Potential for response to potash application: the case of maize and rice production in Tanzania

J. Wickama; N. Mnzava; S. Mwango; Z. Mkangwa

Introduction

- Maize and rice are the two most consumed cereals in Tanzania.
- Potassium is required in these crops to stimulate plant vigor, development of root system, resistance towards pests and diseases and preventing crop plants from lodging (Chianu *et al.*, 2012)
- Plants with insufficient K have difficulty absorbing water and N from the soil, which makes them more vulnerable to drought stress

Introduction (cont…)

- study of potassium's role in plant nutrition in Tanzania did not receive much enthusiasm in the past partly because it was taken for granted that the level of K was not limiting for the soils of Tanzania (Acland, 1971)

- Studies conducted in the rice fields of Lake zone (Meertens, 2003) and 8 rice growing areas from Mbeya, Coast and Morogoro(Semoka & Mnguu, 2000) found that extracted K values were higher than critical values
- **Potential response for potash nutrition in maize and rice in Tanzania is not adequately understood**

objectives

This paper examines status of Potassium in smallholder in selected areas in Tanzania and critically looks at;

- levels of soil exchangeable potassium in selected areas known for maize and rice production and;
- potential for response or non-response from selected sites towards K-application.

Materials and Methods

Data sources – 497 soil samples from;

- 13 rice irrigation schemes (116 samples)
- Smallholder farms from 14 districts (381 samples)
- Evaluation of exchangeable K was done from the top 30 cm of the soils.

Materials and Methods….. cont

- *Yields information*; Yields of maize and rice were obtained from farmers, Extensionists and other secondary sources

- Yields given in terms of bags (90 kgs bags per acre) were eventually converted into tons per hectare through calculations.

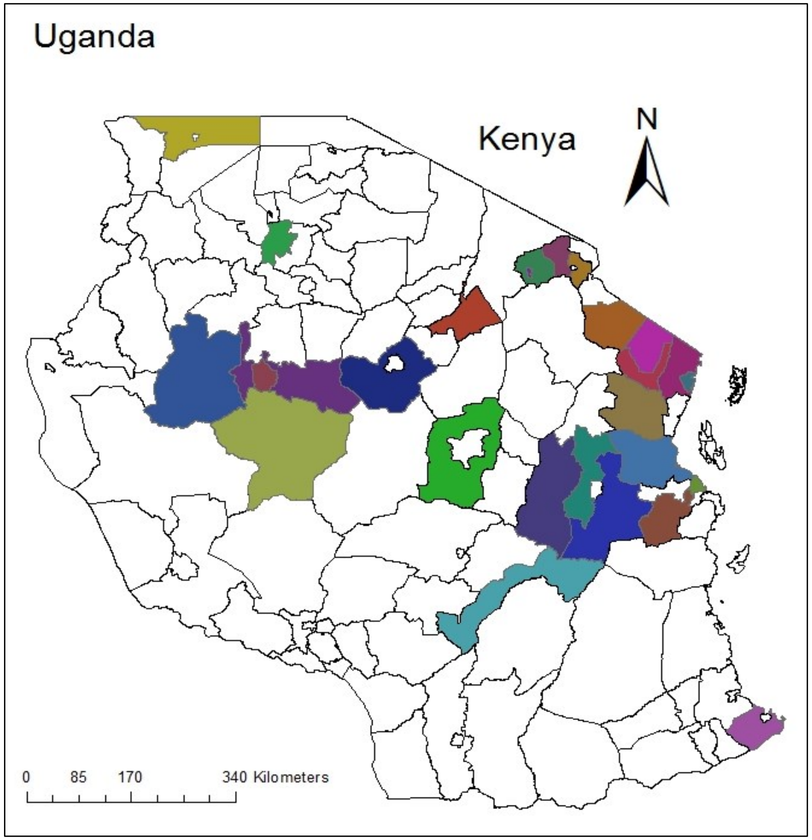
Materials and methods …. cont

- Data collected from each scheme were stored in spread sheets (Excel 2010). Statistical analyses on the soil properties were performed using Statistical software called Develve.

