

SOIL MANAGEMENT PRACTICES: INFLUENCE ON SOIL NUTRIENTS

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INTRODUCTION

Large scale and aggressive tillage practices have caused dramatic declines in soil productivity during the 20th century (Lal and Kimble, 1997). For many decades, tillage has been the preferred method of soil preparation for planting, organic matter and fertilizer incorporation, accelerate soil warming and increase soil aeration (Llewellyn *et al.*, 2012). Because of increased aeration and residue mixing encouraged by tillage, Hendrix *et al.*, (1986) reported that nutrient uptake by plants is generally greater with conventional tillage compared with no tillage. Crop rotations, especially one that includes legumes and cover crops can influence soil nutrient status. Legumes have been reported to add both organic matter and N to the soil (Omay *et al.*, 1997; Sainju *et al.*, 2003) and increase soil fertility. Cover crops can reduce nitrogen and phosphorous loss by scavenging these excess nutrients. Our objective was to evaluate the influence of a combination of tillage, crop rotation and cover crop on soil nutrients..

HOW THE RESEARCH WAS CONDUCTED

This study was conducted at Lincoln University's Freeman farm during the 2011-2013 growing seasons. The 3 factors (treatments) were two levels of tillage (no-tillage vs moldboard [conventional] tillage), two levels of cover crop (no-rye vs rye) and four levels of rotation (continuous corn, continuous soybean, corn/soybean, and soybean/corn rotations). Soil samples were taken each year at four different depths in each plot; 0-4 inches, 4-8 inches, 8-16 inches and 16-24 inches and analyzed in the laboratory for soil nutrients



Above: Corn/Soybean rotation
Right: Soil Sampling



KEY FINDINGS

- ❖ During the first year of the study, NO_3^- levels were about 40% greater when the soil was tilled compared with no tillage. This suggests that soil tillage can lead to nitrate leaching.
- ❖ In the second year of study, a combination of tillage and crop rotation showed that NH_4^+ was greatest when the field was tilled with a monoculture of continuous corn compared with any other treatment for the interaction.
- ❖ The effect of a combination of Cover crop and crop rotation in the third year for potassium is shown in fig. 1
- ❖ The influence of a combination of crop rotation and tillage for soil phosphorus in 2013 is shown in fig. 2.
- ❖ After three years of study, rye cover crop enhanced soil Fe^{2+} by 4% while no till improved soil Mn^{2+} by 9%.

