Calcium, Magnesium, and Potassium as Affected by Tillage and Cropping System

Ruben A. Ortiz and R. N. Gallaher

Department of Agronomy, IFAS, University of Florida, Gainesville, FL 32611

INTRODUCTION

Higher soil Ca and Mg levels have been reported in no-tillage systems compared with conventional-tillage (Hargrove et al., 1982, Ferres, 1984). Blevins et al. (1977) found no significant effects in exchangeable Ca under different tillage methods. Triplett and Van Doren (1969), and Ferrer (1984) pointed out that soil K levels in the first 5.0 cm were greater for no-tillage treatments. In contrast, Hargrove et al., (1982) showed lower K concentrations in no-tillage compared to conventional-tillage. The purpose of this study was to evaluate soil extractable Ca, Mg, and K as affected by tillage and cropping system in a 7 year-old multiple cropping experiment.

MATERIALS AND METHODS

The experiment was conducted at Green Acres Agronomy farm near Gainesville, Florida on an Arrendondo loamy sand, a member of the loamy, silicious, hyperthermic family of grossarenic Paleudults. The field study started in 1976 included cropping systems of oat (Avena sativa/soybean (Glycine max L. Merr.) versus oat/grain sorghum (Sorghum bicolor L.). Cropping systems were split plots radomized within whole plots of four tillage variables. The whole plots were in a randomized complete block design with four replications and included no-tillage versus conventional-tillage with and without in-row subsoiling. Soil samples were taken in 12 increments to a depth of 80 cm for laboratory analyses of Ca, Mg, and K extracted by two methods, Mehlich I and Neutral Normal Ammonium Acetate.

