Effect of Potassium Fertiliser on Crop Yields under Cassava-based Systems in the Coast Region of Tanzania

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BACKGROUND INFORMATION

Importance of Cassava in the Coast Region, Tanzania

- Is a food and cash crop, plays an important role in food security (drought tolerant crop)
- It is a dominant crop in most of the farming systems - Cassava based production systems
- Those systems occupy 38.4% of the area under production in the region
- Almost 37% of the household grow cassava and 64% of them grow mainly for home use

Problems facing cassava-based systems in the region

- Low crop yields *(cassava – 6.6, maize -1.1, and legumes – 0.6 t/ha) as compared to potential yields (cassava: up to 30 t/ha, cowpea: 2 -3.5 t/ha, maize 3 – 4.5 t/ha)*
- Pests and diseases (CMD, Cassava bacterial blight etc)
- use of local and low yielding varieties,
- moisture stress,
- use of inappropriate crop husbandry
- Low soil fertility status in some areas (N< 0.19%, P (< 5 mg/kg), and K (> 2.22 cmol(+)/kg)

What has been done to solve those problems

- Researchers developed improved crop varieties (cassava: Kiroba; maize: TMV I; cowpea: Vuli 1 and 2)
- Appropriate spacing / plant population for mono and intercropping
- weeding regimes
- Management of pests and diseases

However,

➢ *Little has been done to assess and improve soil productivity in cassava-based systems*

- Few sites (4) were assessed for soil fertility assessment and done in the past 7 -19 years : Low N(< 0.19%, P (< 5 mg/kg), and K (> 2.22 cmol(+)/kg)

- Soil fertility improvement – few sites (3) in cassava – legumes - maize rotation in coconut-based farming system. Rotation system + TSP and CAN improved cassava yields by 77 - 97%)

- N fertiliser trial - applied N increased cassava tuber yield by 43% to 86% with optimum yield at 40 kg N/ha in cassava -cowpea – maize intercropping.

From the previous research work, it is evident that:

- The existing information on soil fertility status is insufficient to be representative information for the soils under cassava-based systems
- Further more, there was no information related to P and K nutrient rates required for optimum production althoughnutrient mining is increasing (eg 30 t/ha cassava tuber remove 140 – 160 kg K_2O_5/ha)
- Crop yields are still low (cassava – 6.6, maize – 1.1, and legumes – 0.6 t/ha).

OBJECTIVES

Main Objective

To establish optimum and economic P and K fertiliser rates required for improving yields in two cassava cropping systems, namely cassava-cowpea intercropping system and cassava mono-cropping in the Coast region of Tanzania.

For the purpose of this symposium, this paper present the effect of K on crop yields under selected two systems

Specific objectives

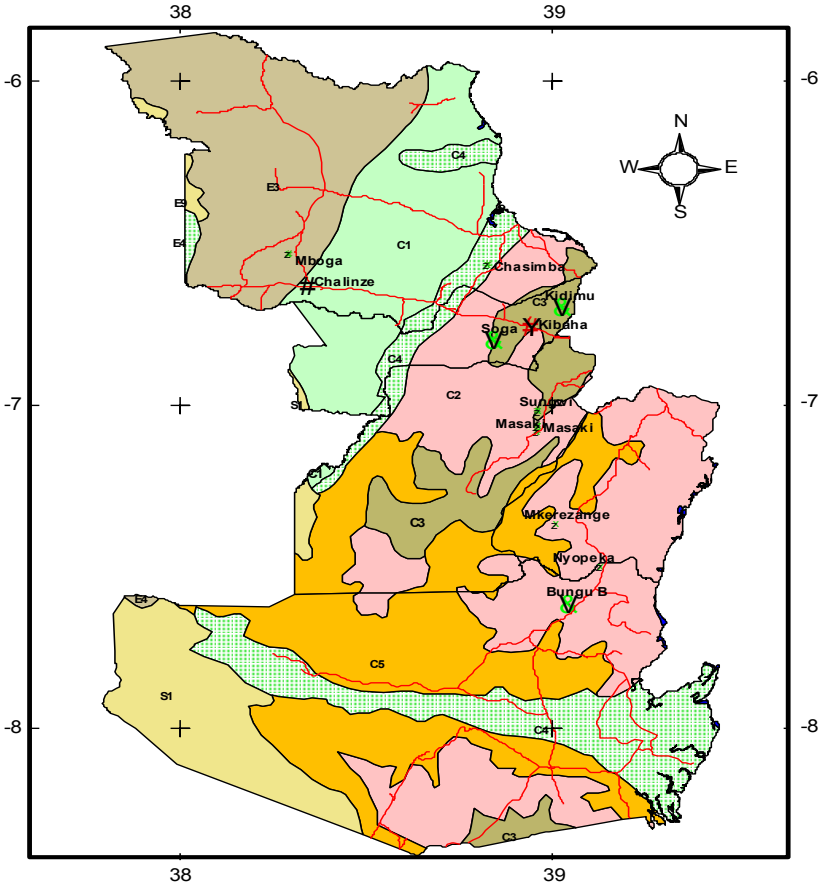
i. To assess soil fertility status in the major cassava producing areas of the Coast region.

