Quantification of Plant Available Potassium (K) at Various Depths in Soils of the Texas High Plains

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Introduction

•Potassium (K) is an essential plant nutrient required for cotton growth. Deficiency may decrease lint yield and fiber quality and reduce drought and disease tolerance.

•Most Texas soils are reported to be close to or above the critical value (150ppm) of K for optimum cotton production.

•Severity of K deficiency symptoms in cotton on these highly productive soils has been increasing over the past decade.

•Potential for K fixation is high in highly weathered illitic soils.

•It is also possible that current ammonium based extraction solutions may be overestimating plant available K in soils containing certain 2:1 clay minerals.

Objectives

•Quantify K using different extraction methods in selected soils of the Texas High Plains.

•Determine potential for K fixation in soils of the Texas High Plains.

Materials and Methods

Potassium Extractions

•Study was conducted in Spring 2015 and Spring 2016.

•Pre-plant soil samples were collected and analyzed for their K content using the Optical Emission Spectroscopy of the Inductively Coupled Plasma (ICP-OES) ICAP series (Thermo Fisher Scientific, Waltham, MA).

•Soils here are of the Acuff (Lubbock), and Amarillo series (Lamesa). Soil samples were collected at the 0 - 15cm, 15 - 30 cm, and 30 - 60 cm depths.

• K concentration determined using three extraction methods

1. Mehlich III (Mehlich, 1978)

2. Ammonium acetate extraction (Carson, 1980)

3. H3A (Haney et al, 2006)

Potassium Fixation

•Following the incubation method developed by Casmman et al, 1982.; and modified by Galvak et al, 2005.

•K extraction mean differences were tested using SAS v 9.4 at the 95% confidence interval level.

•Means were separated using the Fishers Protected least significant difference (LSD).

•Soil textural analysis based on the Bouyoucos method was conducted to determine clay percentages of the soils.

Table 1: Pre-sampling soil characterization (0-60cm)

	pH	EC	P	Ca	Mg	S	Na
		(dS/m)			(mg/kg)		
Lubbock	7.8	0.301	16	1329	304	16	5
Lamesa	7	0.149	21	1223	298	7	8

