Phosphorus Mineralization and Uptake from Cattle and Goat Manure-based Phospho-Composts by Maize grown under Tunnel house conditions

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INTRODUCTION

- **W**idespread phosphorus (P) deficiency problem noticeable on many South Africa's smallholder farmlands (Mandiringana *et al*., 2006; Kutu, 2008)
- Such deficiency results in poor plant growth and low productivity (Trehan *et al*., 2001; Amanullah *et a*l., 2009)
- Soil P deficiency correction traditionally achieved through expensive inorganic P fertilization programme
- Compost constitutes a key technology for waste (nutrient) recycling in South Africa though its use as sole P source for crops is limited
- Agronomic use of non-reactive Phalaborwa ground phosphate rock (GPR) confers limited immediate nutrient advantage to the fertilized crop
- Production of P-rich phospho-composts from non-reactive GPR such as Phalaborwa phosphate rock had been reported elsewhere as cheaper P-source in under-resourced communities (Sekhar and Aery, 2001; Sarr et al., 2009)
- Hence, possible agronomic potential of co-composted Cattle and Goat manures with Phalaborwa GPR was evaluated through laboratory incubation and tunnel house bio-availability studies

MATERIALS AND METHODS

- **E**ight phospho-composts (Cattle and Goat-Manure based) produced by thermophilic process using Phalaborwa GPR (36.5% P_2O_5) mixed at ratios 7:3, 8:2, 9:1 & 5:5 (w/w). Composts without GPR and ordinary ground P rock treatments were included as checks.
- Cured phospho-composts were chemically characterized prior to use for P mineralization (incubation) and bio-availability (tunnel house) studies.

Phospho- Compost preparation

INCUBATION STUDY

- 1 kg air-dried soil mixed with compost in 15 mm plastic pot at targeted contribution of 200 kg N ha^{-1}, moistened & incubated for 42 days
- Soil scooped from pots at days 7, 14, 21, 28, 35 & 42 for extractable Bray P1 quantification

TUNNEL HOUSE STUDY

- Phospho-composts including inorganic P treatment (P_i) evaluated at 60 kg P ha^{-1} rate
- Two different surface soils (10% & 29% clay content with low in P level) were used
- 12 kg soil filled pots containing each treatment and three maize seeds arranged in RCBD
- Growth data and plant tissue P determined after 42 days

Incubated soil samples

RESULTS

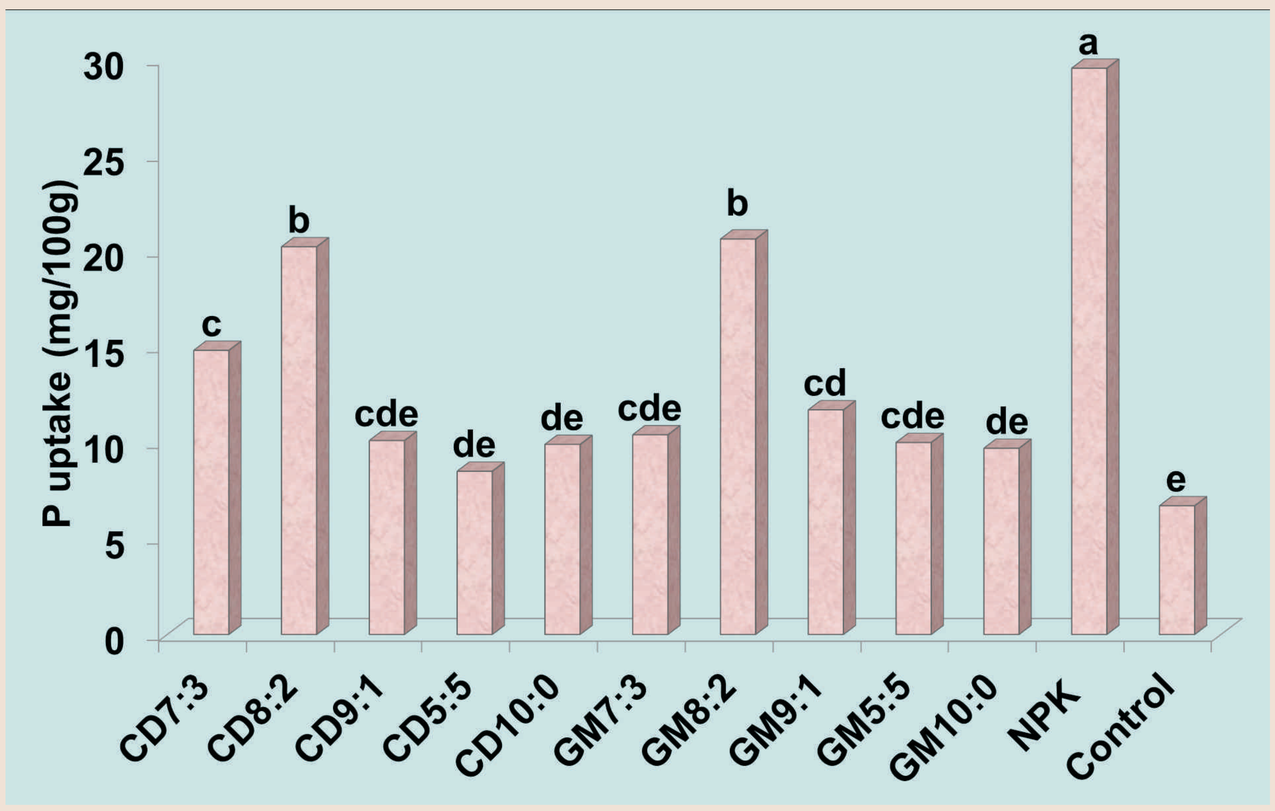

Fig 1: Tissue P uptake of maize plant as affected by application of different phospho-composts and inorganic fertilizer