- Reference criteria on the sufficiency and implication of exchangeable K were obtained from literature (Landon, 1991, Baize, 1993).

Materials and methods cont……

Location of the study sites



Results-rice

Irrigation Schemes	Sampled locations	clay	Sand	pH	OrgC	TN	Av.P	Ca	Mg	K	K:Mg	Na	Rice yields
	n	%	%	(w)	%	%	(mg/kg)	(cmols/kg)	(cmols/kg)	(cmols/kg)	ratio	(cmols/kg)	ton/ha
Bahi-Dodoma	7	48	34.8	7.3	0.74	0.076	3.84	14.02	4.08	0.68	0.16	2.66	3.6 (b)
Dakawa-Mvomero	11	39.1	49.6	7.84	0.89	0.06	4.54	18.94	5.39	0.39	0.07	0.74	3.5 (b)
Eurorpryima	13	69.3	10.6	6.1	1.26	0.13	9.51	1.75	16.33	3.23	0.19	1.75	4.3(d)
Ilonga-Kilosa	20	36.3	46.6	7.3	1.21	0.13	38.85	8.59	2.75	1.27	0.46	0.09	4.9 (c)
Itigi-Singida	6	50	32.3	7.85	1.18	0.13	5.2	1.89	3.23	5.54	1.71	0.44	4.3(d)
Kitivo-Korogwe	5	34	54	7.86	17.57	0.21	7.655	29.76	1.31	1.15	0.87	0.51	5.1 (c)
Kivulini-Moshi	3	40	33	7.03	1.37	0.12	18.68	26.81	15.61	3.73	0.23	0.93	3.8(a)
Lekitatu-Arumeru	3	24	48	7.1	1.3	0.08	13.93	19.43	4.94	1.49	0.30	1.62	4.2(a)
Lower Moshi-Moshi	3	28	42	6.5	0.84	0.05	40.72	11.01	4.39	2.42	0.55	0.74	3.2 (c)
Lukenge-Mvomero	8	44.5	40.75	6.33	1.15	0.11	4.665	25.93	4.56	0.735	0.16	1.18	3.6 (b)
Mombo_Korogwe	13	42	38	7.35	1.76	0.2	27.87	21.2	3.98	0.78	0.19	1.26	3.9(a)
Ndungu-Same	16	42	39	6.59	1.39	0.12	3.24	14.24	5.16	0.67	0.13	9	4.3 (c)
Ruvu-Same	8	32.3	39.5	6.75	1.16	0.16	7.9	13.3	59.2	4.9	0.08	1.64	4.8(d)
Total/Mean	116	41	39	7.1	2.4	0.1	14.4	15.9	10.1	**2.1**	0.4	1.7	4.1