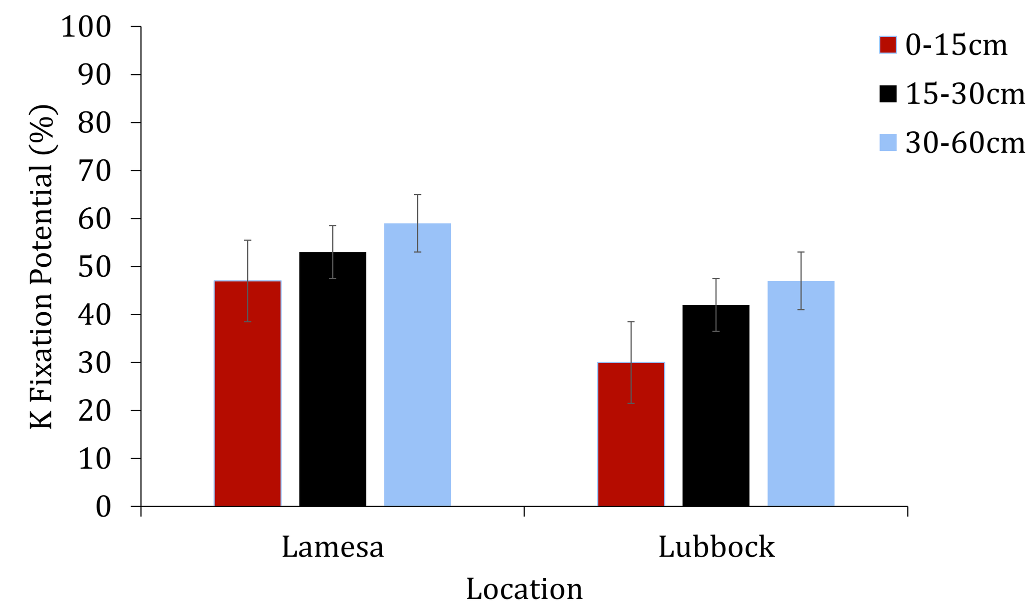

Figure 1: K fixation potential in the studied locations

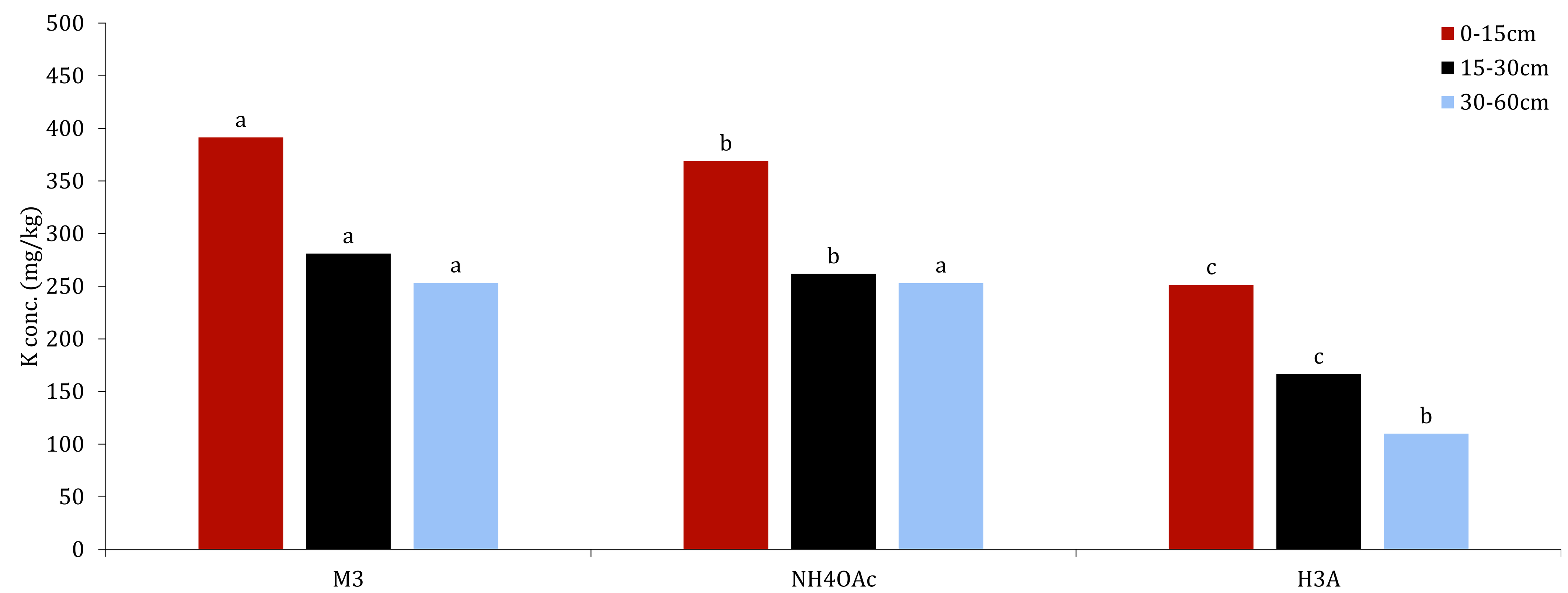

Figure 2: Potassium concentrations by method of extraction at different depths in 2015 for Lamesa. Means within depth with the same letters are not significantly different at $p \leq 0.05$