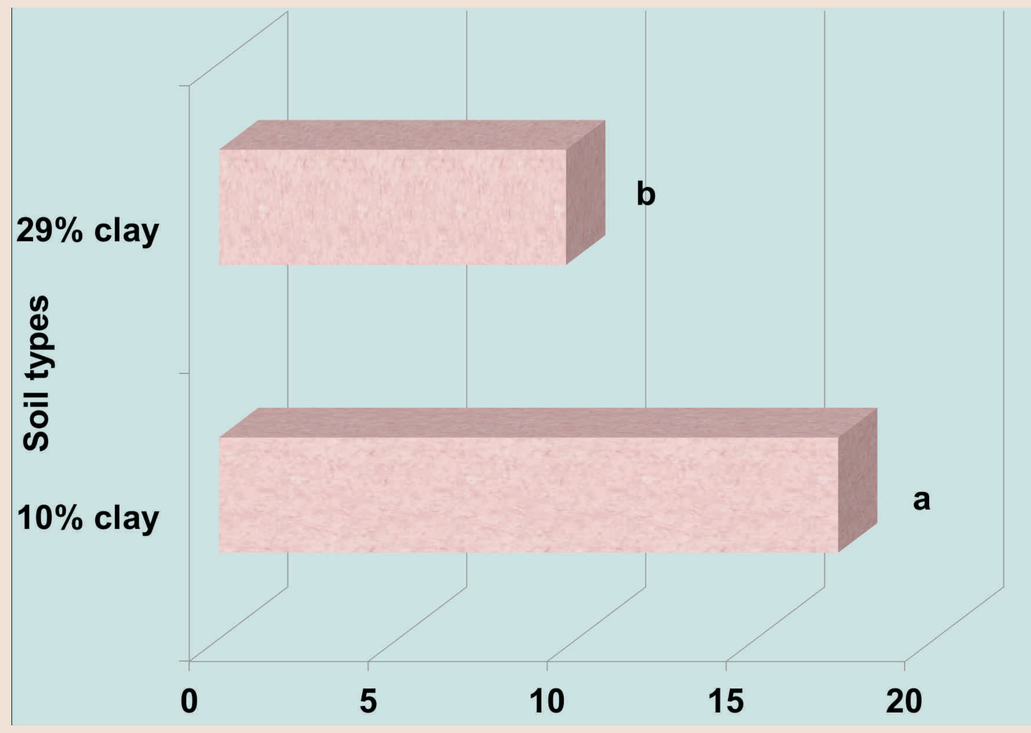

Fig 2: Maize plant tissue P uptake (mg/100g) in soils with different characteristics following phospho-compost application

Table1: Comparison of phosphorus mineralization (mg/kg) from the different phospho-composts

Phospho-composts and mix ratios		7DAI	14DAI	28DAI	35DAI	42DAI
manure - based	7:3	11.6a	5.8a	35.7a	33.9a	25.1a
	8:2	12.8a	3.6b	8.6b	4.2b	3.8cd
	9:1	6.3a	3.6b	5.8b	4.2b	3.4d
	5:5	8.0a	3.9ab	14.4b	6.1b	6.1bc
	10:0	7.4a	3.8ab	5.5b	2.8b	2.9d
Goat manure based	7:3	13.6a	3.8ab	15.6b	6.4b	6.9b
	8:2	12.6a	3.3b	15.5b	5.1b	3.2d
	9:1	12.4a	3.5b	8.9b	3.9b	2.9d
	5:5	11.1a	3.9b	20.1ab	6.0b	6.3bc
	10:0	4.9a	3.6b	5.0b	5.0b	4.4bcd
Ground phosphate		4.8a	3.1b	4.9b	3.8b	4.2cd
CV (%)		34.8	19.4	44.1	17.1	13.8
Prob		0.016	0.025	0.000	0.000	0.000

SUMMARY AND CONCLUSIONS

- Application of 8:2 phospho-compost mix ratio gave significantly ($P \leq 0.05$) and consistently higher maize tissue P uptake than any other mix ratios for both cattle and goat manure.
- Variation in percent soil clay content exerted significant influence on plant P uptake following application of phospho-composts; with plant P uptake being significantly higher in soil with reduced percent clay content.
- Amount of P mineralized during each sampling date from the different phospho-compost mix ratios differed significantly ($P<0.05$).
- Quantitatively higher P concentration was mineralized from cattle manure-based phospho-composts than from goat manure-based phospho-composts.

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