Mehlich I Extractable Soil Calcium, Magnesium, and Potassium in an Oat/Soybean Doublecropping System as Affected by Tillage and Time

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INTRODUCTION

The reason for this research project was to study the change in soil test of available nutrients over time as affected by tillage in an oat (Avena sativa)/soybean (Glycine max L. Merr.) doublecropping system. There have been conflicting reports of tillage influence on nutrients in the past and this may be due to a diurnal fluctuation of available nutrients in the soil. If this is the case, the time of sampling would be an important factor in interpreting the results of tillage comparison studies. The purpose of this study was to determine the influence of tillage and time of year on soil extractable Ca, Mg, and K in an oat/soybean double cropping system.

MATERIALS AND METHODS

The experiment was set up as a randomized complete block design with four replications. The four tillage treatments are no tillage (NT) and conventional tillage (CT) plus and minus subsoiling. The oat/soybean doublecropping system is located at the Green Acres agronomy farm, 12 miles west of Gainesville, FL. Samples are taken approximately monthly and sampled at the 0–20 cm and 20–40 cm depths over a 24 month period. The data to be discussed includes soil samples taken from September 6, 1983 to December 12, 1984. The Melich I (double acid) method of soil testing was used and the data on Ca, Mg, and K will be presented for the average of no–tillage versus conventional tillage treatments.

RESULTS AND DISCUSSION

Calcium in both CT and NT decreased over time at the 0–20 cm soil depth (Fig 1). Dolomitic limestone was last applied in the Fall of 1976. Calcium and Mg, at the 0–20 cm soil depth in the NT plots were higher than in CT plots (fig. 1&3)however, Ca and Mg at the lower soil increment of 20-40 cm was higher in the CT plots (fig. 2&4). This is due to the plant roots in the NT plots mining soil nutrients from the lower depths and depositing them on the surface in crop residues. Old root channels in the NT plots can cause excessive leaching at this lower level. The Ca/Mg ratio at both soil increments shows that Ca is higher in relation to Mg in the CT plots (fig. 5&6). There is more available Mg for the plants in the NT plots as compared to Ca.

Potassium at the 0-20 cm depth is not different in either tillage treatment but, NT is slightly higher at the 20-40 cm depth than for CT (fig. 7&8). Due to incorporation and mixing of the residue in CT, K could be released more readily and be utilized by the plant or leached out of the soil causing K to be lower. The NT treatment could possibly hold or conserve K better than the CT treatment. There is no difference between tillage treatments in the Ca+Mg/K ratio at the 0-20 cm depth, however, a seasonal fluctuation is observed in both tillage treatments associated with each cropping system (fig. 9). Potassium is higher at the very end and beginning of each crop life cycle in relation to Ca+Mg, showing its higher availability during this time. It seems from the data so far that K is favored over Ca+Mg in residue release. Calcium and Mg are more available for plant use during the time periods, as shown on the graph, where the slope is positive. At the 20-40 cm soil depth, CT is higher in all the cropping systems for the Ca+Mg/K ratio (fig. 10). Calcium and Mg contents are favored in the CT plots compared to K. In the NT plots, K is held more efficiently than in the CT plots at the lower soil depth. The total extractable Ca+Mg+K decreased over time at the 0-20 cm depth in both tillage treatments (fig. 11). The NT treatment was higher in the CT plots at the 0-20 cm depth because of the mining effect of the roots in NT. The nutrients are pulled up and left on the surface, depleting the lower depths. The CT plots are higher in Ca+Mg+K at 20-40 cms due to the mining effect in the NT and more leaching (fig. 12).

CONCLUSIONS

Magnesium and Ca were higher at the 0-20 cm soil depth for NT due to roots drawing up these nutrients and leaving them on the surface. Magnesium and Ca were lower at the 20-40 cm depth in the NT rather than the CT plots because of leaching due to old root channels and also mining effect of roots in the NT plots depleting the lower depths. Potassium is conserved more in relation to Ca+Mg in NT compared to CT. Further study may confirm that K is favored over Mg and Ca in residue release.