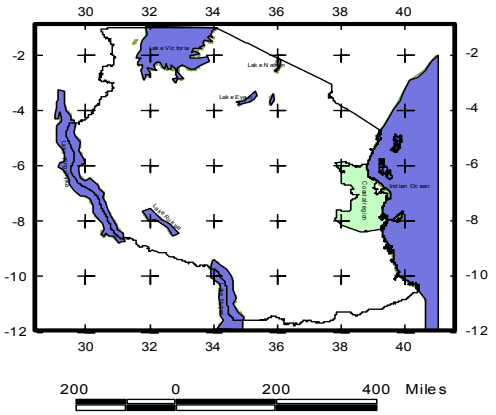
ii. To assess the effects of K fertiliser on cassava and cowpea yields in cassava mono-cropping and cassava-cowpea intercropping systems

iii. To determine the optimum and economic K fertiliser rates for the two cropping systems.

Objective	Methodology	Data collected
<u>Objective 1</u> To assessed soil fertility status in major cassava producing areas	• Ten (10) representative villages were selected from 24 major cassava producing villages • Selection of study fields •Soil sampling (21 fields) •Lab soil analysis • Interviewing farmers (80)	• Information on soil fertility management practices •soil nutrient levels •Crop yields

- Coastal Zone 2 (C2) 50%,
- Coast al Zone 3 (C3) 20%,
- Coastal Zone 4 (C4) 15%,
- Agro ecological Zone E (E3) 15%





Legend

Roads

Rivers

Villages where soil fertility survey conducted

Experimental site villages

AEZ_Code	Altitude m (asl)	Aver annual rainfall (mm)
C1	<200	1000 - 1200
C2	<500	800 - 1000
C3	<500	800 - 1000
C4	<200	1200-1400
C5	<200	1000-1200
E3	200 - 750	800-1000
E4	200 - 1000	800-1000
S1	200 - 500	1000-1200

Distribution of the studied villages in the Agro-Ecological Zones

Objective	Methodology	Data collected
Objective 2 To assess the effects of K fertiliser on cassava and cowpea yields in the two cassava cropping systems	**Field Experiment** **Treatments:** i) Absolute control ii) $N_{40}P_{30}K_{0}Zn_{10}$ iii) $N_{40}P_{30}K_{40}Zn_{10}$ iv) $N_{40}P_{30}K_{80}Zn_{10}$ v) $N_{40}P_{30}K_{160}Zn_{10}$ **Exp. design**: 2 x 5 factorial, **Split plot design** ❑Variety: Kiroba (cassava) Vuli (cowpea) ❑Plot size: 5 x 6 m	•Soil exchangeable K • Cassava and cowpea yields •Rainfall data (Figure) • Prices of inputs, labour costs and crop yields

Objective	Methodology
Objective 3 To determine the optimum and economic K fertiliser rates for the two cropping systems.	•Data from K experiments were statistically analyzed to establish optimum fertilizer rates •Partial budget, Benefit: Cost Ratio and VCR were used determine economic fertilizer rates

DATA ANALYSIS

- Data were subjected to two way and factorial ANOVA using Mstat C programme and means were compared using DNMRT

