

THE VALUE OF MAINTAINING A GOOD SOIL PH

Most agricultural soils in Nova Scotia are naturally acidic and require lime to help improve their productivity. Without lime or other calcium amendments, crop yields can decrease, and fertilizers become less efficient. Liming has many benefits other than reducing soil acidity, including:

- Improving crop yield and quality,
- Increasing the availability of macro and micronutrients in your soil,
- Improving soil aggregate stability,
- Reducing levels of toxic mobile aluminum,
- Increasing soil microbial activity, and
- Improving fertilizer efficiency.

How does liming improve your fertilizer efficiency?

One of the main purposes of liming is to neutralize acidic soils and increase soil pH. Soil pH plays a large role in the availability of nutrients. Phosphorous, potassium, and nitrogen all become more plant available at a pH greater than 6 (see Table 1). Most cropping systems have an optimal pH of 6.5.

Soil pH and Nitrogen:

At low pH, root activity is greatly decreased and can impair the uptake of nitrogen. Liming helps increase microbial activity, particularly nitrifying bacteria and rhizobacteria, which help convert atmospheric nitrogen into plant available forms.

Soil pH and Phosphorous:

At low pH, phosphorous can bind with aluminum or iron and become insoluble. Maintaining an optimal pH in the range of 6.5-6.8 results in phosphorous being the most available for plant uptake. In addition, soils with a pH around 6.5 helps to promote biological activity and phosphorus cycling in soil.

Soil pH and Potassium:

At low pH, aluminum and manganese can become mobile and impair root growth. As pH increases, aluminum gets bound up, which reduces competition between potassium and aluminum on the cation exchange sites of soil, thereby increasing potassium availability to crops.

What that means for fertilizer efficiency and optimal soil pH

Fertilizer efficiency refers to the nutrients from fertilizer application that can be taken up by the plant and contribute to plant growth. **The more efficient your fertilizer use is, the more money you will save!**

Table 1. Fertilizer efficiency rates of different nutrients at different soil pH values.

Soil pH	Nitrogen Efficiency	Phosphorous Efficiency	Potassium Efficiency	Overall Fertilizer Efficiency
6.5	95%	63%	100%	86%
6	89%	52%	100%	80%
5.5	77%	48%	77%	67%
5	53%	34%	52%	46%

Modified from Pub 534-84; Atlantic Soils Need Lime

Fertilizer Prices Through the Years

Fertilizer prices have been trending upwards as a result of increases in manufacturing and transportation costs, global food demands, supply chain disruptions, and fluctuations in the Canadian dollar.

Table 2 shows the value of each nutrient in three different common fertilizers. Fertilizer costs for 2021 are based on the cost of 25 kg bags of Urea (46-0-0), Superphosphate (0-46-0), and Potash (0-0-60), divided by the percent of N, P₂O₅, and K₂O in each fertilizer to get the bulk price for each nutrient. Similar methods were used for pricing in earlier years except ammonium nitrate was used instead of urea.

Table 2. Nova Scotia bulk fertilizer price trends (\$/kg).

Year	Nitrogen	Phosphorous (P ₂ O ₅)	Potassium (K ₂ O)
2021	\$1.52	\$1.74	\$1.13
2014	\$1.75	\$0.68	\$1.01
2010	\$1.27	\$0.72	\$1.07
2005	\$1.34	\$0.75	\$0.68
2001	\$1.07	\$0.60	\$0.51

How does pH impact the value of applied fertilizer?

Failure to maintain optimal pH in your fields can lead to financial losses from decreases in yield, lower quality crops, and losses from poor fertilizer efficiency (leaching, volatilization).

Table 3 shows the lost fertilizer in dollars per hectare (\$/ha) at a pH of 5.5 and 6.5 for different crops. Crop removal values were estimated from the Canadian Fertilizer Institute. The lost fertilizer was calculated by multiplying the cost of fertilizer (Table 2) by the number of kilograms removed for each nutrient and the fertilizer efficiency (Table 1) and subtracting that from the value at 100% efficiency.

Table 3. Potential economic fertilizer loss.

Crop	Dry Yield (tonne/ha)	N-P-K Removed	Lost Fertilizer (\$/ha) Efficiency at 6.5 pH	Lost Fertilizer (\$/ha) Efficiency at 5.5 pH
Corn Silage	12.5	133-50-128	\$42	\$103
Alfalfa (3 cuts)	10.5	*25-45-222	\$31	\$107
Grass (2 cuts)	8.8	133-33-100	\$31	\$101
Grain Corn	7.5	139-48-47	\$42	\$104
Soybean	3.3	*25-44-78	\$30	\$69
Winter Wheat	5	111-50-111**	\$40	\$112
Barley	3.8	70-31-67**	\$25	\$70

*Alfalfa and soybeans remove more than 25kg/ha of N, but most N removed is supplied by N-fixation.

**Nutrients removed by winter wheat and barley include straw removal.

Losses from poor fertilizer efficiency resulting from a pH drop from 6.5 to 5.5 can result in financial losses of \$39-76/hectare of fertilizer investment.

What happens to my lost nutrients?

Nutrients that are not taken up by the plants after fertilization are likely lost due to leaching, volatilization, converted to unavailable forms, or bound to clay particles or organic matter. It is difficult to reach 100% fertilizer efficiency; however, increasing your pH greatly improves fertilizer efficiency and can save money on fertilizer purchase and application.

Tips for maintaining a good soil pH

- The addition of calcium amendments (liming) such as calcite, dolomite, and/or wood ash, can help add plant essential nutrients to the soil and neutralize acidity.
- In addition to being less effective in lower pH's, fertilizers can promote acidity in your soil, so it is important to apply the appropriate amount.
- Build up and maintain healthy levels of organic matter in your soil.
- Test your soil regularly.

Keep in mind:

- Gypsum does not affect pH (but can be a good source of calcium and sulfur).
- When larger amounts of lime are needed, it is best to do split applications and not apply more than 3 T lime/ha/application.
- Larger lime particles change your soil pH slower than finer lime particles.
- Liming materials have very little mobility in the soil, they can be incorporated for maximum effectiveness.
- No-till systems often become quite acidic on the soil surface (top 1-2" of soil) very quickly. If you have an entirely no-till system, it is recommended to just sample the top 2" of soil to determine soil pH and liming needs.
- Some crops do best with more acidic soils (both high and low bush blueberries, potatoes, cranberries, etc.).