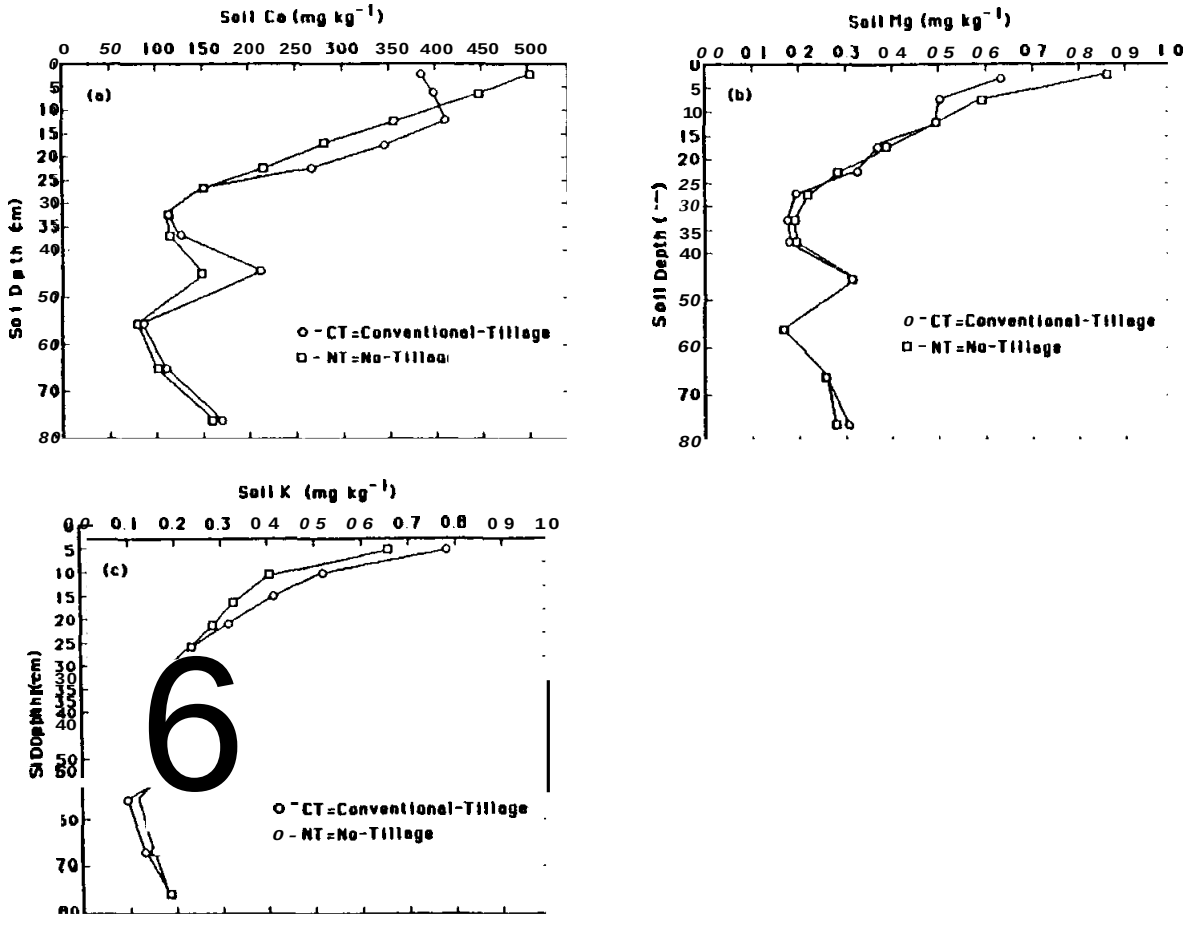

Fig. 1. Extractable Ca, Mg, and K as affected by tillage.

RESULTS AND DISCUSSION

Tillage

Tillage influenced Ca to a depth of 25 cm. Higher Ca contents were observed in no–tillage through a depth of 10 cm as opposed to conventional–tillage which showed more Ca content from the 10 to 25 cm depth. This can be explained by soil mixing and Ca dispersion during conventional plowing operations (Fig. la). Magnesium content was also higher in no–tillage at the 0-10 cm depth (Fig. lb).

Greater soil K concentration was observed in conventional–tillage at the 0–15 cm depth. Old root channels in the soil may be acting as capilar pathways, resulting in leaching of K from no–tillage plots (Fig. lc).

