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SEASONAL AND FERTILISER EFFECT ON THE YIELD OF BELL PEPPER (*Capsicum annuum* L.) IN IBADAN, SOUTH WESTERN NIGERIA

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ABSTRACT
Emerging supply crisis in the food chain of crops such as Bell pepper (*Capsicum annuum* L.) from traditionally major producing areas of Southern and Northern guinea savannah of Nigeria to other parts of the country makes it expedient to cultivate the crop under different weather conditions and fertiliser requirements. Field trials were conducted in Ibadan, South western Nigeria (derived savannah agro-ecological zone) on a loamy sand Alfisol during the wet and dry seasons of 2011 and 2012 respectively to determine productivity of Bell pepper (*Capsicum annuum* L.) in the two seasons. Effects of varying rates of Phosphorus (P) fertilizer as Single Super Phosphate (SSP) and Potassium (K) fertilizer as Mu-rate of Potash (MOP) were also investigated. Phosphorus and K fertilizers were applied at four rates of 0, 30, 45 and 60 kg P/ha and 0, 15, 30 and 45 kg K/ha respectively in single dose by banding in a split plot arrangement in a Randomised Complete Block Design, replicated three times. Bell-pepper fruit yield (harvested green) which was the response parameter was analysed using analysis of variance (α0.05) while Duncan Multiple range test was used to separate means.There were significant differences between the yields of Bell pepper in the two seasons and varying rates of P and K. Yields in the dry season of 2012 were significantly higher than wet season of 2011 (about 2.5 times higher) with an average of 3.64 and 8.96 t/ha in the wet season of 2011 and dry season of 2012 respectively. There were significant increases in yield with rates of applied P and K. Consistent and maximum yield were obtained at 45 kg P/ha (12.21t/ha) and 30 kg K/ha (10.33 t/ha) in the two seasons. Bell pepper could be profitably grown in Ibadan from December to March at 45 kg P and 30 kg K/ha.
Keywords: Bell pepper, wet and dry seasons,agro-ecology, P and K fertilisers, yield.

INTRODUCTION

Soil fertility and climate greatly influence the cultivation and productivity of crops. This is why cultivation of crops is soil specific and limited to certain regions and climate. Erinle (1989) wrote that Southern and Northern guinea savannahs of Nigeria are the major producing area of Bell pepper (*Capsicum annuum* L.). Bell pepper (*Capsicum annuum* L.) is a crop of high economic and nutritional value in Nigeria. Nigeria as the largest producer of Pepper in Africa accounts for about 50% of the African production (Erinle, 1989) and was adjudged second in the world in 1979 (Yamaguchi, 1982) although FAO in 2001 put China as the largest producer with 10 million tons, followed by Mexico (1.9 million tons) and Turkey with 1.5 million tons The FAO 2001 statistics, estimated world production of capsicum pepper at 21.3 million tons

from a harvested area of 1.6 million ha with average yield of 13.4 t/ha. Sweet pepper may yield up to 30 t/ha in the field and up to 100t/ha in protected cultivation. The yield in African countries is generally very low as a consequence of extensive cultivation technology and poor soil fertility. Bell pepper requires adequate application of P and K for optimum yield. In a work on response of Pepper Cultivar to Nitrogen and Phosphate fertilization by Olanrewaju and Sowemimo (2003) on a Sandy Loam Alfisol, highest yield was obtained at 24.2 kg N and P/ha. But in an earlier similar work by Aliyu *et al.* (1996) maximum economic yield was recorded at 140 kg N/ha and 24 kg P/ha. There was consistency on rate of P fertilizer requirement of 24 kg P/ha unlike N which vary by about 5 times. Increasing Bell pepper production in the Humid Forests and Derived savannah of the country will ensure food security against increasing desertification in the North and the menace of climatic change. It is therefore, important to study the yield and response of bell pepper to fertiliser under different weather condition such as in Ibadan, a derived savannah zone. The study investigated the yield of Bell pepper (*Capsicum annuum* L.) on loamy sand Alfisol in two different seasons and its yield response to P and K fertiliser in Ibadan.

MATERIALS AND METHODS

Field trials were conducted at NIHORT Headquarters Ibadan (a derived savannah agro-ecological zone) to determine productivity of Bell pepper (*Capsicum annuum* L.) from August 25 to December 8, 2011 and December 22, 2012 to March 20, 2013 on loamy sand Alfisol (Soil Survey, 1990) in response to application of P and K combination. Ibadan is located at 7^0 30`N, $3^0$ 54`E and 168 m above sea level with an annual rainfall of 1300mm. As shown in Table 1, the site which was 173m above sea level composed of Hill wash soils, well drained and formed from Colluvial-alluvial materials derived from the basement complex formation (Askira, 2000). The site had been cropped annually for experimental purpose and grown to leafy and fruit vegetables such as Pepper and Cabbage among others. Routine chemical soil tests such as pH, textural classification, effective cation exchange capacity, total N, available P, exchangeable K and organic carbon were carried out on the composite soil samples (0 – 30 cm) taken from the site before planting. The pH was determined in 1:1 soil-water suspension (Black, 1965), while textural class was determined by hydrometer method (Bouyoucos, 1951).

