Residual Phosphorus Influence Carrot Production in African Humid Tropics

Note: Speaker was not able to attend and present at conference.

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Abstract

Productivity of carrot (*Dacus carota*) could be improved at reduced cost through combined use of low-cost Rock Phosphate (RP) phosphorus sources. Very little is known about RP residual release of phosphorus (P). It is probable that the differential performances exhibited by the RPs might be a function of their P residual properties after cropping. Based on these premises this study was carried out to evaluate the residual influences of P sources under continuous croppings for carrot production. The study was a completely randomized design with five replications. In order to monitor the residual effects of the P sources the experimental plots were cropped consecutively three times. Results from the study revealed that yield and Relative Agronomic Efficiency (RAE) decreased with continuous cropping for SSP but increased with continuous cropping for ORP and SRP . Averaged over the three continuous consecutive croppings, SRP and ORP were 66.3% and 70.8% as effective as SSP in increasing carrot yield respectively. It was concluded therefore that ORP could be an alternative P source for carrot production under continuous cropping system in the humid tropics.

Keywords: Carrot, Phosphorus, Residual Effect, Phosphorus Sources, Continuous Cropping.

RESEARCH BACKGROUND

*Sources of fertilizer raw materials influence fertilizer prices.

*Prices of phosphate (P) fertilizers rose more steeply than the N-based urea because production sources are more limited for P fertilizers.

*Most of the world's phosphate fertilizers are produced in the U.S., Morocco, and along the Baltic sea while plants that use natural gases (most of which are flared as the case in Nigeria) are dispersed and many around the world.

*The sharp rise in fertilizer prices around the world emphasizes the need for more research to improve fertilizer use efficiency.

*Too little do we consider the technical impacts of fertilizer use on ecology/environment, food security, energy crises, social, economics, cultural as well as governance[2].

INTRODUCTION

*Tropical soils are often low in available phosphorus (P) and therefore its application is essential for optimum crop growth and yield, especially for rapidly growing annual crops such as carrot (Zapata et al. 1995).

*Over US$100 million is spent on conventional, water soluble P fertilizers in Nigeria for instance annually (Sobulo, 1992).

*While differences in P uptake efficiencies from soil has been studied for some vegetable species differences in P sources uptake efficiencies are lacking.

*Such information will be useful for identification, selection and subsequent development of breeding programmes in selecting genotypes with high capabilities for low-P soils.

INTRODUCTION CONTD.

***Finely ground PR has been tested and applied directly to the soil as fertilizers as a low-cost alternative to the conventional water soluble P fertilizer (Zapata et al. 1996).**

***The high cost of conventional P fertilizers constrains their use by the resource-poor farmers especially in sub Saharan Africa.**

***It is probable that carrot exhibits yield differences under various P residual properties after cropping.**

***Based on this premise the present study was carried out to determine the response of carrot to residual effects of P sources under continuous cropping.**

MATERIALS & METHODS

*Two soils, Arenic Haplustalf and Kandiudult were used for the study.

*Soil samples were taken and analyzed for physico-chemical properties.

*The Relative Agronomic Efficiency (RAE) of the phosphate rocks was determined according to the method of Butegwa *et al*. (1996):

$$RAE = \frac{\text{Yield of P Source} - \text{Yield of Control}}{\text{Yield of SSP} - \text{Yield of Control}} \times 100$$

MATERIALS & METHODS CONTD.

*Three P sources: SRP, ORP and SSP were each applied at the optimum rate 55kg ha-1.

*SSP was used as a reference fertilizer.

*There was a control treatment to which no P was added

* Each plot also received N and K using calcium ammonium nitrate and muriate of potash as sources respectively at 60 kg ha-1 each.

*The plots were arranged in a completely randomized design with four replications.

MATERIALS & METHODS CONTD.

*Carrot seeds were drilled 0.20m apart and later thinned to one stand at 0.05m X 0.20m spacing two weeks after sowing.

*Ten weeks after sowing (WAS), plants were separated into roots and leaves.

*The roots were washed and air dried for 3 days before weighing.

*While the leaves were oven dried at 75°C for 24 hours, weighed and ground for chemical analyses.

*Data collected were subjected to analysis of variance. Mean comparisons were made using Duncan Multiple Range Test (DMRT) and least significant difference (LSD).

Table1: Chemical properties of P sources used in the study.