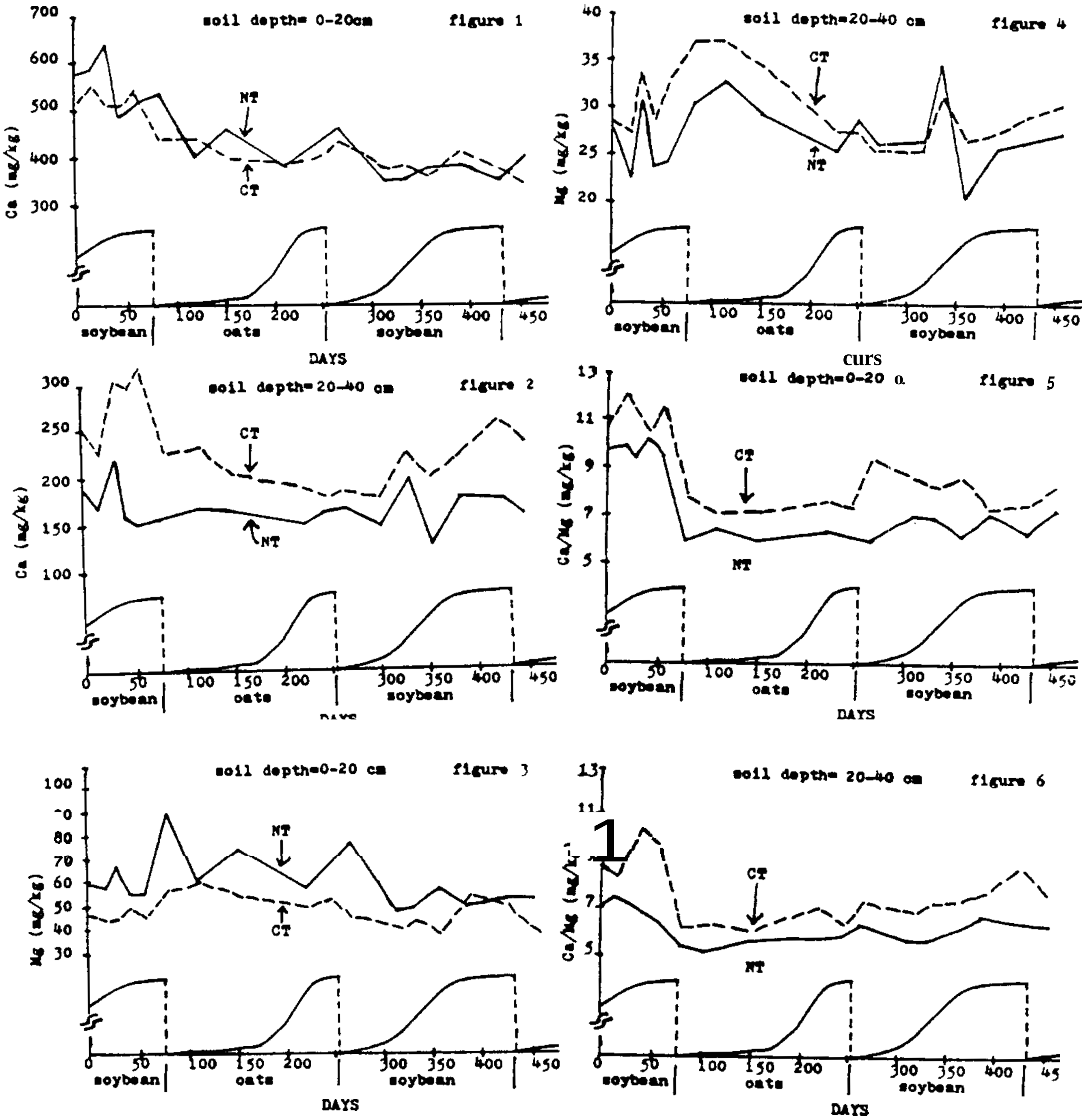

Figure 1-6. Extractable soil Ca, and Mg, and the Ca/Mg ratio as affected by tillage, time, and soil depth in an oat/soybean double cropping system. CT= Conventional tillage, NT= No tillage.