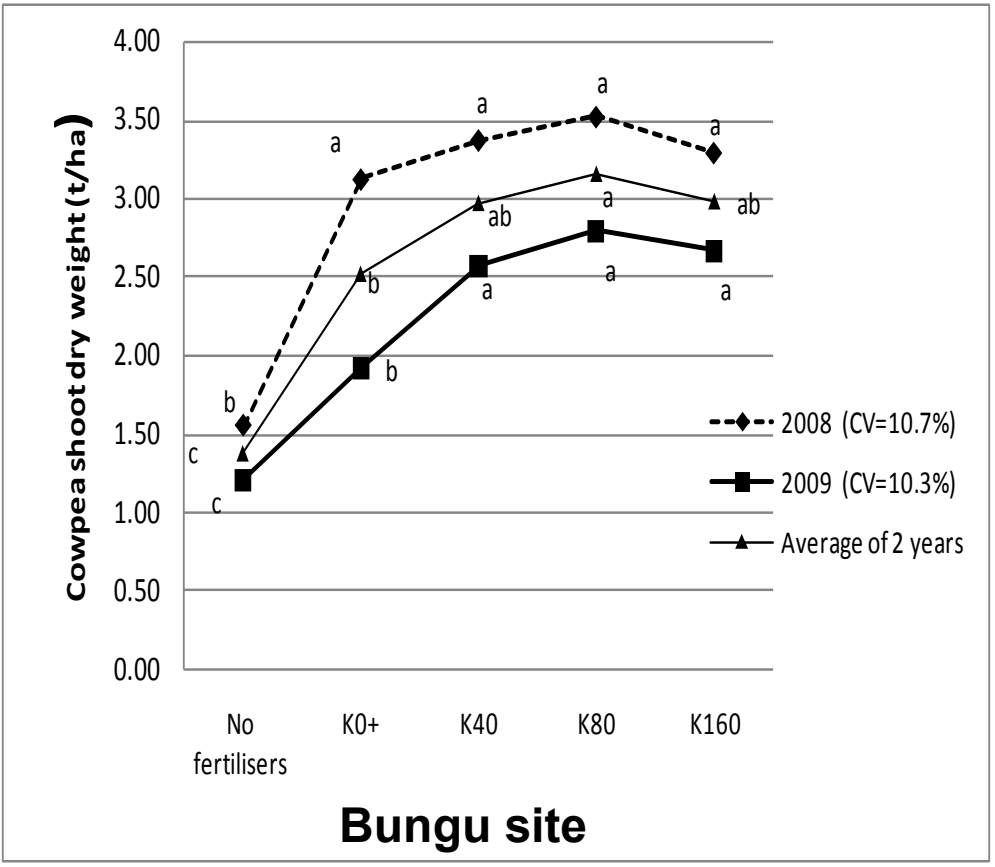
➢ Partial budget, Benefit: Cost Ratio (BCR) and Value: Cost Ratio (VCR) were used to assess the profitability of the tested fertilisers in the two cassava cropping systems