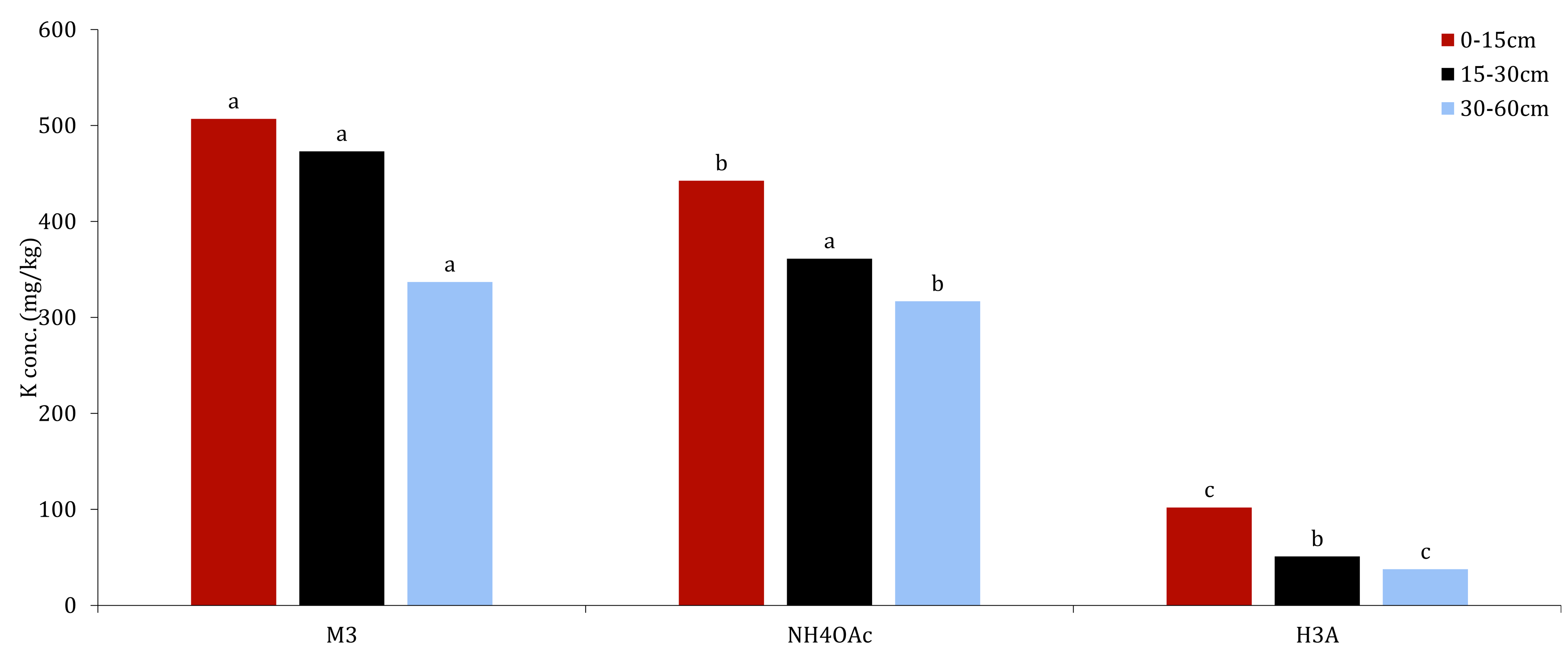

Figure 3: Potassium concentrations by method of extraction at different depths in 2016 for Lubbock. Means within depth with the same letters are not significantly different at $p \leq 0.05$