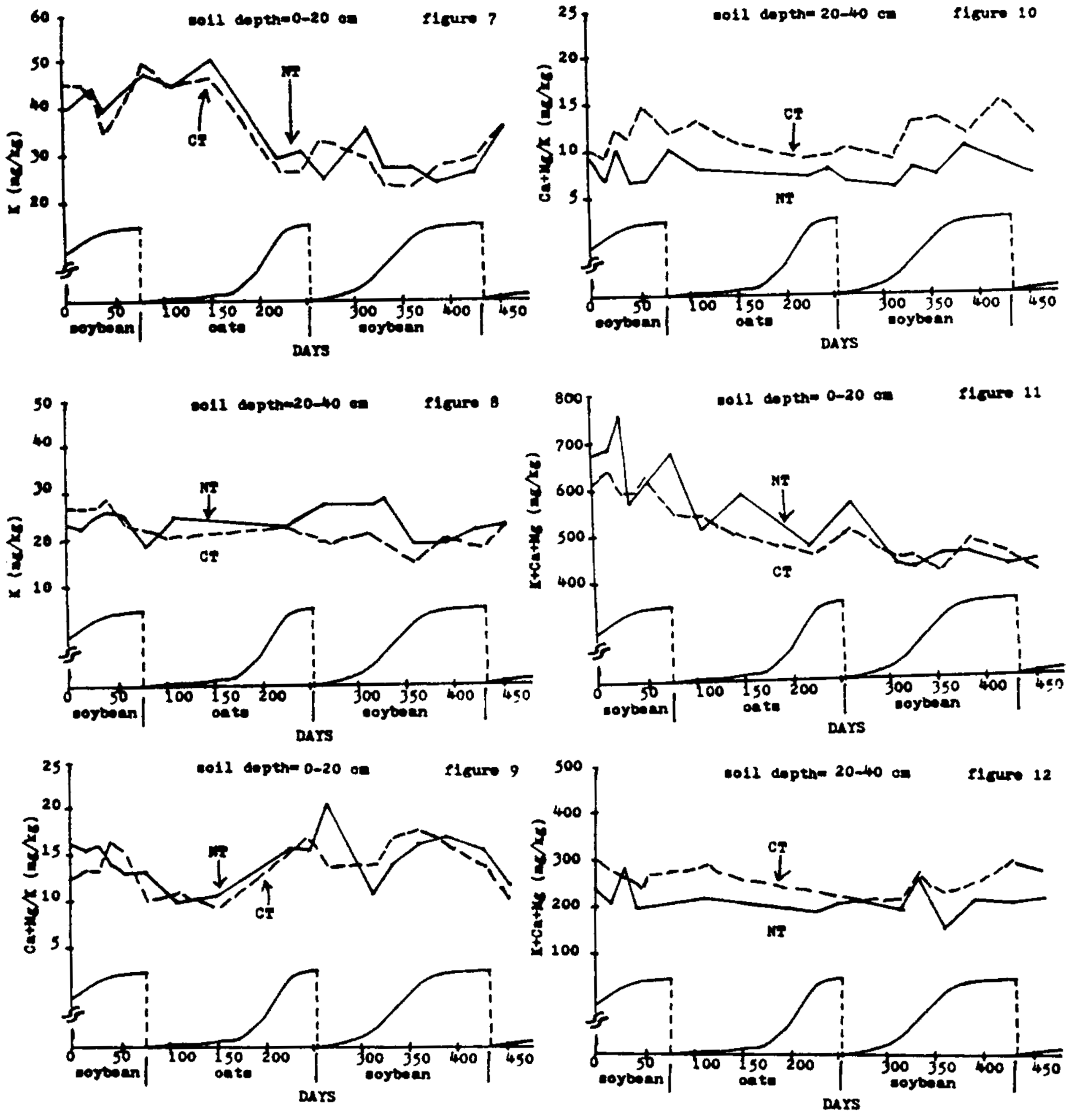

Figure 7–12. Extractable soil K, Ca+Mg/K ratio and the total extractable Ca+Mg+K *as* affected by tillage, time and soil depth in an oat/soybean double cropping system. CT= Conventiona tillage, NT= No tillage.