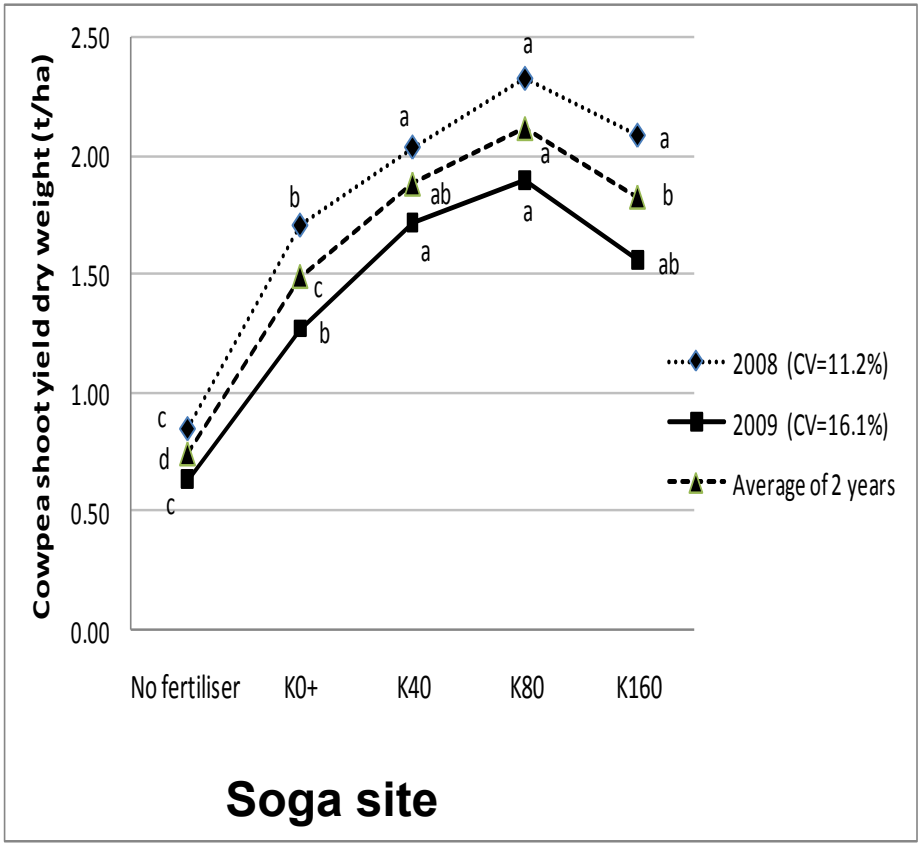
RESULTS AND DISCUSSION

Selected Soil Properties and Fertility Status of the Soils

Soil properties	Range	Fertility status
Soil texture	Loamy sandy to Sandy clay	43% - LS; 38% - SCL; 9% - SL; 5% - SC; 5% - CL
Soil pH	4.1 - 6.4	38% strong acidic soils (< 5.5); 62% Slightly to medium acidic (5.6 - 6.5)
Total Nitrogen	0.02 – 0.13%.	100% very low to low levels
Organic Carbon	0.18 – 1.51%.	100% very low to low levels
Extractable P	0.6 – 22.8 mg/kg	91% low Bray-1 extractable P
Ca	0.50 - 4.70 cmol(+)/kg	43% low levels
K	0.10 -0.80 cmol(+)/kg	33% low K
Zn	0.06 – 2.0 mg/kg	52 % low extractable Zn
CEC	3.2 – 16.8 cmol(+)/kg	91% low CEC

Response of cowpea shoot yields to K fertiliser rates in the cassava-cowpea intercropping system at Soga and Bungu

