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WATER VERSUS AMMONIUM ACETATE EXTRACTED POTASSIUM IN NEW MEXICO SOILS

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Abstract

Soil test potassium (K) for New Mexico cotton growers usually returns a high value for ammonium acetate extractable K. Despite high soil test K many commercial soil test laboratories recommend the addition of potash (K_2O) fertilizer. It appears that soil test laboratories are using basic cation saturation ratios to assess the relative availability of potassium to cotton. Water extractable potassium used by New Mexico State University may avoid the confusion this causes cotton producers. Grid sampled cotton fields were assessed for relationships between water and ammonium acetate (NH_4OAc) extractable potassium. Soil samples were also tested for exchangeable calcium (Ca) and magnesium (Mg). Cotton yield and lint quality was also assessed for each grid point for comparison to soil test parameters. Clay textured soil samples exhibited a positive relationship between ammonium acetate and water extractable K. The Ca:Mg ratio had no effect on lint yield or quality. Water extractable K may be a better method to assess K sufficiency since the interpretation considers K less than 60 mg kg^{-1} to be deficient for cotton.

Introduction

Soil K exists in solution, exchangeable, and non-exchangeable forms that are in dynamic equilibrium with each other. Exchangeable K is defined specifically as that which is extracted with neutral 1.0*N* NH_4OAc minus the water soluble K (Knudsen et al., 1982). This procedure is highly recommended for soils that are saline and can be ignored for non-saline environments. It has also been recommended that soil with a high calcium carbonate content be extracted for K using BaCl, buffered to pH 8.0 to 8.2. Calcium carbonate contents of most soils used for cotton production in southern New Mexico have more than 5 percent calcium carbonate by weight. Western soils will generally have more than a few parts per million water-soluble potassium. The magnitude of the difference between water-soluble K and exchangeable K could contribute to the confusion experienced by cotton producers when potash is suggested for soils testing high in NH_4OAc extractable K.

Pettiet (1988) suggested that high exchangeable magnesium concentrations in Mississippi Delta soils may be primarily responsible for potash fertilizer response in cotton despite high levels of exchangeable K. Eckert (1987) suggested an ideal basic cation saturation ratio that included 65 percent Ca, 10 percent Mg, 5 percent K. More recently, Gladbach et al. (2000) have begun investigations on the effect of soil Ca:Mg ratios on potassium uptake and cotton yield. Although no significant effects were reported there still appears to be an adherence by soil testing labs to follow Eckert's (1987) assertion of balanced ratios when cotton is the chosen crop. For example, in one proprietary agronomic handbook the desired concentrations of K, Mg, and Ca for a soil with a cation exchange capacity of 20 meq/100 g are 195 - 275 ppm K, 240 ppm Mg, and 2600 ppm Ca. The greater the exchange capacity the greater the concentrations of K, Mg, and Ca. A study was begun in 2001 to assess the relationships between exchangeable K, water soluble K, and the Ca:Mg ratio on soils used for cotton production in NM.

Materials and Methods

Soil samples from grid sampled fields in Lea, Chaves, Eddy, Dona Ana, and Luna counties were analyzed for water soluble K, exchangeable K using 1.0*N* NH_4OAc, Ca, and Mg. Yield and lint quality samples were taken at harvest from each grid location within the field. Sample results were classified according to sufficiency range. Potassium was considered sufficient when water extractable K exceeded 60 ppm K (Herrera, 2000). Exchangeable K was considered sufficient at levels above 105 ppm (Weir et al., 1996).

Results and Discussion

Sufficiency classification changed from sufficient to low or moderate when water replaced ammonium acetate K as the extracting agent (Table 1). One site exhibited a positive correlation between electrical conductivity and water extractable K which is thought to be common in saline soils. Subtracting water soluble K from exchangeable K did not affect K sufficiency range. Clay textured soil samples had a more positive correlation between exchangeable and water extactable K (data not presented) Field Ca:Mg ratio varied depending on location but had no correlation with yield for each site (Table 2). Yield and fiber quality did not appear to be affected by Ca:Mg levels, water soluble K or exchangeable K.

Conclusions

Exchangeable K adequately describes K availability for cotton yield. Water soluble K often justifies the addition of potash fertilizer since levels remain low when exchangeable K is high. Ca and Mg ratios had no effect on cotton lint yield or quality. This makes the use of base saturation indexes suspect for fertilizer recommendation in New Mexico.

References

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Table 1. Median exchangeable, water soluble, and NH_4OAc extractable K from four NM locations with their respective sufficiency rating using 105 mg kg^{-1} for exchangeable and NH4OAc extractable and 60 mg kg^{-1} for water soluble K.

	Exchangeable		**Water soluble**		**NH_4OAc**		**e.c.**	**K vs EC**
Site	**mg kg^{-1}**	**Rating**	**mg kg^{-1}**	**Rating**	**mg kg^{-1}**	**Rating**	**dS m^{-1}**	**correlation**
1	290	Sufficient	22	Low	312	Sufficient	1.87	0.75
2	152	Sufficient	12	Low	163	Sufficient	2.42	0.31
3	119	Sufficient	9	Low	128	Sufficient	0.86	-0.08
4	529	Sufficient	44	moderate	583	Sufficient	0.65	0.02

Potash fertilizer was recommended despite high levels potassium extracted with NH_4OAc.

Table 2. Median Ca:Mg ratio, lint yield, and correlation between each for four sites sampled in 2001.

		Ca:Mg			**Lint Yield**	**Yield vs Ca:Mg**
Site	**n**	**median**	**max**	**min**	**lb lint /acre**	**r**
1	52	1.01	1.51	0.60	2757	-0.01
2	48	4.65	5.17	4.17	1917	-0.10
3	54	4.39	5.72	2.68	1240	-0.07
4	90	4.28	8.14	1.41	N/A	N/A