Should Calcium be Used on Ontario Soils?

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Many fertilizer suppliers to the industry are recommending the addition of calcium to turf. This practice has been adopted by some golf course superintendents in the province. This begs the question – should calcium be used on Ontario soils? I am going to try to answer that question by looking at the role of calcium in the turfgrass plant, the role of calcium in the soil and report on some research findings on adding calcium to turf.

Role of Calcium in the Turfgrass Plant

There are 17 elements that are essential for plant nutrition in relatively large amounts. These are classified as plant macronutrients and are found in the plant dry matter in concentrations of at least 1,000 ppm. They are: carbon, hydrogen, oxygen, nitrogen, potassium, calcium, magnesium and sulfur. Calcium ranks third after nitrogen and potassium in abundance in the turfgrass plant. Calcium plays an important role in cell wall formation, cell division and cell growth. Calcium deficiencies may occur in low pH, sandy soils. Turf leaves turn reddish brown. These symptoms have only been able to be demonstrated by using hydroponic solutions in a laboratory situation. Deficiency symptoms are very rare in the field. Sufficiency ranges for tissue nutrient content for calcium in turfgrasses is 0.5-1.3%. Sufficiency ranges for the major nutrients can be found in Table 1.

Role of Calcium in Soil

Calcium is a positively charged element that occurs in the soil. Soil particles are negatively charged. These negative and positive charged elements work like magnets and are attracted to each other. The negatively charged ions in the soil hold on to the cations so that they can be exchanged with cations in the root system and be taken up by the plant. The ability of the soil to attract these cations is called the cation exchange capacity (CEC) and it is measured in milliequivalents per 100 grams of soil. The CEC...

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Table 1. Sufficiency ranges for tissue nutrient content of turfgrasses.

Element	Content
Nitrogen	2.8 - 3.5%
Phosphorous	0.3 - 0.6%
Potassium	1.0 - 2.5%
Calcium	0.5 - 1.3%
Magnesium	0.2 - 0.6%
Sulfur	0.2 -0.5%

has an impact on how fertilization is conducted. A low CEC soil may need repeated applications of moderate levels of fertilizer. A soil high in CEC can have larger amounts of fertilizer applied less frequently.

The second role of calcium is its role in soil pH. The pH is a measure of the hydrogen cations in the soil solution and on the cation exchange sites in the soil. Soil pH ranges from 3-11 with 7 being neutral. Soils with a pH below 7 are categorized as acidic and above 7 are alkaline. The pH of the soil has an effect on the availability of plant nutrients. Some nutrients are more available at high pHs and some are more available at a low pH. The optimum range of soil pH for most turfgrasses is between 5.5 and 7.

If a soil pH is low, calcium in the form of lime can be added to the soil to raise the soil pH. This should not be done unless a soil test has been performed and has indicated the need for lime. The standard form of lime is calcium carbonate ($CaC0_3$). If too much lime is added to a soil, the pH of the soil may be increased to a range that is too high for proper plant growth. Lime can burn turfgrass plants. This is especially true when lime is applied during hot weather. It is also very difficult to get lime into the rootzone of mature turf. The best time to add lime to adjust pH is at the time of turf establishment.

Role of Lime in Controlling Moss

Another reason that is cited for the addition of calcium in the form of lime to soils is to control moss. The addition of lime to soils to control moss is only effective if the soil pH is low. In most cases in Ontario, moss is a result of soil compaction, poor drainage, overwatering or too much rain, shade, low mowing height and poor fertility – not because of low pH soils.

Ontario Soils

When glaciers receded from Ontario 10,000 years ago, the materials left behind were deposited directly by the glaciers, deposited by melt waters running from the retreating glaciers or deposited in the bottom of glacial lakes. These became the parent material of soils in southern Ontario. Most of these materials are limestone based and are neutral to basic in pH and are termed calcareous soils. Because of this, it is rare to find soils in this part of Ontario that are low in pH and that would benefit from additional calcium in the form of lime.

There are areas in Ontario where the soil pH is not alkaline. These include

pockets of soil in the Canadian Shield, but the majority of soils in southwestern and south-central Ontario are calcareous.

Fertilizer Company Claims

Based on this role of calcium in the plant and in soils, fertilizer suppliers make the claim that it makes plants stronger and more resistant to wear, neutralizes soil acidity, improves activity of favourable soil bacteria, promotes root development, improves soil structure, improves the efficiency and availability of fertilizer, reduces phosphate fixation and increases water penetration and water holding capacity. Some of these statements are true, but only in very specific situations or circumstances, and they should not be used as generalizations for the benefits of calcium.

Calcium Fertilization Research

Researchers at the University of Iowa, Nick Christians and Rodney St. John, conducted trials on calcareous-based sand greens. Their research was to determine the benefits or detriments of applying supplemental calcium to turfgrass established on calcareous sand. They wanted to know whether additional calcium increases the amount of calcium absorbed by the grass plant, whether it increases clipping yield and quality and if it affects the availability of other nutrients to the plant.

A greenhouse study looked at adding additional calcium to Kentucky bluegrass and creeping bentgrass grown in calcareous sand. The additional calcium treatments consisted of calcium sulphate, calcium carbonate, calcium nitrate and a chelated calcium. The calcium, regardless of the source, was incorporated into the growing medium at a rate of 4.7 lbs of calcium per 1,000 sq. ft.

A two-year field study on creeping bentgrass established on a calcareous sand putting green also received 4.7 lbs. of calcium per 1,000 sq. ft. applied as five separate monthly applications.

In both the greenhouse and field studies, the additional calcium did not increase the growth, colour or leaf calcium content of the grasses established on the calcareous sands. In the greenhouse study, the additional calcium reduced the leaf magnesium content by 15% and by 11% in the field trial. In the field studies, the calcium carbonate and calcium nitrate treatments reduced the soil extractable potash levels and the calcium sulphate, calcium nitrate and calcium chelate reduced the amount of soil extractable magnesium. Over time, with continuous additions of calcium, both magnesium and potash could become deficient in the soil leading to deficiencies in the turfgrass plant. The greenhouse study did show that creeping bentgrass had nearly twice the amount of calcium in the leaf tissue as did Kentucky bluegrass and none of the treatments increased the tissue calcium levels in either species.

So the claims that additional calcium increases resistance to wear can only be true if the added calcium is taken up by the turfgrass plant. This research demonstrates that it is not. As far as the addition of calcium increasing the availability and efficiency of fertilizers, the calcium actually made the magnesium and potash less available.

The take home message from this research is that supplemental applications of calcium did not increase clipping yield, leaf calcium content or turf quality and that the addition of calcium could limit the availability of magnesium and potash to the plant when applied to calcareous sand. ♦

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— *Green is Beautiful,* October, 2004

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Toronto, ON, Info: (905) 602-8873
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Guelph, ON
Info: (519) 767-5000

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Cancun, Mexico
Info: (847) 705-9898
www.TurfGrassSod.org

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University of Guelph
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