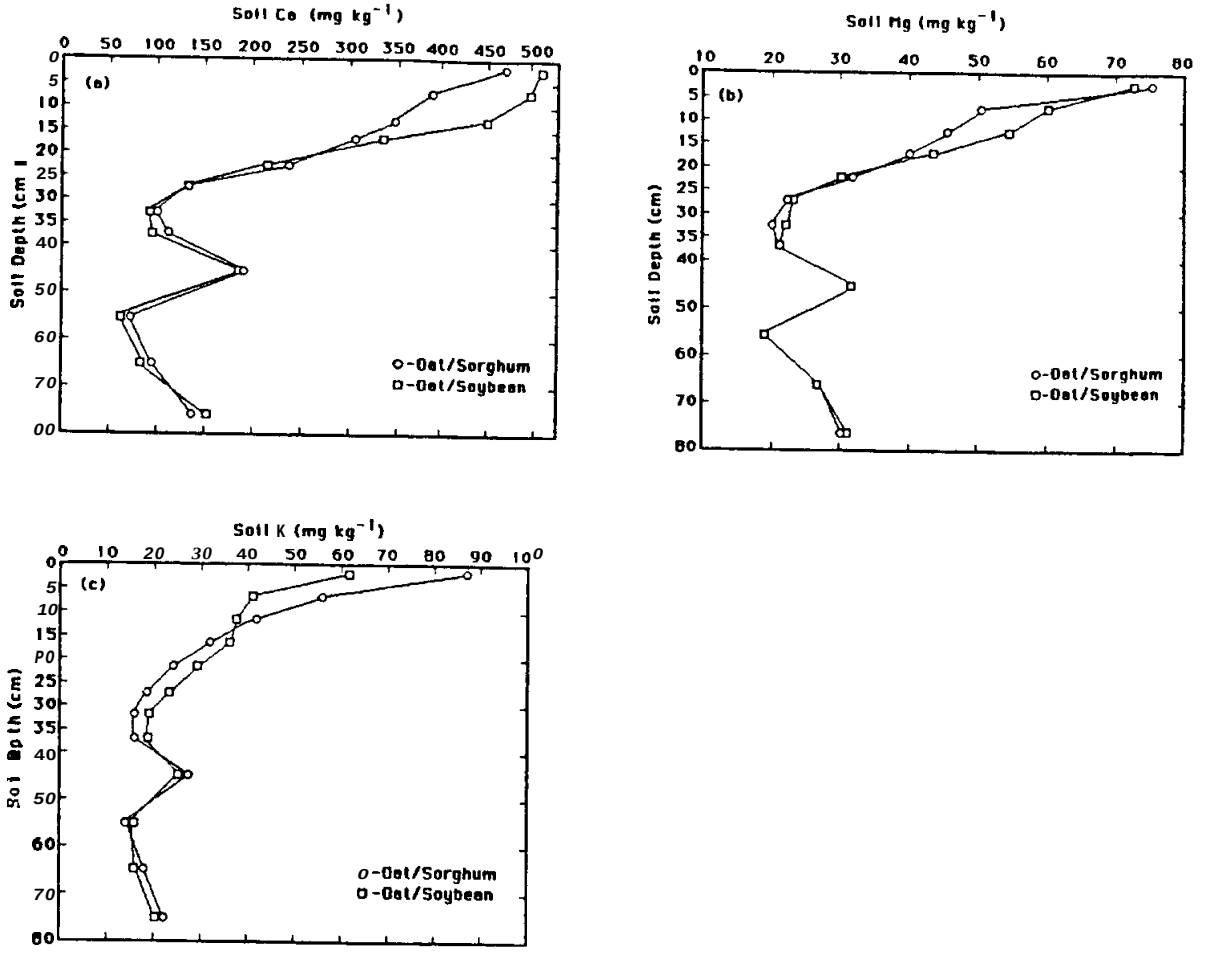

Fig. 2. Extractable Ca, Mg, and K as affected by cropping system.

Cropping System

Higher Ca and Mg contents were found in the oat/soybean soil surface compared to the oat/grain sorghum cropping system. These results indicate a greater Ca and Mg return and more nutrient conservation in the oat/soybean system (Fig. 2a and 2b).

However, more soil K was observed at the 0–10 cm depth in the oat/sorghum compared to the oat/soybean cropping system. A reverse effect occured at the 20–30 cm depth which indicates K is being taken out from the lower depths and accumulated in the soil surface by the sorghum system (Fig. 2c).