Potassium was determined in 1N Ammonium acetate at 7.0 pH extract with Flame Photometer. Effective Cation Exchange Capacity (ECEC) was determined by summation method while total nitrogen from concentrated Sulphuric acid digest was determined by colorimetric method.

Table 1 Site and soil description of experimental site

Elevation (m)	Parent Material	Mode of Formation	Drainage class
173m	Colluvial-alluvial materials derived from the basement Complex	Hill Wash	Well drained class 4

Source: Adapted from Askira (2000)

Phosphorus was determined in Bray 1 extract and organic carbon determined by colorimetric complete oxidation method (Heanes, 1984). Bell pepper (*Capsicum annuum* L.) seedlings were raised in the nursery for 4 weeks before transplanting into the field at a spacing of 30cm within rows and 50cm (66,666 plants/ha) between rows on plot size 0.9 x 1.5 m. Granular Single Superphosphate (SSP, 18 % P) was the source of Phosphorus and was applied at 0, 30, 45 and 60 kg P/ha in a single dose at two weeks after transplanting (2 WAT). Granular Muriate of Potash (MOP, 60 % K) was the source of Potassium (K) fertilizer applied at the same time interval as for P in a single dose at 0, 15, 30 and 45 kg K/ha by banding. Nitrogen fertilizer in form of granular Urea (46% N) at 40 kg N/ha was applied in two equal split doses at 2 WAT and at flowering by banding.The experiment was laid out in a 4 x 4 split plot in a Randomized Complete Block Design replicated three times where Potassium was assigned to the main plot and Phosphorus to the sub plot. Fruits were harvested green as they mature, counted and weighed at weekly intervals. The experiments were carried out in the wet season of 2011 and dry season of 2012. Supplementary watering was carried out in the dry season of 2012. Bell pepper fruit yield was subjected to analysis of variance to determine significant differences between the yields of in the two seasons and between varying rates of P and K. Means were separated by Duncan Multiple Range Test. Furthermore, for easy comparison, relative yield of Bell pepper was determined as the yield of a treatment divided by the highest yield in the two seasons expressed in per cent.

RESULTS AND DISCUSSION

The properties of the soil are presented in Table 2. The soil was slightly acidic with a pH of 5.2 and texturally classified as loamy sand. Organic carbon content and Nitrogen (N) level of the soil were low while the available P was medium. Exchangeable K level of the site was low but with high per cent base saturation with an ECEC value of 2.35 cmol/kg. The soil was deficient in major nutrients; therefore adequate fertilizer application was necessary for profitable Bell pepper production.

There were significant differences in the yield of bell pepper in the wet and dry seasons as shown in Tables 3 and 4. Higher yields were recorded in the dry season of 2012 than the wet season of 2011. Highest yield (16.43 t/ha) was observed in the dry season of 2012 and the lowest yield of 0.60 t/ha was in the wet season of 2011. Average yield were 3.64 and 8.96 t/ha in the wet season of 2011 and dry season of 2012 respectively. Highest bell pepper yields were obtained at different P and K combination in 2011 and 2012 seasons, but treatment P3K3 was considered the best across the seasons because yields obtained in the two seasons were significant and consistent. Yields obtained in treatment P3K3 in 2011 and 2012 were 15.00 and 14.03 t/ha respectively while the highest of 16.42 t/

Table 2 Pre-cropping soil textural classification and chemical properties

Soil Series	pH (H_2O)	Org. C	N	Av. P	K	ECEC	Base Saturation	Soil Textural Class
		g/kg		mg/kg	cmol/kg		g/kg	
Apomu	5.2	6.0	0.5	13.44	0.18	2.35	923.4	Loamy Sand

ha obtained in P4K1 in 2012 was 3.43 t/ha in the preceding year. Applied P and K had significant increase on the yield of bell pepper (Tables 3 and 4). Table 3 show the effect of treatment combinations on the yield of bell pepper in the two seasons while Table 4 shows individual effect of P and K. The best P and K treatment combination was P3K3 (45 kg P and 30 kg K per hectare) as shown in Table 3 while the poorest was P1K1. Yield increased with P rate until optimum was reached at 45 kg P/ha. Decline in yield at 60 kg P/ha implies that optimum P rate has been exceeded. FAO (2001) put the average yield of Pepper at 13.4 t/ha. Aliyu *et al.* (1996) and Olanrewaju and Showemimo (2003) obtained highest yield for Pepper at 24 and 24.2 kg P/ha respectively. There were also significant increases in yield as applied K rate increases until optimum was reached at 30 kg K/ha after which there was a decline. The relative yields of bell pepper in the two seasons are shown in Figure 1. Yield increases of 1.47 - 6.83 times were obtained in 2012 dry season over 2011 season (average of about 2.5 times). Apomu soil series is typically well-drained and allows for free movement of P and K from the soil into soil solution