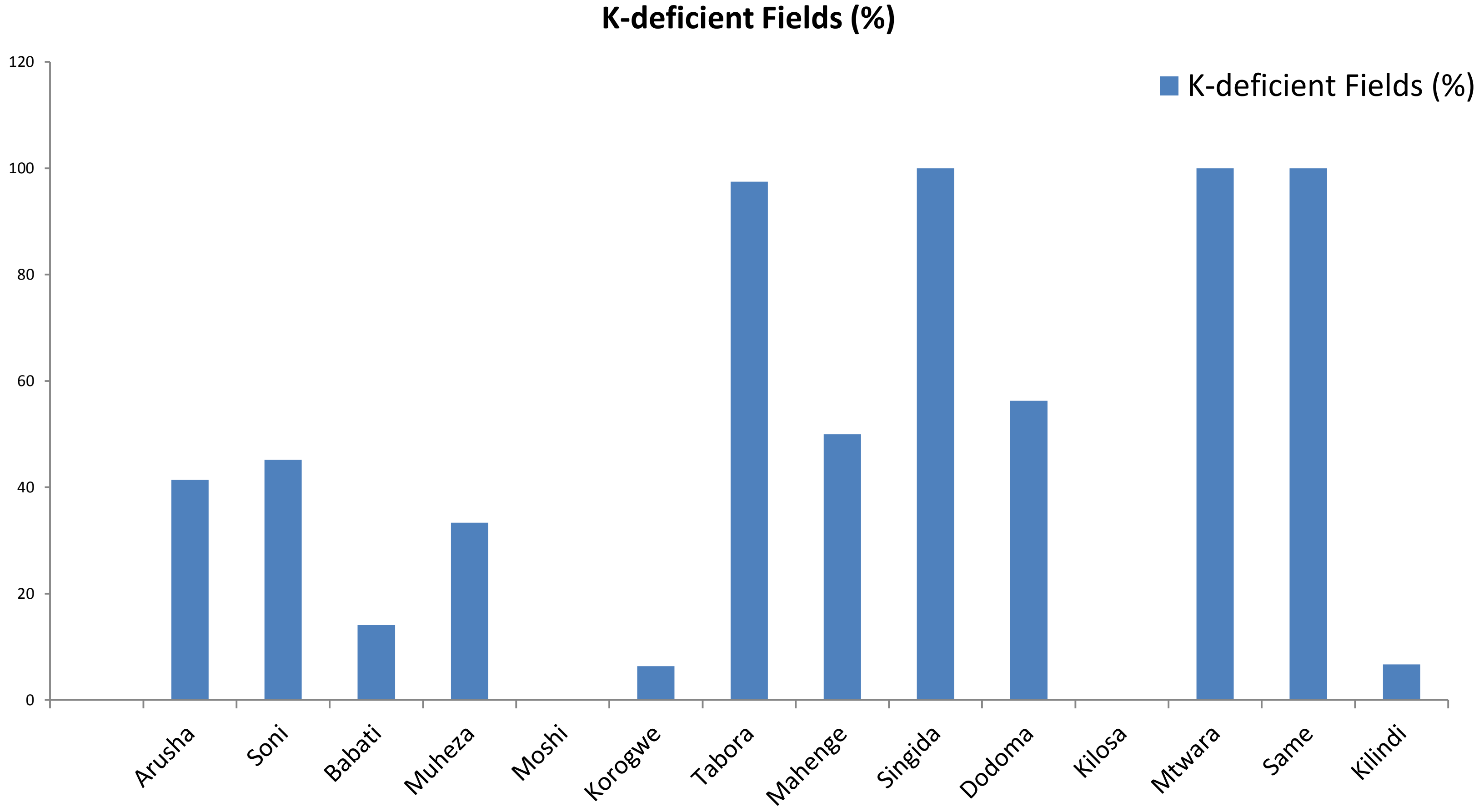
Stats-rice schemes

	clay	Sand	pH	OrgC	TN	Av.P	Ca	Mg	K	K:Mg	Na	Rice yields
Sampled loca	0.066	-0.025	-0.005	-0.039	-0.147	0.025	-0.061	-0.012	-0.054	-0.051	0.055	0.049
	0.81	0.93	0.98	0.88	0.59	0.93	0.82	0.97	0.84	0.85	0.84	0.86
clay		-0.838	-0.249	-0.170	-0.234	-0.368	-0.446	-0.067	0.155	0.033	0.121	-0.048
		0.00	0.35	0.53	0.38	0.16	0.08	0.81	0.57	0.90	0.65	0.86
Sand			0.513	0.401	0.251	0.140	0.564	-0.198	-0.451	0.046	-0.133	0.129
			0.04	0.12	0.35	0.61	0.02	0.46	0.08	0.87	0.62	0.64
pH				0.410	0.272	-0.093	0.178	-0.285	-0.039	0.508	-0.339	0.241
				0.12	0.31	0.73	0.51	0.29	0.88	0.04	0.20	0.37
OrgC					0.546	-0.145	0.481	-0.166	-0.149	0.320	-0.151	0.529
					0.03	0.59	0.06	0.54	0.58	0.23	0.58	0.04
TN						0.006	0.351	0.417	0.073	-0.009	-0.146	0.471
						0.98	0.18	0.11	0.79	0.97	0.59	0.07
Av.P							-0.111	-0.160	-0.036	0.031	-0.360	-0.090
							0.68	0.55	0.89	0.91	0.17	0.74
Ca								-0.121	-0.459	-0.309	-0.068	-0.083
								0.66	0.07	0.24	0.80	0.76
Mg									0.576	-0.302	-0.007	0.291
									0.02	0.26	0.98	0.27