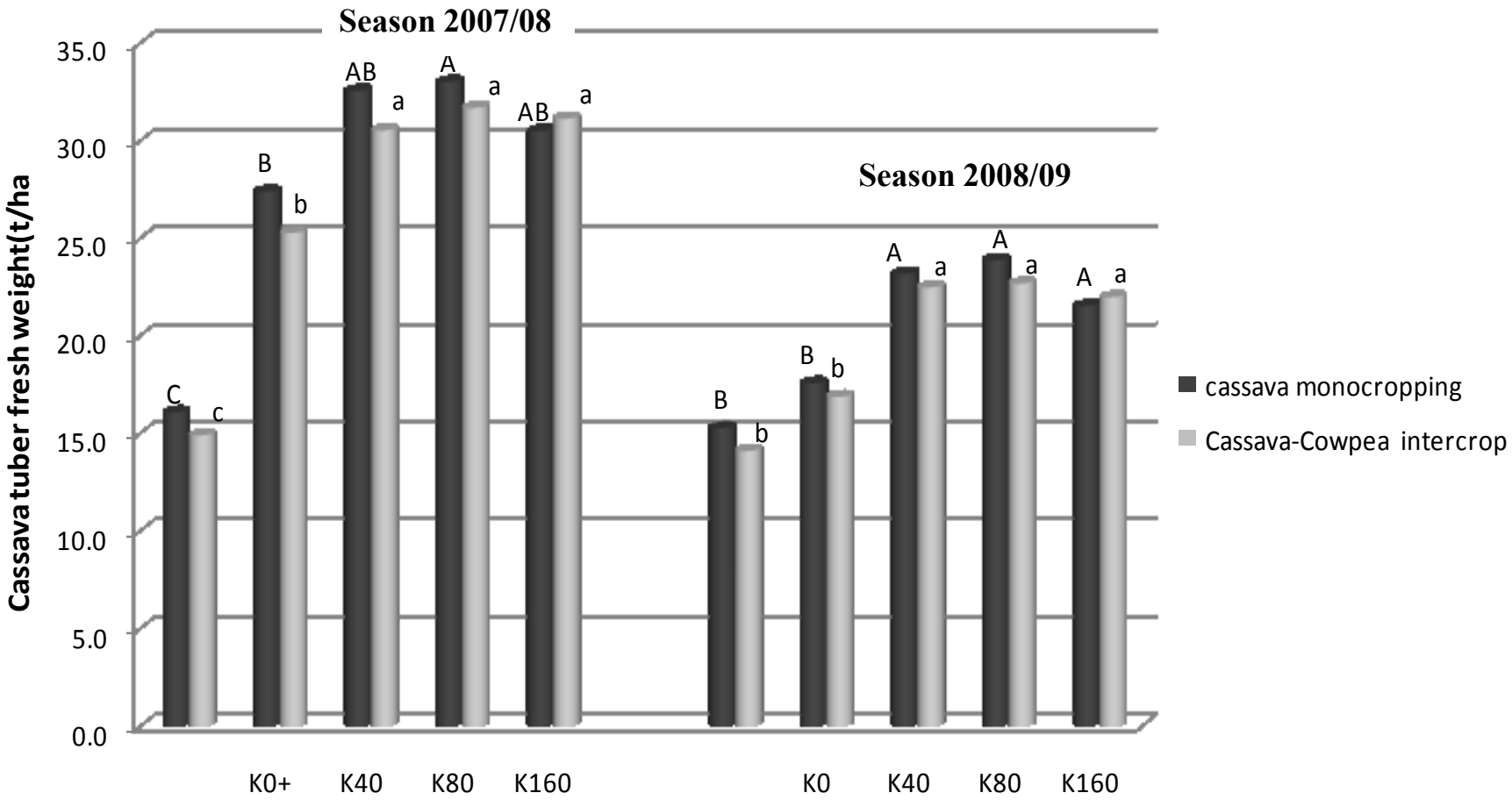




Points within the same line bearing the same letter are not significantly different (P<0.05) using DNMRT

+ All K treatments received P and Zn at the rates of 30 and 10 kg/ha, respectively

Response of cassava tuber yields to K fertiliser at Soga site



Bars with the same colour bearing the same letter in each season are not significantly different (P<0.05) using DNMRT

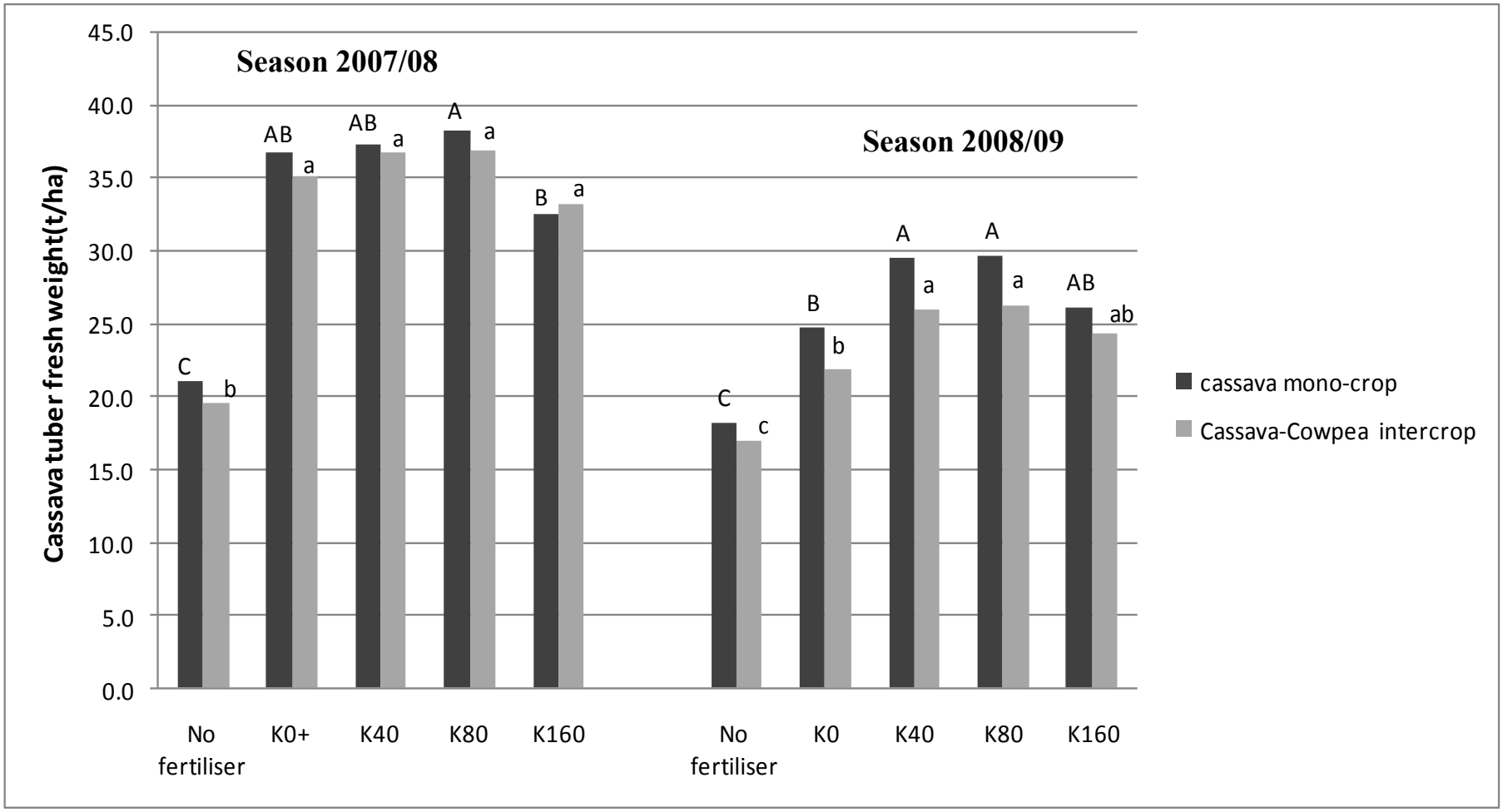
+ All K treatments received N, P and Zn at the rates of 40, 30 and 10 kg/ha, respectively