Chemical properties (constituent in % weight)	P Sources[1]				
	SSP		SRP		ORP
Total P	**9.22**	**<**	**15.67**	**>**	**13.62**
Total P205	**21.10**	**<**	**35.87**	**>**	**31.19**
Water soluble P205	**14.69**	**>**	**0.24**	**<**	**0.36**
2% Citric acid soluble P205	**2.77**	**<**	**6.81**	**>**	**5.13**
pH (H20)	**4.32**	**<**	**6.24**	**>**	**4.46**
Ca	**1.29**	**<**	**1.50**	**>**	**1.83**
Fe203	**-**		**1.53**	**<**	**8.49**
Al202	**-**		**1.30**	**<**	**7.11**
K20	**-**		**0.13**	**>**	**0.06**
Si02	**-**		**24.02**	**>**	**19.18**
Mn0	**-**		**0.30**	**<**	**0.39**
Mg0	**-**		**0.22**	**>**	**0.91**
Na20	**-**		**0.27**	**<**	**0.99**
S	**-**		**1.21**	**>**	**1.40**
Org. C	**-**		**0.46**	**>**	**0.48**

[1]SSP **= Single Super Phosphate;** SRP **= Sokoto Rock Phosphate;** ORP **= Ogun Rock Phosphate.**

Table 2: Precropping chemical and physical soil properties of the soils used.

Properties	Haplustalf		Kandiudult
PH (H20 1:1)	5.11	>	4.93
Organic carbon (gkg-1)	0.39	>	0.33
Total Nitrogen (gkg-1)	0.44	>	0.38
Available P (mg kg-1)	5.13	>	4.20
Exchangeable Ca (cmol kg-1)	1.21	>	0.73
Exchangeable Mg (cmol kg-1)	0.50	>	0.22
Exchangeable K (cmol kg-1)	0.20	>	0.14
Exchangeable Mn (cmol kg-1)	0.14	<	0.20
Exchangeable Na (cmol kg-1)	0.31	>	0.16
Exchangeable Al (cmol kg-1)	0.12	<	0.17
Exchangeable Fe (cmol kg-1)	1.22	<	4.04
Total acidity (cmol kg-1)	0.50	>	0.37
CEC (cmol kg-1)	2.78	>	1.61
Sand (g/kg)	860.0	>	820.40
Silt (g/kg)	120.0	>	99.60
Clay (g/kg)	20.0	<	80.0

Table 3: Influence of P sources on soil fertility status under continuous cropping.

P source[1]	pH (H20)	Org. C(g/kg)	Avail. P	Mn	Ca	Al
			………..mg/kg …………..		…………. Cmol/kg ………..…	
1st CROPPING						
Control	5.53	0.32	4.59	0.24	1.80	0.08
SSP	5.36	0.68	10.70	0.35	1.51	0.09
ORP	5.58	0.43	7.03	0.47	2.46	0.05
SRP	6.60	0.44	6.55	0.42	2.56	0.07
Lsd (5%)	0.38	0.03	0.53	NS	0.12	NS
2nd CROPPING						
Control	5.33	0.60	4.48	0.24	1.22	0.15
SSP	5.44	0.66	10.80	0.45	1.53	0.19
ORP	6.21	0.55	8.82	0.66	2.49	0.28
SRP	7.32	0.52	8.40	0.53	2.58	0.14
Lsd (5%)	NS	NS	2.01	0.12	0.13	NS
3rd CROPPING						
Control	5.30	0.48	4.88	0.52	0.80	0.19
SSP	6.50	0.45	8.80	0.86	0.82	0.25
ORP	5.82	0.46	8.22	0.84	1.88	0.13
SRP	6.00	0.50	8.03	0.84	1.24	0.15
Lsd (5%)	0.18	NS	3.38	NS	0.11	0.03

Means followed by same letter in a column, in a cropping season, are not significantly different by DMRT at 5%. [1]SSP = Single super phosphate; ORP = Ogun rock phosphate; SRP = Sokoto rock phosphate; Control = no fertilizer applied.

