

Nitrate leaching in no-tilled crop rotations in the Brown soil zone

F. Selles^{1*}, R. P. Zentner¹, C. A. Campbell², R. DeJong², R. Lemke¹, B. G. McConkey¹

¹ Semiarid Prairie Agricultural Research Centre. Swift Current, SK.

² Eastern Cereal and Oilseed Research Centre. Ottawa, ON.

* sellesf@agr.gc.ca, 306 778-7245

Abstract

High nitrate in drinking water is a health hazard, causing methaemo-globinaemia (blue baby syndrome). Much of the nitrate found in ground waters is attributed to excessive use of nitrogen fertilizers in agricultural land. Although the climate of the Brown soil zone is semiarid with a net water deficit, there are still opportunities for leaching of nitrate, especially when high water recharge winters are followed by a wet spring. Under these conditions there is high risk of NO₃-N leaching before annual crops commence active growth. Additionally, soil and crop management practices may increase the risk of leaching NO₃-N below the rooting depth of crops.

We sampled the soil in a crop rotation study established in 1987 to evaluate the effect of crop rotations on the amounts and distribution of NO₃-N in the soil to a depth of 2.4 m in 30-cm depth increments. The rotations studied were continuous wheat (Cont W), fallow-wheat-wheat (F-W-W), annual legume green manure-wheat-wheat (LGM-W-W), and continuous crested wheatgrass hay (CWG). All crops, except the green manure legume were fertilized with nitrogen (N). Nitrogen application rates were based on soil test criteria, using NO₃-N levels in the soil the previous fall to a depth of 60 cm; wheat after the legume received N per soil test recommendation minus 20% of the N in the above-ground legume growth; CWG received as much N as the removal in the hay the previous years.

In 1987, at the beginning of the field study, the soil had 149 kg ha⁻¹ of NO₃-N down to 2.4 m, with 60 kg ha⁻¹ in the rooting depth (1.2 m) and 89 kg ha⁻¹ below the reach of crop roots. After 17 years of cropping, CWG reduced the amount of NO₃-N by 104 kg ha⁻¹ in the whole profile ($P \leq 0.05$), F-W-W produced a drop of 49 kg ha⁻¹, and no other rotation decreased the total amount of NO₃-N to 2.4 m depth ($P > 0.05$). Within the rooting depth, all rotations except LGM-W-W produced a significant ($P \leq 0.05$) decrease in NO₃-N, reflecting the plant uptake. Below the rooting depth, only CWG ($P \leq 0.05$) and F-W-W ($P \leq 0.10$) produced a significant reduction in NO₃-N content. Continuous wheat produced no change, and LGM-W-W produced a significant ($P \leq 0.05$) increase in NO₃-N, revealing the contribution of symbiotically fixed N to mineralizable N in this last rotation.

With the fertilization regime used in these rotations there was no increase in the risk of NO₃-N leaching under Cont W, and FWW, there was reduction in the risk of NO₃-N leaching under a perennial forage grass, and a substantial increase in the leaching risk under the LGM-W-W rotation.