



Controlled Tile Drainage *Increasing yields and helping the environment*



WEBs program demonstrates merits of conservation practice

Tile drainage—networks of perforated pipes installed below ground to prevent soil from becoming too wet for crop growth—is a common practice in some regions of Canada. While important in maintaining productivity in wetter landscapes, tile drains can impact water quality because nutrients end up in municipal drains and ditches more quickly than from non-tiled fields. However, a beneficial management practice (BMP) like controlled tile drainage (CTD) can reduce tile discharge and retain soil water for crop growth. CTD can also pay for itself through increased crop yields in as little as four years for corn. Studies in the South Nation Watershed near Ottawa, Ontario by the **Watershed Evaluation of Beneficial Management Practices (WEBs)** program of Agriculture and Agri-Food Canada (AAFC) are yielding some promising results.

What is WEBS?

A long-term research program initiated by AAFC in 2004, WEBS evaluates the economic and environmental performance of BMPs at a small watershed scale. To gain a regional perspective, this information is being scaled up to larger watershed areas using hydrologic models. WEBS findings are helping researchers and agri-environmental policy and programming experts to understand how BMPs perform and interact with land and water. This knowledge will also help producers determine which BMPs are best for their operations and regions. WEBS studies are conducted at nine watershed sites across Canada. These outdoor living laboratories bring together a wide range of experts from various government, academic, watershed and producer groups. Many valuable findings have emerged, and research continues at all sites.

How does CTD work?

With uncontrolled drainage (Figure 1), drainage occurs from the tile directly into the water body (usually a ditch or municipal drain). With CTD (Figure 2), flow control structures are installed on the tile headers.



Figure 1: Uncontrolled drainage

CTD structures are opened in the spring to permit free drainage and allow for field operations and improved soil aeration. The structures are then closed to restrict drainage, storing nutrient-rich water that crops can access during the growing season. This BMP reduces nutrients in surface water by reducing the volume of tile drainage water leaving the field. As a result, CTD may completely eliminate tile outflow in dry years.



Figure 2: Controlled tile drainage

While AAFC and others have previously carried out CTD studies, none have been conducted at the watershed-scale like those in the South Nation WEBS project. Using a 'twin watershed' approach in two adjacent small watersheds, researchers have installed over 90 CTD structures within the 480-hectare test watershed over a four-year time period, effectively regulating more than 95% of its drainage. The other watershed has had uncontrolled drainage. Water quality and quantity in both watersheds were monitored and compared at the edge-of-field and watershed outlets. Crop yields were also evaluated.

Economics and water quality findings

Research on silt loam soils within the relatively flat landscape of the South Nation

WEBS test site shows that CTD increases crop yields by an average of 3% for corn (Figure 3) and 4% for soybeans (not shown). The cost of installing CTD is approximately \$208/ha and each structure has a lifespan of 25 years. Using a five-year corn and three-year soybean net revenues on a typical crop operation in the watershed (160 ha with 103 ha in corn and 57 ha in soybean), this BMP would amount to an annual benefit of \$5,700 (\$55/ha) for corn and \$1,200 (\$21/ha) for soybeans.

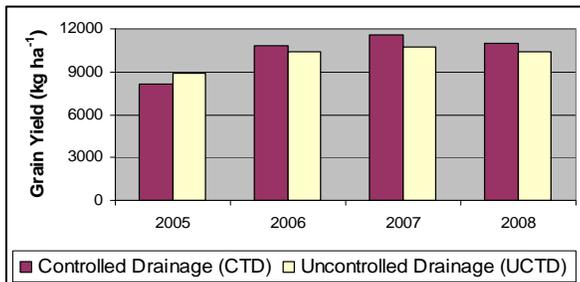


Figure 3: Average Corn Grain Yields

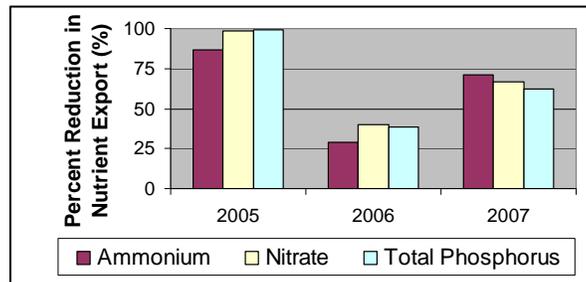


Figure 4: Average percent reduction in tile drainage nutrient export from corn fields over growing season

Water quality findings show that CTD reduces nutrient losses to surface water, both at the edge of individual fields and at the watershed outlet. Significant growing season reductions in field nutrient exports (Figure 4) were found for ammonium (57%), nitrate (65%) and phosphorus (63%). On a watershed basis, mass loads of total nitrogen (not shown) were reduced by 50-100% when compared to uncontrolled drainage.

Overall effect

In wetter soils, there is often an increased risk of 'denitrification'—a process whereby nitrogen can convert into nitrous oxide, a powerful greenhouse gas. However, monitoring of the wetter soils under CTD indicates that the practice may have actually reduced nitrous oxide loss—a factor attributed to the more efficient use of nitrogen and water in the CTD fields. Further monitoring is required to confirm this potential side-benefit.



Ontario producer Christian Laflièche with a controlled tile drainage structure

"We've used this system in our field for a few years now and it seems to work great," said Christian Laflièche, a dairy producer from St-Albert, Ontario whose operation has been part of the South Nation WEBS project from the outset. "We've also seen our corn yield increase slightly, so the installation cost of the control structures will probably pay for itself in a few years," he said. "This is really a win-win situation for our farm and the surrounding area."

David Lapen, the AAFC research scientist leading the WEBS project in South Nation agrees: "The numbers speak for themselves. It's encouraging to see a BMP that is effective in reducing nutrient loading as well as increasing yields. Most encouraging of all has been the response from those local producers who have seen their yields and those of their neighbours increase."

Due in part to the research conducted under WEBS, controlled tile drainage has been included as a BMP eligible for cost sharing under the Canada-Ontario Farm Stewardship Program. The South Nation Conservation Authority and the City of Ottawa (under the Rural Clean Water Program) are offering an incentive to producers as well.

AAFC leads the national WEBS program and provides funding under its *Growing Forward* initiative. Ducks Unlimited Canada has been a key contributing partner. Other partners at the South Nation project include: South Nation Conservation; Environment Canada; Health Canada; Public Health Agency of Canada; Ontario Ministry of Agriculture, Food and Rural Affairs; University of Ottawa; University of Calgary; University of Alberta; Agri-Drain and several international agencies.

For more information on WEBS, please visit www.agr.gc.ca/webs or contact WEBS at webs@agr.gc.ca.