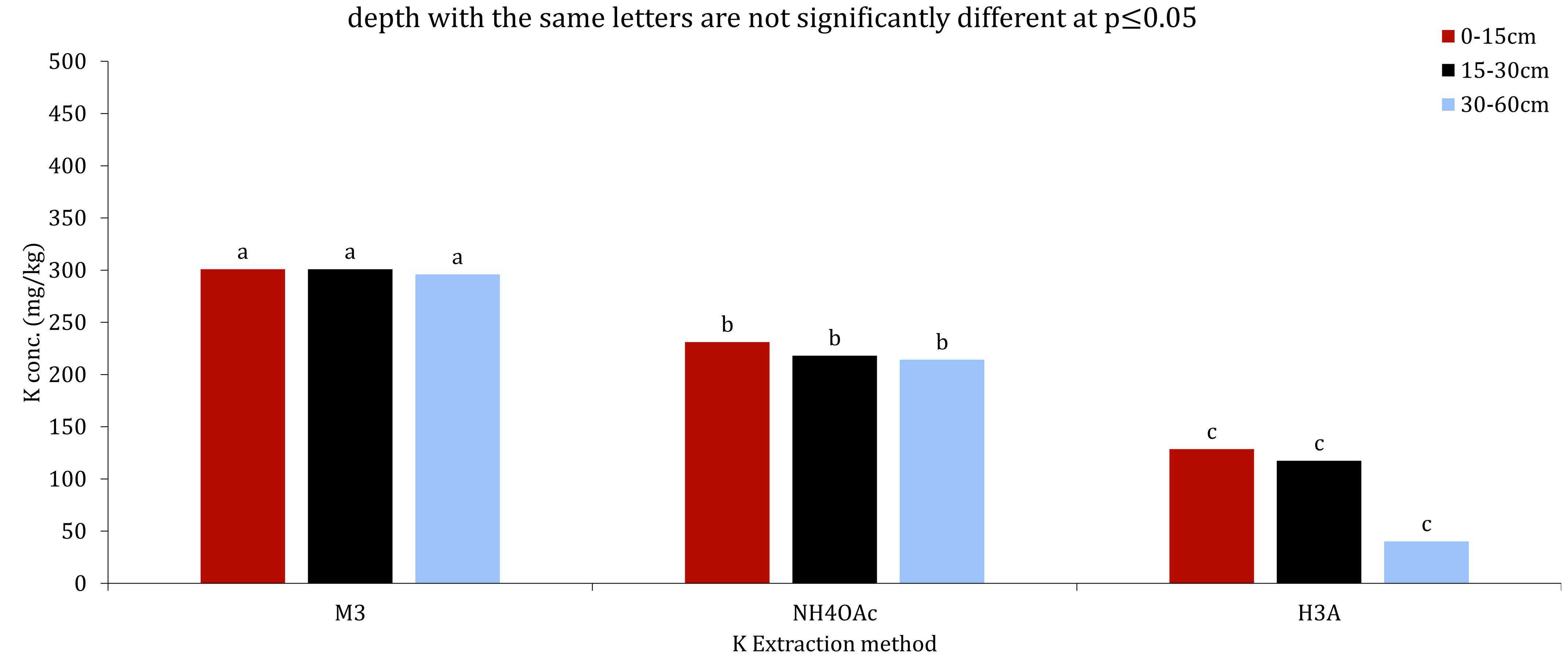

Figure 4: Potassium concentrations by method of extraction at different depths in 2016 for Lamesa. Means within depth with the same letters are not significantly different at $p \leq 0.05$

Discussion

•Mehlich III extraction resulted in K levels ranging from 299 to 450 mg/kg across years.

• Ammonium acetate extraction resulted in K levels ranging from 221 to 373 mg/kg

• H3A extraction method resulted in K levels ranging from 63 to 175 mg/kg

•Both NH_4OAc and Mehlich III extracted greater compared to H3A.

•The Amarillo series had 15%, 16% and 20% clay in the 0-15, 15-30, and 30-60 cm depths, respectively.

•The Acuff series had 19%, 119% and 27% clay in the 0-15, 15-30, and 30-60 cm depths, respectively.

•The K fixation test revealed that Lamesa soils have a potential K fixation capacity of 40-60% in both years, and 30 – 48% in Lubbock.

Conclusion

•About 25-60% of the applied K gets fixed. Clay minerals in the soil could be responsible for K fixation.

•The potential for NH_4^+ in ammonium-based extractants to replace K in the soils is high, leading to overestimation of plant available K in the soil.

•Re-evaluation of soil extraction methods for K may be necessary

Further Research

•Clay mineral identification will be conducted using XRD to determine their role in the fixation of K in the soils.

•Laboratory and field tests to determine efficiency of commercial soil K release products.

•CEC and base saturation measurements to determine the soils nutrient release potential.

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