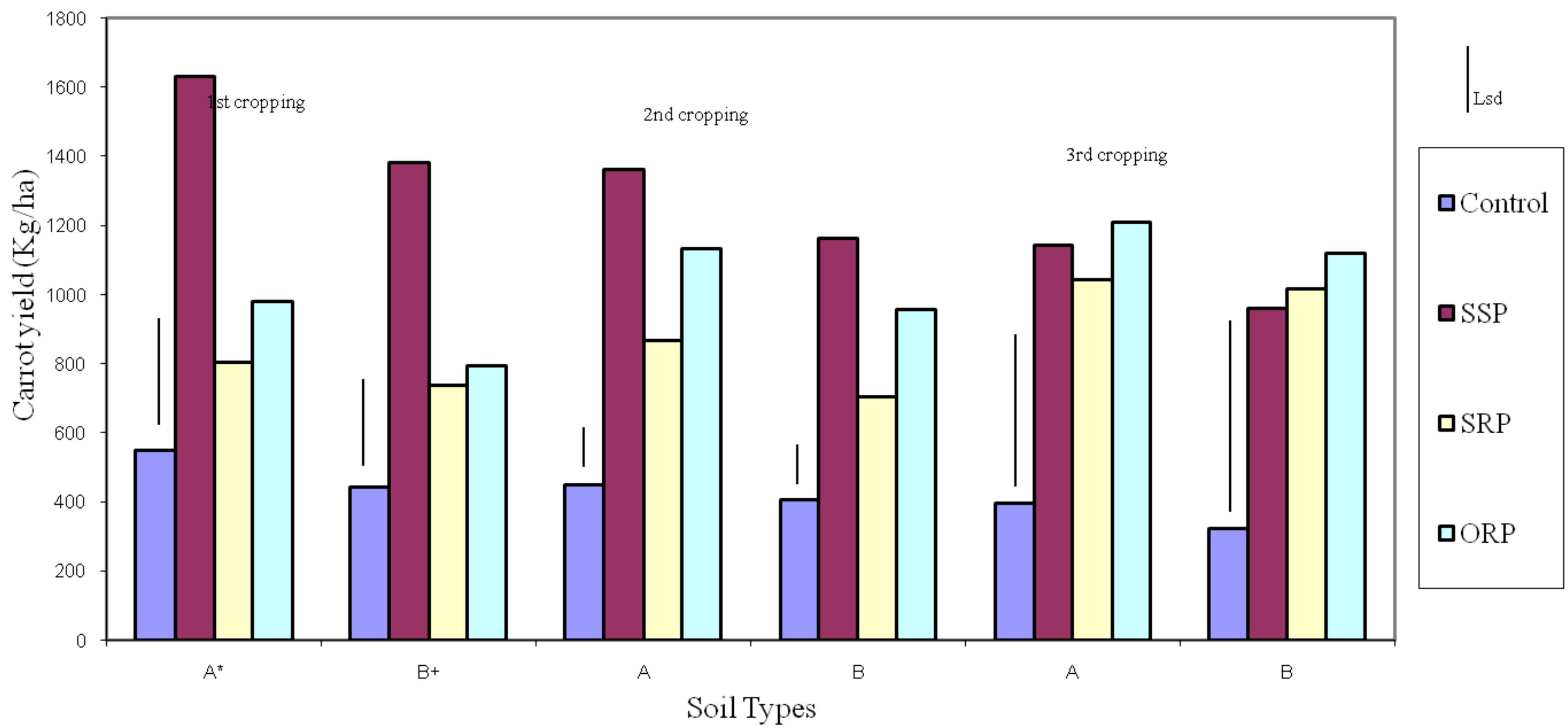

Figure 1: Influence of P sources on carrot yield under continuos cropping. SSP = Single super phosphate; ORP = Ogun rock phosphate; SRP = Sokoto rock phosphate. A* (Haplustalf); B+ (Kandiudult) within a cropping season.