Table 3 Effect of P and K combinations on the yield (t/ha) of Bell pepper (Capsicum annuumL.) in 2011 and 2012.

Treatment	Yield(t/ha)	
	2011 wet season	2012 dry season
P1K1	0.598o	2.491m
P2K1	4.100ijk	9.490e
P3K1	1.530n	12.910d
P4K1	3.427k	16.429a
P1K2	2.569lm	9.591e
P2K2	2.408m	7.250gh
P3K2	3.910jk	15.049b
P4K2	1.191no	8.140f
P1K3	1.471n	7.909fg
P2K3	4.380ij	8.770ef
P3K3	15.007b	14.028c
P4K3	1.900mn	7.020h
P1K4	3.360kl	4.952i
P2K4	9.071e	8.000fg
P3K4	1.410no	6.850h
P4K4	1.840mn	4.501ij

Means with the same letters are not significantly different ($P<0.05$)

P rates – 0, 30, 45, 60 kg P/ha

P1, P2, P3, P4

K rates - 0, 15, 30, 45 kg K/ha

K1, K2, K3, K4

Table 4 Effect of P and K fertiliser application on the yield (t/ha) of bell pepper (*Capsicumannuum* L.)in 2011 and 2012.

Fertiliser rates	2011 season	2012 dry season
P (kg/ha)		
0	1.99c	6.24d
30	4.99b	8.38c
45	5.46a	12.21a
60	2.08c	9.02b
K (kg/ha)		
0	2.41c	6.08d
15	2.52c	9.43b
30	5.69a	10.33a
45	3.92b	10.01a

Means with the same letters in a column for each nutrient are not significantly different ($P<0.05$)

to the roots of crops. This is probably responsible for the efficiency of applied P and K. Results obtained in the two seasons revealed that Bell pepper production was better in the dry season than in the wet season. This is an indication that with appropriate practices, bell pepper could be profitably grown in Ibadan.

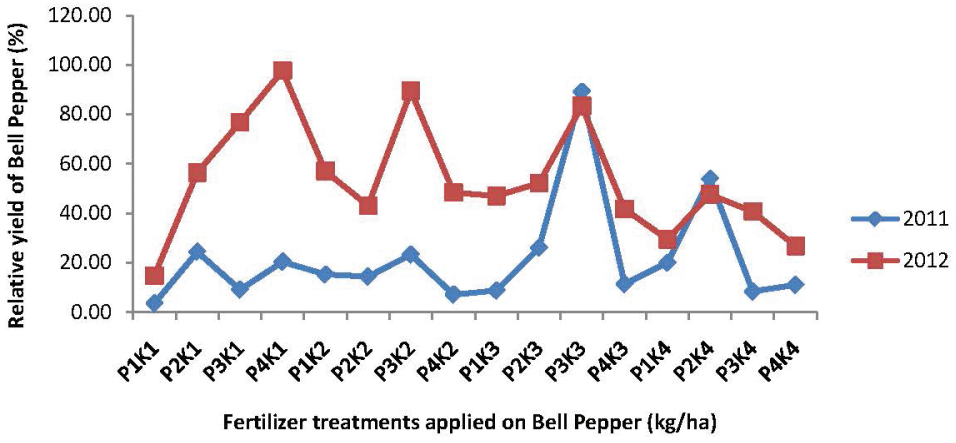

Fig. 1 Relative Yield of Bell Pepper in 2011 and 2012

CONCLUSION

Bell Pepper showed significant yield increase with applied P and K and in the dry season of 2012 over wet season of 2011. Yields were higher in the dry season of 2012 than the wet season of 2011. Higher temperature in the dry seasons is probably responsible for this. At high temperature, translocation of photosynthates increases with metabolic activities thereby leading to higher yield. Phosphorus and Potassium are known to stimulate root and fruit development and also stimulate flowering and improves fruit quality. Bell pepper production is therefore recommended in Ibadan, a derived savannah agro ecological zone of Nigeria between the months of December to March at 45 kg P and 30 kg K/ha.

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