

# How much rainfall will leach nitrogen in corn?

*Heavy rainfall can cause nitrates to move down through the soil and possibly below the corn crop's root zone where it is less available for uptake. How much rainfall is needed to leach nitrogen (N)? Should we be applying extra N to corn to cover losses if a lot of rainfall has occurred in July and August? At the 2023 Southwest Crop Diagnostic Days we did an experiment to see how much water was needed to move nitrates.*



## The simple answer

A simulated 6" rain event in July caused the highest concentration of leachate to occur at a depth of 16-20", where it is still accessible for uptake by corn roots. Adding additional N would not be necessary. Heavy rainfall events in the spring, when soil is more likely to be saturated, would cause greater leaching potential in coarse-textured soils. This illustrates the benefit of split N applications to minimize the risk of leaching and to maximize availability during critical periods of crop development.

## A little more information

The trial was completed at the end of June on a very dry sandy/fine sandy loam soil (Figure 1). Potash (KCl) was applied in the test area at 1,000 lb/ac. Water was later applied at various amounts (0-6"). Four soil cores were pulled from each water treatment and segmented into 4" increments to 36" depth to follow chlorides through the profile. As simulated rainfall amounts increased, the concentration of chlorides was highest at increasing depths with the highest concentration occurring at 16-20" after a 6" simulated rain event.



**Figure 1.** Soil profile of leaching experiment.

## The full story

### Why potash?

Chloride (Cl) from potash moves very similar to nitrate ( $\text{NO}_3$ ) in soil water but is not susceptible to the same microbial transformations. This provides a similar but more stable representation of solute movements in soil water.

### Measuring movement

Chloride movements are summarized in Table 1. Not surprisingly, with no rainfall, chlorides in the top 4" were very high as dry fertilizer granules remained on the soil surface. Also not surprisingly, chlorides moved deeper as more water was added. With the highest amount of water tested (6"), the chloride pulse moved down about 20-24".

**Table 1. Chloride movement in soil profile.**

Applied water						
Depth	0"	1"	2"	3"	4"	6"
	% of Cl in the 36" soil profile					
0-4"	92%	64%	32%	29%	6%	9%
4-8"	3%	16%	16%	45%	27%	10%
8-12"	2%	3%	12%	15%	11%	17%
12-16"	0%	2%	9%	6%	21%	18%
16-20"	0%	2%	11%	1%	13%	29%
20-24"	1%	1%	7%	1%	8%	9%
24-28"	0%	1%	7%	1%	8%	3%
28-32"	0%	1%	3%	1%	3%	4%
32-36"	1%	10%	3%	1%	5%	2%

Corn rooting depth varies depending on factors like soil texture, compaction and water tables. In general, full-size corn in Ontario might be able to pick up nitrates within a 3' or 36" depth. If nitrates don't move below the root uptake zone of corn, they should still be available. In this experiment, N movement with even 6" of water should still be accessible by corn plants.

### The soil factor

Soil acts like a sponge. Unless saturated, water does not usually just flow to depth with gravity. Capillary forces in small spaces are strong enough to hold water against the force of gravity. Before water can move deeper with gravity these small pores must be filled. Coarse-textured soils have fewer micropores and lower water holding capacity than fine-textured soils, and are more likely to see leaching losses as the water moves downward quicker through the soil profile, assuming there is sufficient water in the soil already.

From late June through July and August, potential evapotranspiration (water loss from evaporation from soil and transpiration from plants) is typically much greater than precipitation. This dries out the soil sponge. Before water moves below the rooting zone the soil must be fully saturated, which requires substantial amounts of precipitation at this time of year. This partly explains why leaching losses tend to be a more significant issue outside of the main growing season when soils are more easily saturated (e.g. late fall or early spring when evapotranspiration is lower than precipitation) than during warmer months.

However, if multiple heavy rainfall events occur in a relatively short time – keeping the soil saturated – there's more potential for the nitrate to leach below the rooting zone.

### The bottom line

While there were inevitably some N losses in 2023, a single heavy rainfall during the middle of the growing season (e.g. late June through August) is less likely to cause a significant rate of N loss than if the same rainfall had been received earlier in the growing season.

The greatest N leaching losses occur after corn harvest if there's excess N fertilizer in the soil. That's why it's important to match the N rate to a realistic yield goal, and adjust based on the previous crop, soil type, application timing and manure application.