., 1999) and means were separated using the Duncan multiple range test at 5%. Partial budgeting analysis was performed after CIMMYT (1988).

Results

This soil was deficient in K and plantain-melon intercropped responded to the application of the fertilizer (Table 1). The morphological attributes of plantain increased significantly ($p<0.05$) with increasing K fertilizer (Table 2). Results of yield and yield components of plantain intercropped with melon showed that number of hands and fingers bunch^{-1}, mean length of plantain bunch as well as mean bunch and total bunch weight responded significantly ($p<0.05$) to K fertilizer applied and maximum yield was obtained at 360 kg K ha^{-1} in both cropping seasons (Table 3). In Table 4, results of yield attributes of melon intercropped with plantain are presented and it shows that these attributes were not significantly different at all the levels of K fertilizer applied but all these were significantly different from the control. Similarly, the following attributes of melon intercropped with plantain increased as the K fertilizer applied increased but not significantly in both years. Optimum K fertilizer for melon was 240 kg K ha^{-1}.

Table 1: Physical and chemical properties of the soil at the experimental site.

Soil Properties	**1993**	**1995**
pH (H_20)	6.6	6.3
Organic Carbon (g/kg)	21.5	22.5
Total Nitrogen (%)	2.10	2.10
Available P (mg/kg)	3.50	5.4
Exchangeable Ca (cmol/kg)	9.52	8.54
Exchangeable Mg (cmol/kg)	1.32	1.24
Exchangeable Mn (cmol/kg)	0.15	0.14

Exchangeable K (cmol/kg)	0.18	0.20
Exchangeable Na (cmol/kg)	0.30	0.25
ECEC (cmol/kg)	11.46	10.37
Sand (g/kg)	660	670
Silt (g/kg)	160	170
Clay (g/kg)	180	160

Discussion

Application of potassium decreased plantain days to shooting while at a dosage of 480 kg ha^{-1}, it reduced the bunch yield of plantain. This response might be explained by the fact that K is needed in the process of photosynthesis and in the formation of carbohydrate (Obiefuna, 1984, Bhargara *et. al.* 1992; Shailendra *et. a.l.*; 1999; Espinosa and Belalcazar, 2000). In plantain and banana the bunch was the organ mostly affected by lack of K, according to Lahav and Turner (1983) .

Turner and Barkus (1980) reported that while low K supply reduced the total plantain dry matter by half, the bunch was reduced by 80% but the roots were unaffected. In this study, potassium significantly increased plantain bunch yield up to 360 kg K/ha. Higher plantain bunch yield was obtained in non-intercropped fields (results not presented) compared with that intercropped with melon. This showed that K requirement of plantain in this study was affected by the companion crop in the intercropping system. In a mixture like this, the ability of mixture components in competing for nutrient has been found to depend on lateral root spread, root density as well as duration of the crop on the field (Wilson and Allison, 1978; Akinyemi and Tijani –Eniola, 2000). Akinyemi et al. (2003) reported that the critical soil exchangeable K in plantain intercropped with arable crops such as cassava, maize and melon on an Alfisol ranged between 0.20 and 0.21 cmol/kg. Results of the partial budgeting method for the intercrop at different K fertilizerrates were ₦10, 000.00 (or $384.60) in 1993 and ₦ 6, 700.00 ($ 257.69) in 1995 cropping seasons.

Table 2. Effect of K fertilizer on morphological parameters when intercropped with melon

K levels (kg/ha)	Plant height at shooting (cm)	Stem girth at shooting (cm)	No. of functional leaves at shooting	No. of days to shooting	No. of suckers/stool at harvest	Height of oldest sucker at harvest (cm)
1993 cropping season						
Control	290.38c†	49.67b	8.50b	511.00a	6.25c	97.00b
120	312.38bc	59.78a	8.50b	420.00b	8.00b	144.50a

240	349.00ab	62.04a	9.13ab	362.50c	8.75a	156.00a
360	363.50a	60.41a	9.38a	330.00c	9.25a	158.00a
480	345.40ab	58.01a	9.00ab	340.00c	9.00ab	161.75a
			1995 copping season			
Control	267.50c	51.40c	6.12c	505.00a	6.75a	109.50a
120	274.40bc	54.06bc	7.25b	442.75b	7.25a	107.25a
240	289.58a	59.07a	8.38a	385.50c	7.26a	113.00a
360	297.44a	58.79a	8.00ab	372.50c	7.50a	112.25a
480	286.76ab	57.45ab	8.25a	363.25c	7.75a	111.50a

† Means followed by same letter in same year and column are not significantly different at 5% (DMRT).

Table 3. Effect of K on yield and yield components of melon intercropped with plantain

K levels (kg/ha)	No. of hands/bunch	No. of fingers/ bunch	Average bunch length (cm)	Average bunch weight/plant (kg)	Total bunch weight (/ha)
			1993 cropping season		
Control	4.63c†	10.25c	22.35c	3.65c	4.20c
120	5.13bc	12.50bc	26.90abc	5.40b	6.84b
240	6.13a	16.00ab	30.78a	6.80a	9.97a
360	6.25a	17.25ab	28.28ab	7.25a	10.39a
480	5.88ab	17.50a	24.38bc	6.74a	10.11a
			1995 cropping season		

Control	4.88a	10.75b	21.00bc	4.01b	4.01c
120	5.13a	12.25b	19.50c	4.75b	6.60b
240	5.63a	14.50ab	27.63a	5.72a	8.86a
360	5.50a	17.00a	27.00a	6.32a	9.38a
480	5.50a	17.50a	24.98abc	6.11a	9.22a

Table 4. Effect of K fertiliser on the yield and yield components of melon intercropped with plantain

K levels (kg/ha)	Fruit weight (t/ha)	Seed weight of fruit (g)	Seed number/fruit	Seed yield (kg/ha)
		1993 cropping season		
Control	2.29b†	11.58b	76.90b	120.35ab
120	3.59a	18.33a	120.35a	99.18a
240	3.28a	21.31a	123.44a	99.17a
360	3.11a	21.07a	138.62a	97.54a
480	3.17a	20.39a	134.26a	98.15a
		1995 cropping season		
Control	1.63b	14.08b	98.08b	39.00b
120	2.53a	20.82a	137.06a	78.48a
240	2.48a	20.83a	134.89a	77.02a
360	2.35a	20.20a	129.11a	71.03a
480	2.26a	19.18a	128.55a	68.43a

† Means followed by same letter in same year and column are not significantly different at 5% (DMRT).

Conclusion

In conclusion, the optimum K fertilizer that will give the best marginal rate of return was estimated to be 360 kg K ha^{-1}.

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