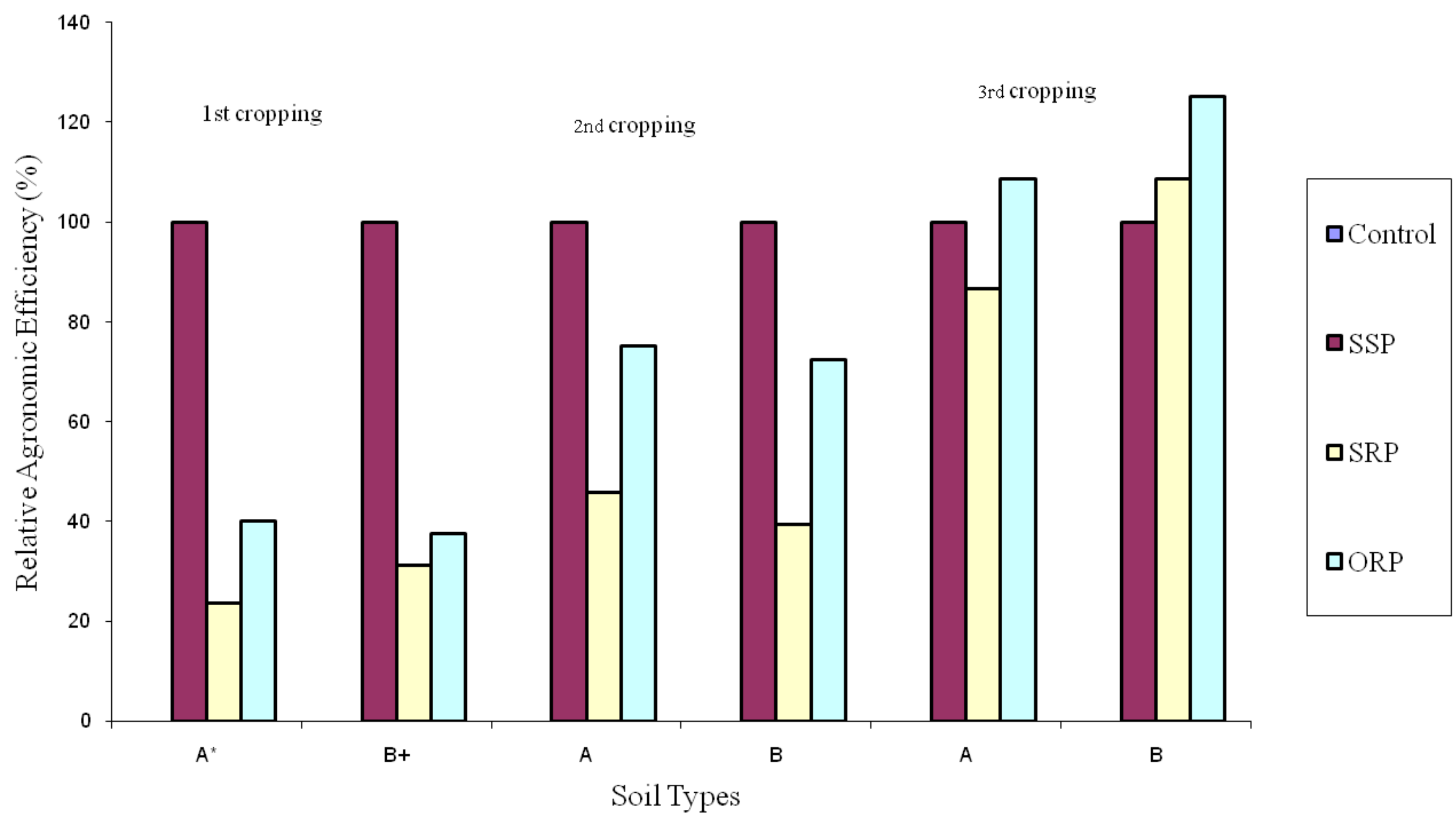

Figure 2: Relative agronomic efficiency (RAE) indices of P sources under continuous cropping. SSP = Single super phosphate; ORP = Ogun rock phosphate; SRP = Sokoto rock phosphate. A* (Haplustalf soil) and B+ (Kandiudult soil) within a cropping.

DISCUSSION

*The results from the study showed that with increased cropping carrot yield decreased for SSP and control but increased for ORP and SRP.

*There was no significant difference between SRP and ORP in this study. Indicating that SRP performed equally well as ORP.

* Increase in yield measurements observed in this study with RP as against SP decreases is in consistent with findings of Rajan et al. 1996 and Yeast, 1993 that RPs could be more efficient than soluble P fertilizers in terms of recovery of P by plants, even for short term crops where soluble P is readily leached as in sandy soils.

DISCUSSION CONTD.

*The observed increase in the yield with increasing P supply might be attributed in part to the inherently low P status of the soil used in this study.

*Among the environmental factors that interact in the field with a crop, phosphorus is perhaps the most important of the nutrients because of its metabolic role and its requirement in large quantities by plants.

* It initiate photosynthetic reactions of splitting water molecule by light energy in the presence of adenosine diphosphate (ADP) and then the subsequent fixing of carbondioxide (Daniel, 1998).

*This process ultimately results in photosynthetic assimilate in plant tissues.

CONCLUSION

*It was concluded therefore that SSP performed best compared to RPs under single cropping.

*However, under continuous cropping as the case in most part of the tropics, RPs performed better that SP.

*Comparing between RPs and soils used in this studies; ORP and Haplustalf soil are best options for carrot production under continuous cropping.

FUTURE RESEARCH TOPICS

*Blending of organic + inorganic sources for optimal crop production.

*Alternate sources of plants nutrient elements.

*Use of lime to improve PR sources.

*Split fertilizer dosage in carrot production.

*Fertilizer placement techniques.

THANKS FOR LISTENING. BYE!

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