K										0.468	-0.263	0.243
										0.07	0.33	0.36
K:Mg											-0.351	0.259
											0.18	0.33
Na												0.014
												0.96

Results-maize fields

Location of maize fields	Sampled locations	Clay	pH	Org.C	Av.P	K	Locations with K < critical level	Percent < critical level	Maize yields
	n	%	(w)	%	(mg/kg)	(meq/100g)	n		tons/ha
Arusha rural	29	35	5.5	1.5	6	1.85	12	41.4	1.623 (c, j)
Soni-Lushoto	31	40	6.1	2.3	2	0.82	14	45.2	1.227(b,e)
Babati	71	56	6.5	1.3	32	1.1	10	14.1	2.499(a)
Muheza	9	47	6.2	1.1	6	0.52	3	33.3	1.483(d)
KATC Moshi	31	31	7.8	0.8	3	1.24	0	0.00	1.423 (c)
Korogwe rural	47	38	6.6	1.3	11	2.03	3	6.4	1.563 (e)
Tabora rural	79	14	5.4	0.7	15	0.13	77	97.5	0.813 (j)
Lupiro-Mahenge	10	21	5.2	1.3	5	0.37	5	50.0	1.020 (g)
Singida rural	3	42	6.9	0.9	3	0.11	3	100	1.328 (e)
Dodoma rural	16	16	5.9	0.8	5	0.39	9	56.3	1.249 (e)
Kilosa rural	14	28	6.8	1.5	32	1.21	0	0.0	1.535(e)
Naliendele	9	10	5.5	0.5	4	0.11	9	100	0.918 (f)
Ruvu village	2	42	5.4	0.9	0.3	0.27	2	100	1.200 (h)
Kilindi rural	30	27	6.6	1.8	18	0.98	2	6.7	1.654 (i)
Total/Mean	381	32	6.2	1.2	10	0.8	149	39	1.395