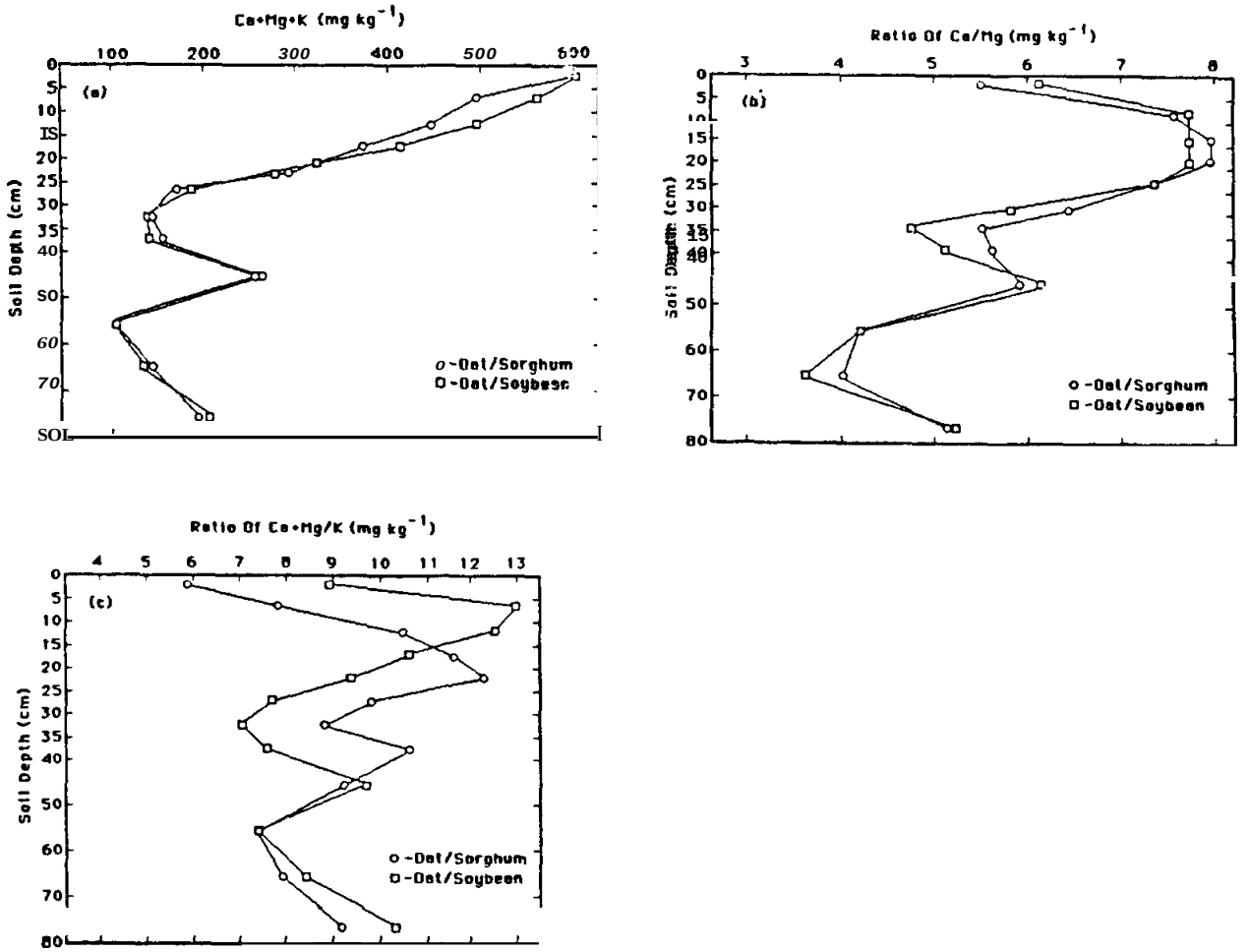

Fig.3. Total extractable Ca+Mg+K and the Ca/Mg and Ca+Mg/K ratios as affected by cropping system.

Total Ca+K+Mg and the Ca/Mg, and Ca+Mg/K Ratios

The total extracted Ca+K+Mg and the ratios of extractible Ca/Mg and Ca+Mg/K were also calculated. In the oat/soybean system there was a higher total extractible Ca+K+Mg in the soil surface, indicating a greater conservation of these elements by this cropping system. The Ca/Mg and Ca+Mg/K ratios of extractible nutrients were higher in the oat/soybean system in the 0–10 cm depth. In contrast, a reverse effect was observed at the 10–15 cm, and 25-40 cm depths for the Ca/Mg ratio, and 20-40 cm depth for the Ca+Mg/K ratio (Fig. 3a, 3b, and 3c). Therefore, there was more Ca in relation to Mg and more Ca+Mg in relation to K. As a result, Ca and Mg were taken up from lower depths and deposited in the surface by the oat/soybean cropping system.

CONCLUSIONS

Tillage affected Ca, Mg, and K in the 0 to 15 cm soil depth. Higher Ca and Mg contents were found in no-tillage compared to conventional-tillage treatments at the 0-5 cm depth. Soil K was higher in conventional-tillage than in no-tillage treatments at 0-15 cm depth. There was a trend for higher Ca and Mg content over the conbined 0-15 cm depth in no-tillage compared to conventional-tillage treatments. The oat/soybean cropping system showed more Ca and Mg in the soil surface than the oat/sorghum cropping system. A reverse effect occured for soil K; the ratios of the total extractible Ca+Mg+K, Ca/Mg, and Ca+Mg/K were higher in the oat/soybean compared to the oat/sorghum cropping system at the 0-15 cm depth. Factors such as tillage, cropping system, crop nutrition, and root system influenced soil Ca, Mg, and K content.

LITERATURE CITED

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