Conservation Drainage Practices for Managing Water and Nutrients in South Dakota

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Introduction

Subsurface (tile) drainage on agricultural land with poor natural drainage allows timelier field operation access and contributes to improved crop yields, but may also may enhance exports of nitrate-nitrogen from the soil to surface waters. Nitrogen is an essential plant nutrient, but excess nitrogen leads to nutrient enrichment which may cause excess algae growth and hypoxic conditions in aquatic ecosystems, such as lakes and estuaries. This creates a *critical need* for strategies that minimize nitrate losses through subsurface drainage from agricultural land.

Our goal is investigating, demonstrating, evaluating, and transferring drainage best management practices, or conservation drainage practices, that maintain the benefits of agricultural subsurface drainage while minimizing unwanted environmental impacts. These practices all represent ways to conserve nutrients or remove nutrients from the drainage water. We are currently investigating some of these practices, Figure 1, to assess their utility and feasibility for use in South Dakota as well as their design criteria and cost.

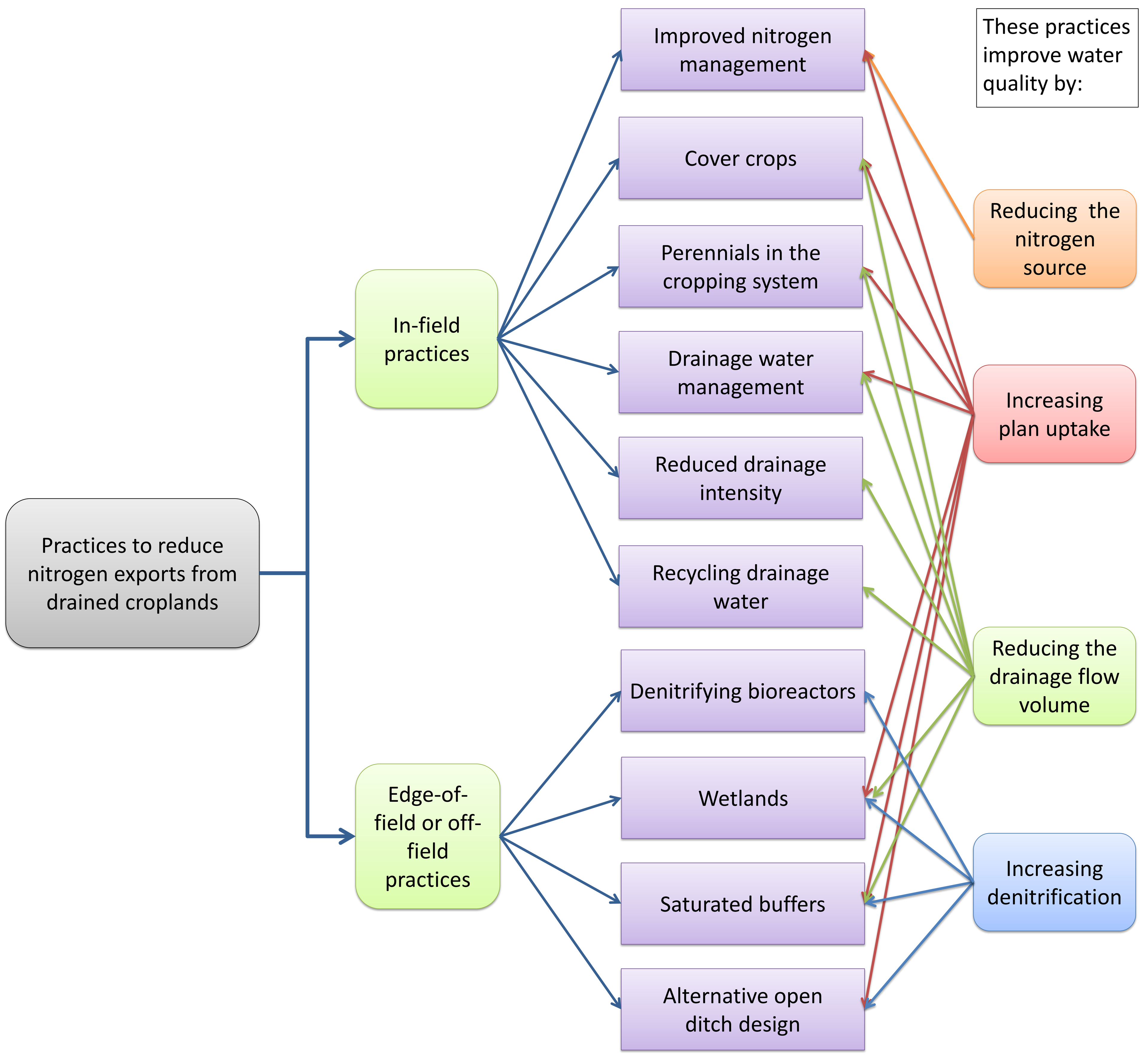

Figure 1. Ten strategies for reducing nutrient loads from subsurface drained row crop systems.

Active research areas

Research is underway within the following areas of conservation drainage:

Denitrifying Woodchip Bioreactors

Bioreactors are surface trenches located at field edges and filled with woodchips, though which the drainage water is passed. Nitrate-nitrogen is converted to inert nitrogen gas by bacteria colonizing the woodchips. Three bioreactors are currently in operation in South Dakota, Figure 2.

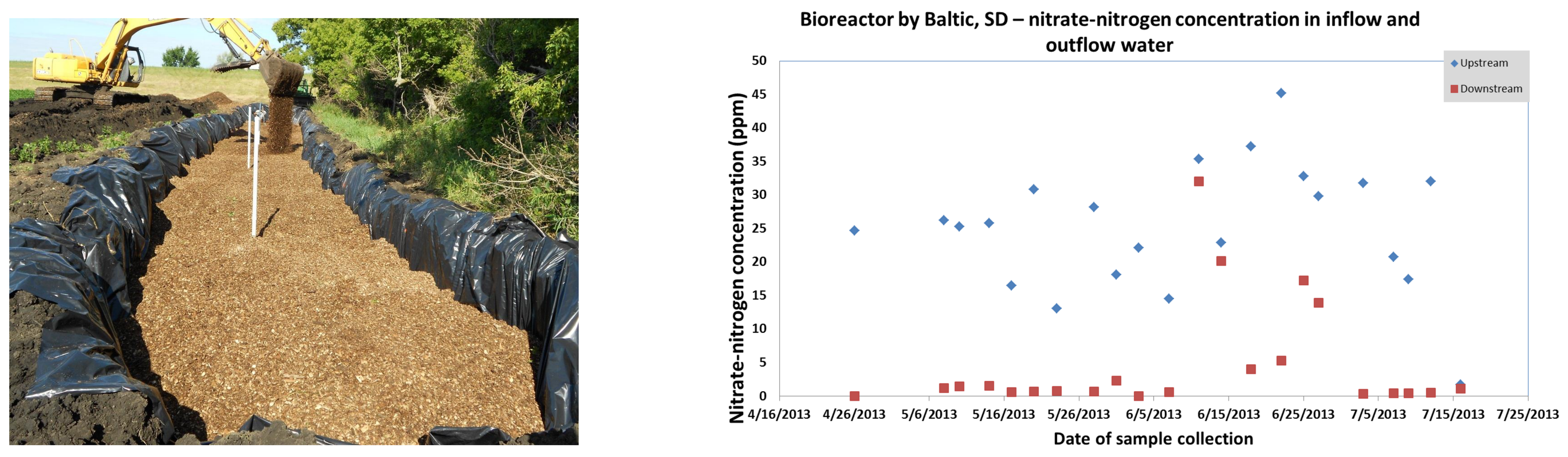

Figure 2. Denitrifying bioreactor during installation (left) and an example of the nitrate-nitrogen removal rates during the spring of 2013 (right).

Saturated Buffers

Saturated buffers may be an option at locations where a field is bordered by a vegetated buffer, typically along a waterway or stream. By diverting the drainage water into a subsurface distribution pipe running parallel to the stream, the water can seep into the soil and make its way downgradient to the stream, Figure 3.