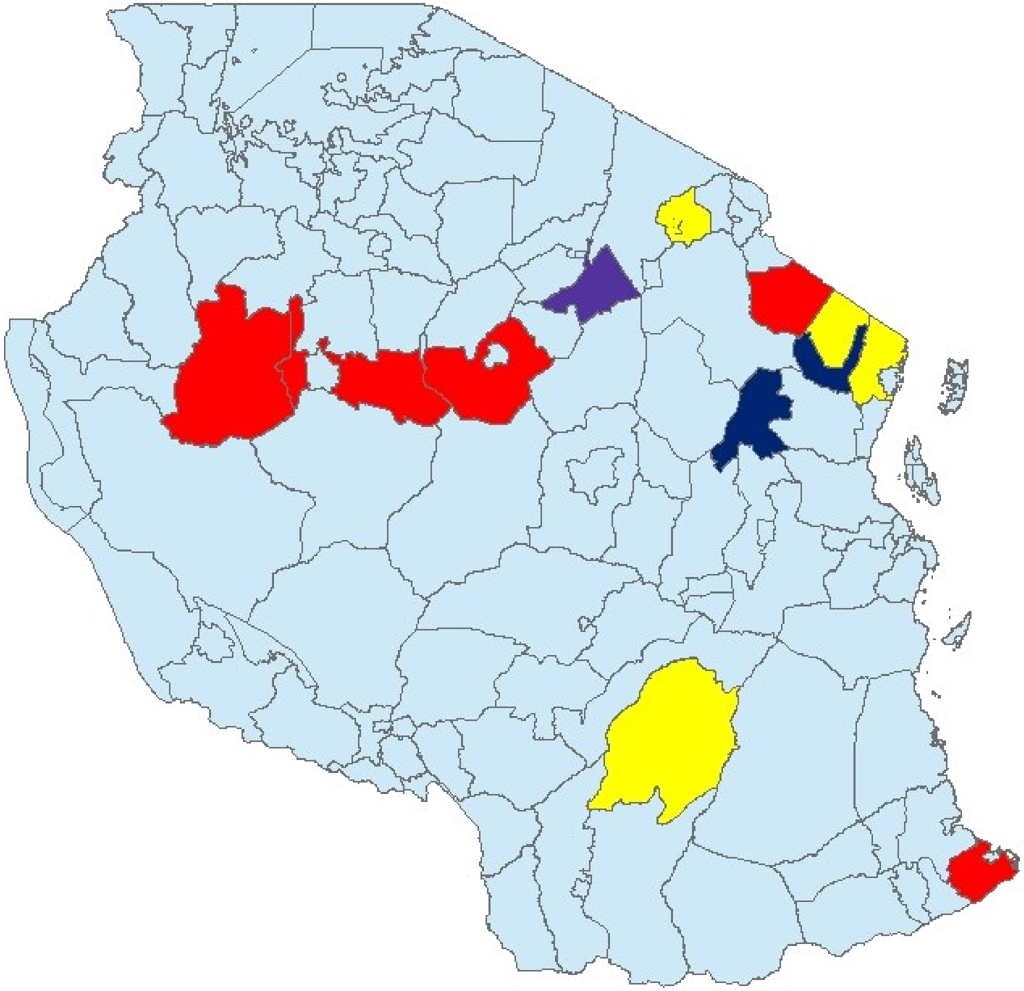
Areas with inadequate potassium in maize fields



Stats-maize fields

	Sampled locations	clay	pH	OrgC	Av.P	K	Locations with K < critical level	Percent < critical level	Maize yields
Maize fields	0.106	-0.560	-0.211	-0.424	-0.109	-0.589	0.611	0.562	-0.564
	0.69	0.02	0.43	0.10	0.69	0.02	0.01	0.02	0.02
Sampled loca		0.078	0.059	0.087	0.507	0.309	0.658	-0.229	0.327
		0.77	0.83	0.75	0.05	0.24	0.01	0.39	0.22
clay			0.351	0.373	0.169	0.334	-0.370	-0.301	0.714
			0.18	0.15	0.53	0.21	0.16	0.26	0.00
pH				0.111	0.248	0.389	-0.399	-0.607	0.458
				0.68	0.35	0.14	0.13	0.01	0.07
OrgC					0.244	0.500	-0.223	-0.530	0.358
					0.36	0.05	0.41	0.03	0.17
Av.P						0.324	0.098	-0.513	0.623
						0.22	0.72	0.04	0.01
K							-0.291	-0.771	0.578
							0.27	0.00	0.02
Locations wi								0.413	-0.384
								0.11	0.14
Percent < cri									-0.642
									0.01

Likely responses-maize



Red- Response > 50%

Yellow - Response 30- 50%

Blue - Response < 30%

conclusion

- There are no immediate dangers of potassium deficiency in most of the irrigated rice schemes
- Potash levels may not be sustained with adoption of high yielding rice varieties
- Nearly 40% of maize smallholder fields already have potassium levels below the critical levels
- There is a significant potential for response to K-application in maize fields