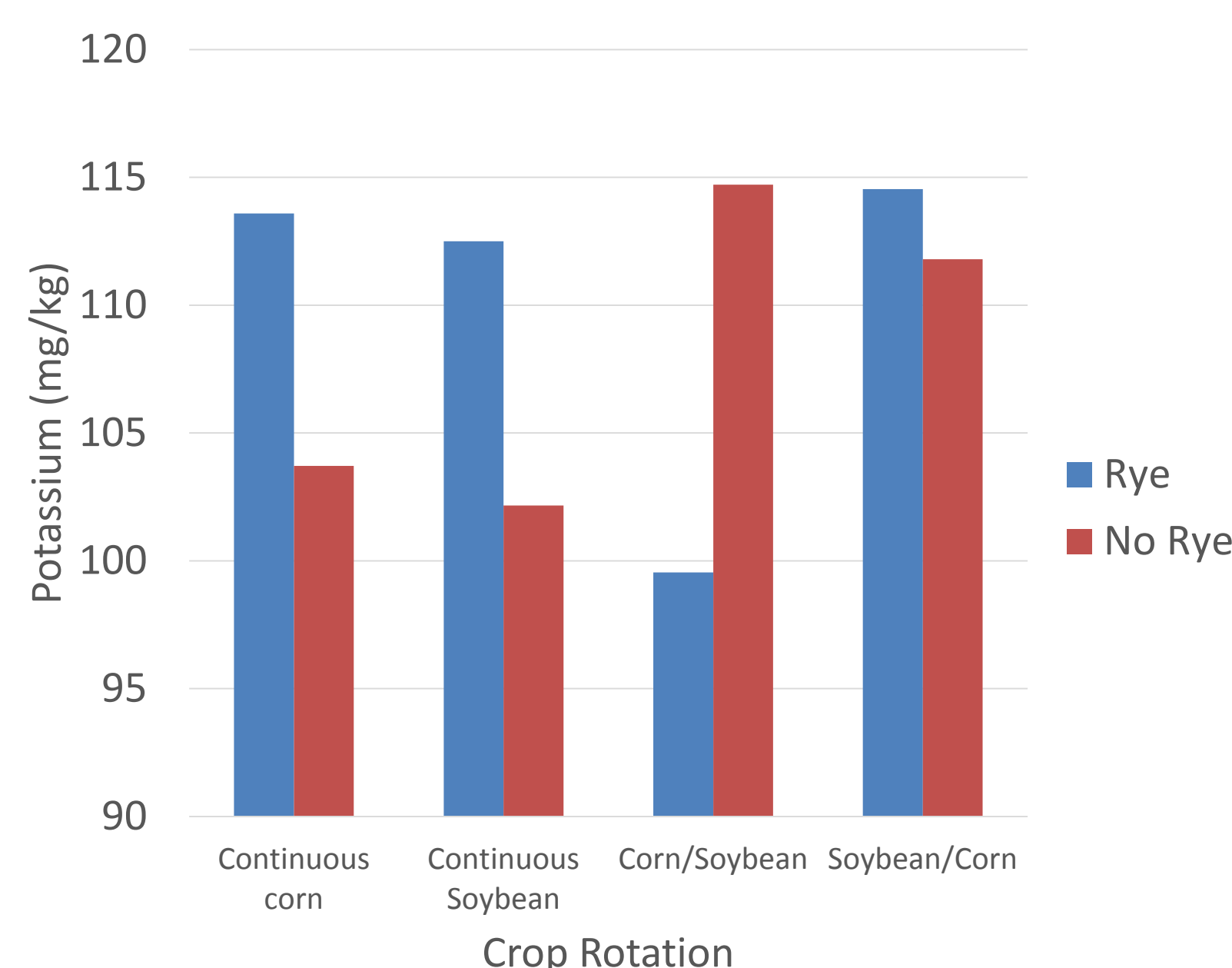


Fig. 1. Effects of crop rotation x cover crop interaction on potassium in 2013

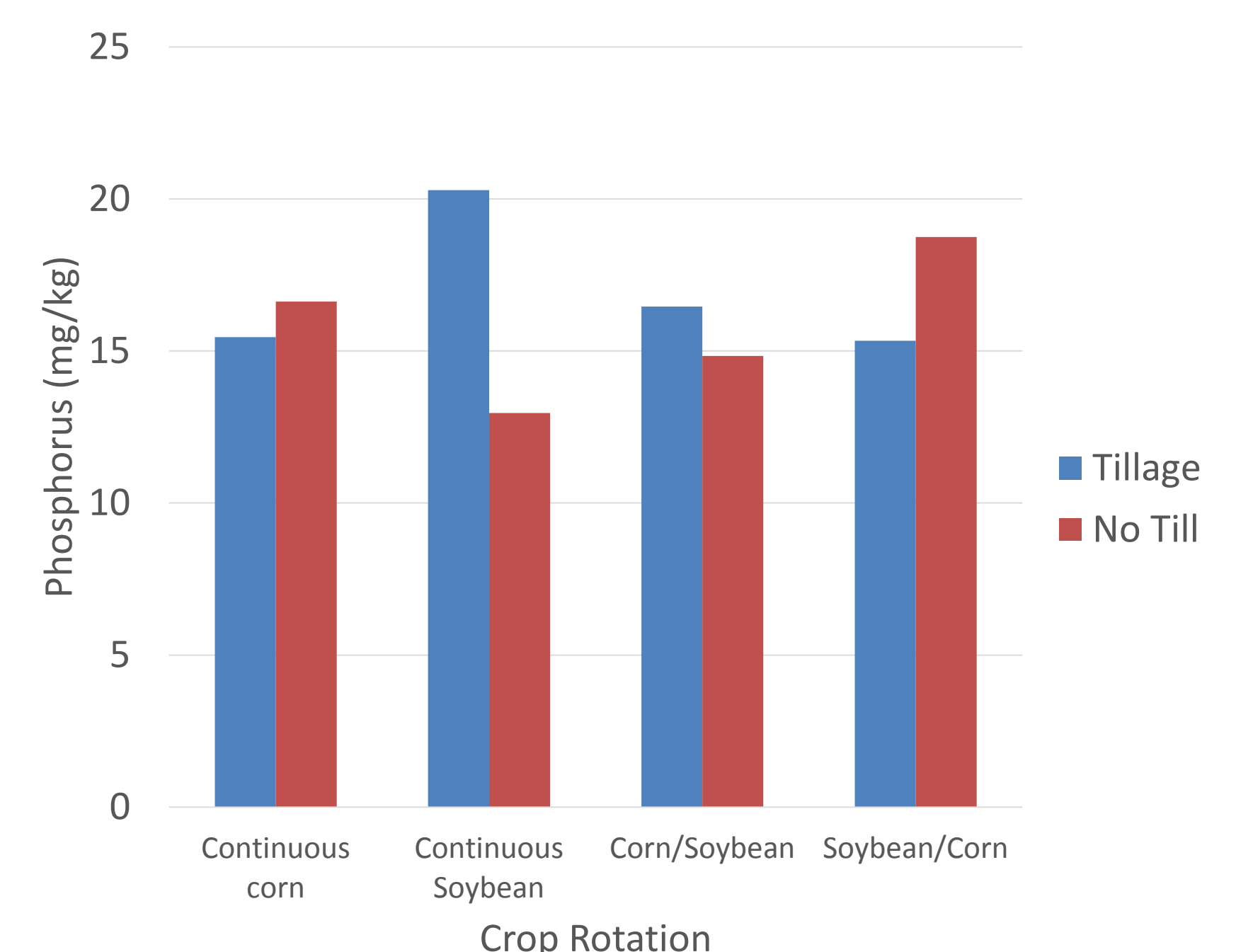


Fig.2. Effects of crop rotation x tillage interaction on soil phosphorus in 2013

CONCLUSIONS/SUMMARY

Agricultural management practices can affect soil nutrient status and crop productivity. We assessed the effects of three years of tillage, crop rotation and cover crop on soil nutrients. In the first year of study we found that tillage improved soil NO_3^- , P and Fe levels by 40%, 25% and 4% respectively compared with no till. In the second year of this study we noticed that rye cover crop reduced Ca^{2+} , Mg^{2+} , NH_4^+ , Cu^{2+} and Zn^{2+} by 5%, 8%, 8%, 7% and 7% respectively. In the third year of the study, tillage x crop rotation interaction showed that no till with corn or soybean rotation had the greatest amount of Ca^{2+} while Mg^{2+} and K^+ were greatest with no tillage and soybean/corn rotation.

RECOMMENDATIONS

- ❖ Tillage has the potential to increase nutrient loss. Therefore, reduced or no-till is encouraged
- ❖ By taking up excess nutrients, cover crops can reduce loss during the period when the soil is left bare. These nutrients can be returned to the soil through cover crop biomass incorporation.
- ❖ Crop rotation produces various biomass that can improve organic carbon and ultimately, soil nutrients

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