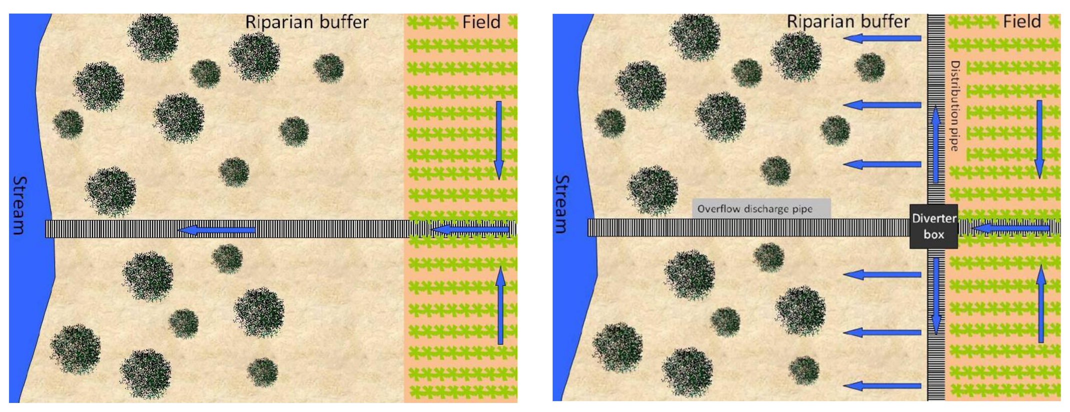

Figure 3. Subsurface drainage leaving the field and bypassing the existing vegetated riparian buffer (left), and a saturated buffer system where the tile water is diverted to flow through the buffer (right). Graphics by D. Jaynes, USDA ARS, Ames Iowa.

Plot scale research

Twelve 1-acre drainage research plots was installed at the SDSU Southeast Research Farm near Beresford, SD in the spring of 2013. Using a split-plot design, the research plots are used to study yield response, soil moisture, drain flow and water quality under drained and undrained conditions, and using conventional fall application of N versus nitrogen stabilizer, Figure 4.

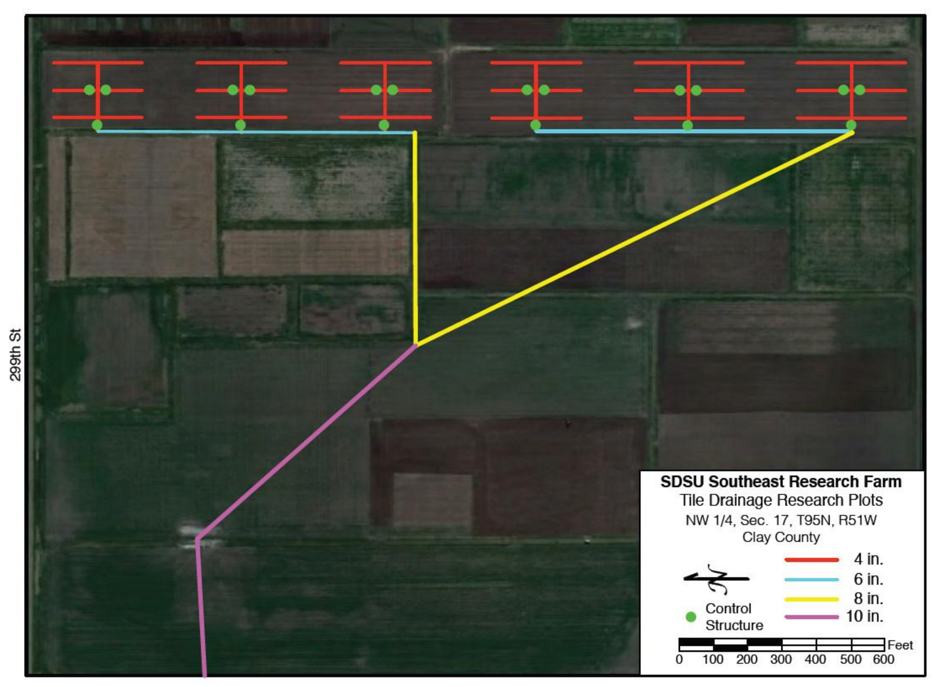

Figure 4. Subsurface drainage plots at the Southeast Research Farm by Beresford, South Dakota. Each tile plot is bordered by an interceptor tile line.