

Creeping Bentgrass Fairway Evaluation of Harsco Minerals Ca/Mg-Silicate Soil Amendment/Conditioner 'Excellerator'

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MATERIALS AND METHODS

In November 2010, a field study of 'Excellerator' Ca/Mg-silicate soil amendment (Harsco Minerals Intl., Sarver, PA) was initiated on a creeping bentgrass (*Agrostis stolonifera* cv. Declaration L.) fairway maintained within the Joseph Valentine Turfgrass Research Center (University Park, PA). The experiment was arranged in a randomized complete split-plot design of five (5) replicate blocks. One of two main plots consisted of a systematic wear treatment. Four (4) 'split-plots' (6 x 10 ft, 1-ft borders) in

each main plot were randomly assigned one of the following treatments (Table 1): full or split application of Harsco Ca/Mg-silicate 'Excellerator', full application of a pelletized dolomitic/ calcitic limestone blend (1:1), or none (control). Annual rate, sans

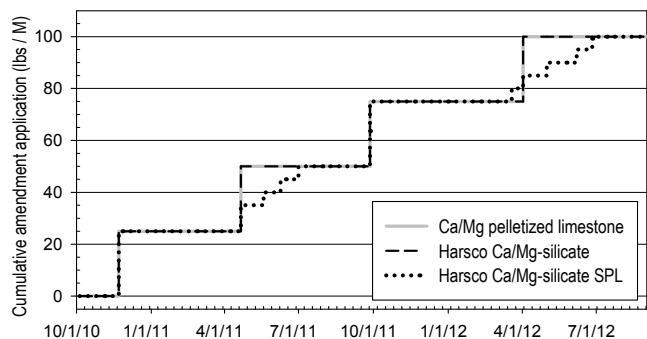
Table 1. Guaranteed analysis of applied soil amendment/conditioner treatments (from labels).

Essential nutrient:	Harsco Ca/Mg-silicate 'Excellerator'		OldCastle pelletized Ca/Mg limestone	
	Content:	Derived from:	Content:	Derived from:
Boron (B)	0.2 %		—	
Calcium (Ca)	24.0 %	Calcium and Magnesium	26.5 %	
Copper (Cu)	0.5 %	Silicates, Boric Acid, Zinc	—	
Iron (Fe)	1.8 %	Sulfate, Copper Sulfate,	—	Calcium and Magnesium
Magnesium (Mg)	6.0 %	Iron (III) Oxide,	6.0 %	Carbonates
Manganese (Mn)	0.5 %	Manganese (II) Oxide,	—	
Molybdenum (Mo)	0.002%	and Molybdic Oxide	—	
Zinc (Zn)	0.05 %		—	

the control, totaled 50 lbs / M (1000 ft²). Initial rates of 25 lbs / M were applied in fall (2010 and 2011). The remaining 25 lbs / M was applied in April (2011 and 2012), except for the 'split' Harsco Ca/Mg-silicate-SPL treatment, which was reapplied monthly spring through early-summer (2011 and 2012) at a 5 or 10 lbs / M rate (graph bottom left). Granular applications were followed by either irrigation or a rainfall event, and fairway mowing (thrice weekly at 0.5") was suspended for a 5-d period following. In 2011 and 2012, weekly wear treatments were applied June through late Sept. as three (3) passes using a dedicated wear simulator (Cockerham and Brinkman, 1989).

The fairway soil fertility, sampled and analyzed in Sept. 2010, indicated optimal saturation of soil cation exchange capacity (Table 2). Likewise, soil P level resided within the optimal range for a mature turfgrass fairway. Thus, supplemental fertilization practices were limited to bi-monthly applications of various urea fertilizers to ensure plant-availability of 0.3 to 0.6 lbs N / M per growing month of the two year study.