Non fertilised tuber at Soga site Tanzania (harvested on August 2008)

Cassava plant treated with Potassium fert. at a rate of 80 kg K/ha at Soga village Tanzania (harvested on August 2008)

Cassava plant treated with TSP-P at a rate of 30 kg P/ha plus K80, N40 and Zn10 at Kidimu village Tanzania (harvested on August 2008)

Response of cassava tuber yields to K fertiliser at Bungu site



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Economic assessment of using fertilizers in cassava-based systems in the study areas

Site and Year	Cropping system	P / K rate which gave highest NB and BCR>2	Highest NB (US $)	Optimum rate	Recommended Economic-optimum rate
SOGA - Year 1 (2007/08)	Mono-cropping	TSP – 30 kg P/ha	3980	15 kg P/ha	15 kg P/ha
	Intercropping	TSP – 30 kg P/ha	3792	30 kg P/ha*	30 kg P/ha
SOGA - Year 2 2008/09	Mono-cropping	TSP – 30 kg P/ha	2349	15 kg P/ha	15 kg P/ha
	Intercropping	MPR – 30 kg P/ha	2336	30 kg P/ha*	30 kg P/ha
BUNGU – Y 1	Mono-cropping	TSP – 30 kg P/ha	4577	30 kg P/ha	30 kg P/ha
	Intercropping	TSP – 30 kg P/ha	4499	30 kg P/ha	30 kg P/ha
BUNGU – Y2	Mono-cropping	TSP – 30 kg P/ha	2848	15 kg P/ha	15 kg P/ha
	Intercropping	MPR– 15 kg P/ha	2603	30 kg P/ha*	30 kg P/ha
Both sites Y1 + Y2	**Both cropping systems**	**KCl – 40 & 80 kg K/ha**	**2314 - 4632**	**Y1 Bungu 0 Y2 Bungu 40 Y1&2 Soga 40**	**40 kg K/ha**

CONCLUSIONS

From the results of this study, it is concluded that:

- The fertility status of most of the soils in the cassava-based production systems is low (N,P, CEC, Zn, K, Ca etc)
- The soils of the study areas require K in combination with N, P, Zn application to optimise yields and sustain production
- K at the rate of 40 kg/ha in combination with N and P at the rate of 15 and 40 kg/ha respectively was optimum and economical rate that farmer can use to improve and sustain production in cassava based systems

Recommendations

- Potassium at the rate of 40 kg/ha be used in both cropping systems in the study areas
- Promotion of the use of the K fertilisers tested and incorporation of crop residues into the soils is required in the study areas
- More research on K fertiliser recommendation is required for enhancing and sustain production in areas under cassava cropping systems in Tanzania

End

Thank you