Cover crop and phosphorus fertilizer management effects on phosphorus loss and nutrient cycling

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Phosphorus (P) loss from non-point agricultural sources has been identified as a main contributor to degraded surface water quality throughout the United States. Excessive P inputs to surface waters can lead to eutrophication, increased water treatment costs, and negative health impacts. Therefore, agricultural best management practices (BMP) that promote water quality, through minimizing P loss, must be identified. Studies outlined in this thesis aim to determine the impacts of cover crops and P fertilizer placement on P loss in surface runoff and nutrient cycling in a no-till corn (Zea mays)-soybean (Glycine max) rotation and provide insight into how cover crop species selection and termination method affects potential P loss from crop tissue. The first study examined combined effects of cover crop and P fertilizer placement on total P, dissolved reactive P (DRP) and sediment losses in surface runoff from natural precipitation events. This large-scale field study was conducted near Manhattan, Kansas, at the Kansas Agricultural Watershed (KAW) Field Laboratory during the 2016 and 2017 cropping years. Two levels of cover crop [no cover crop (NC) and cover crop (CC)] and three levels of P fertilizer management [no P (CN), fall broadcast P (FB), and spring injected P (SI)] were used. Flow-weighted composite water samples were collected from precipitation events generating greater than 2.0 mm of surface runoff. Results from this study found the **CC treatment increased DRP losses compared to NC** in both cropping years; however, CC reduced sediment loss by over 50% compared to NC. Application of P fertilizer increased DRP losses compared CN in both cropping years, although SI resulted in lower quantities of DRP loss compared to FB. In addition, this study found that CC reduced biomass and yield of corn compared to NC and therefore decreased nutrient uptake, removal, and deposition during the 2017 cropping year. However, no negative impacts of CC on biomass or yield were observed during the 2015 (corn) and 2016 (soybean) cropping years. Application of P fertilizer increased the concentration of Melich-3 P and total P in the top 0-5 cm of soil compared to CN; however, no differences between P fertilizer management practice were observed for concentrations of Melich-3 P at 5-15 cm. A greenhouse-based study determined the impacts of cover crop species (brassica, grass, and legume), termination method (clipping, freezing, and herbicide), and time after termination (1, 7, and 14 days after termination) on total P and water-extractable P (WEP) release from cover crop biomass. Freezing increased WEP concentration of crop tissue by more than 140% compared to clipping and herbicide. Additionally, at 7 and 14 days after termination, both concentration of WEP and fraction of WEP compared total P increased compared to 1 DAT. **Findings from these studies suggest the use of cover crops may unintentionally result in greater DRP losses in surface runoff**. However, addition of a cover crop can dramatically reduce erosion losses. In addition, cover crop species selection can directly impact the quantity of P being taken up and released by crop tissue. Understanding the impact of crop species selection may help create new BMPs which aim to reduce P loss.