Triplicate soil samples were collected (0-6" depth) in July and Sept. 2011, and April 2012. Soil cores were divided into 0-2", 2-4", and 4-6" depth segments, then ground and split for 1:1 pHw analysis; extraction by Mehlich-3 to determine soil exchangeable Ca, K, Mg, Mn, and Si; and extraction by 0.5 M acetic acid (Barbosa-Filho et al., 2001) to determine plant-available silica (Si). Clipping yields were collected in June, July, and Sept. 2011; and July and Aug. 2012. Clipping yields (CY) were dried, weighed to



0.1-mg resolution, and split for Si-extraction (Guntzer et al., 2010) and acid digestion/analysis of plant essential nutrient concentrations by the Penn State Univ. Agric. Analytical Services Laboratory (PSU-AASL).

Every 10±5 days from June through Sept. (2011 and 2012), simultaneous measures of 660– and 850–nm canopy reflectance from each plot (four unique readings per) were recording using an ambient light-excluding

FieldScout TCM–500 turfgrass chlorophyll meter (Spectrum Technologies Inc., Plainfield, IL). Reflectance data was used to calculate the normalized differential vegetative index (NDVI). On an identical frequency, a color meter (FieldScout TCM-500-RGB) was employed to collect quadruplicate measures of green, red, and blue canopy reflectance from each plot. Percent color reflectance was converted to hue, saturation, and brightness levels for calculation of the dark green color index (DGCI; Karcher & Richardson, 2003). These NDVI and DGCI indices provide resolute and dependably-reproducible measures of turfgrass canopy density and canopy color, respectively (Zhu et al., 2012).

To prevent inadvertent contamination by wear treatment, all soil cores and turfgrass clipping samples were collected from non-trafficked plots. These measures were modeled by amendment using PROC MIXED (SAS Institute, v. 8.2). Canopy quality measures, collected from all plots, were modeled by amendment, wear, and interaction. All statistically-significant treatment means were separated using Fisher's protected least significant difference (LSD; 0.05 alpha level).

RESULTS

Averaged over the three (3) soil sampling events (July and Sept. 2011, and Apr. 2012), all soil amendments/conditioner applications significantly raised 0-2" soil depth mean pH above levels observed in control plots (graph right). In the 2-4" depth, only the split application of Harsco Ca/Mg-silicate significantly-raised mean soil pH level relative to the control plots. Mean soil pH level in the 4-6" soil depth of all plots was lower than levels observed at shallower depths, while the full application of Harsco Ca/Mg-silicate resulted in a significantly lower mean soil pH than observed in control plots.

The 0.5 M acetic acid extraction quantified availability of silica more dependably than the Mehlich 3 method. Averaged over all soil sampling events and regardless of amendment applied, extractable soil silica levels were highest at the soil surface (0-2" depth), and decreased with depth (data not shown). Either full- or split-application of Harsco Ca/Mg-silicate significantly increased mean extractable Si in the 0-2" soil depth relative to limestone- or un-treated plots, and mean extractable Si in the 2-4" soil depth relative to the limestone-treated plots (data not shown). No differences in acetic acid extractable Si were observed by treatment in the 4-6" soil depth.

Averaged across wear treatments and time, amendments did not significantly influence mean canopy color (DGCI) or density (NDVI) of the creeping bentgrass fairway (Table 3). Likewise, soil amendment did not significantly influence mean vigor or growth (clipping yield) of the fairway (pooled over months). Both full- and split-application of Ca/Mg-silicate soil amendment significantly increased mean leaf Si levels relative to limestone-treated or control plots (Table 3). The Harsco Ca/Mg-silicate soil amendment treatments resulted in significantly-lesser mean leaf P, K, and S than control plots, whereas plots treated by the Ca/Mg limestone did not (Table 3). However, all observed mean leaf P and S levels resided within sufficiency ranges for creeping bentgrass (Carrow et al., 2001). While the Harsco Ca/Mg-silicate amendment contained Fe and Mn, the described treatments did not influence plant assimilation of these important micronutrients, and leaf levels fell within each respective sufficiency range (data not shown).

Table 2. