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Investment Insight

Managing Subsurface Accumulation of Labile Phosphorus

Subsurface P loss through tile lines in agricultural lands has been receiving attention in the last decade. It is not clearly understood how phosphate is distributed in subsoils (up to 180cm) and might be contributing to subsurface P loss. The study from Yuji Arai, Mark David, Jennifer M. Fraterrigo, and Lowell Gentry's NREC project "Understanding Mechanisms and Processes of Dissolved Reactive Phosphate (DRP) Loss in Illinois Tile-Drained Fields" shows that intensively managed Midwestern agricultural soils have accumulated labile P in subsoils and the subsurface distribution of P contributes to P release in subsoils. Although the P release in sub soils is lower than the surface soils, the concentration of labile P in sub soils is high enough to be a eutrophication inducible level.

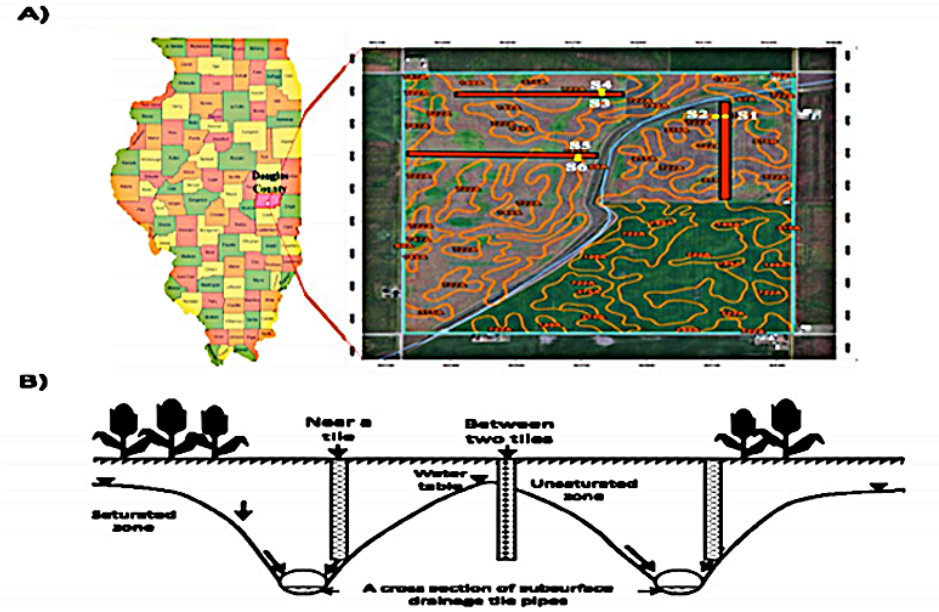

Fig. 1: A) The sampling location at a Douglas county study site (39°43'01" N, 88°14'01" W) in east-central Illinois. Filled red rectangles and filled circles represent tile lines and sampling locations for soil 1-6 (S1-S6), respectively; B) sample location description of selected tile lines: S1, S3, and S5 are near a tile; S2, S4, and S6 are between two tile lines. They are about 15m apart of each other.

As crop roots take up available Phosphorus, the soil's ability to re-supply available Phosphorus determines if the crop will need additional P fertilizer. Non-labile phosphorus refers to slowly available forms, while labile phosphorus is an intermediate form that is weakly adsorbed or bound to various compounds and clay in the soil. When soluble P fertilizer is placed in the soil, it reverts into slowly soluble (non-labile) or insoluble forms, removing soluble Phosphorus from the soil solution.

Non-labile P <—> Labile P <—>

Due to intensively managed fields, P input by fertilizer and crop residues has resulted in accumulation of inorganic Phosphorus in the soil profile up to 180 cm that become a source of labile P in tile lines.

Adsorption sites of P are getting exhausted in surface soils, increasing the concentration of P in soil solutions. This facilitates the movement of P to subsoils regardless of slow solute transport process in clay rich soils. Because of the presence of shrink and swell clays, the contribution of preferential flow during wet-dry season cannot be dismissed. The agronomic P test suggests that surface soils contain sufficient P for corn and soybean. The management of P in subsoils remains a challenging task to protect the water quality in the Midwest.

The release of phosphate was highest in surface soils and sharply decreased with increasing depth. Slightly alkaline soil pH in subsoils suppressed the release of P, but the process was continuous after 30 days. The subsurface P loss is contributed by the dissolution and desorption process of these inorganic P phases and or preferentially transported P from surface soils. The subsurface P loss should not be neglected when developing the strategy to reduce the agricultural P loss in the Gulf of Mexico.

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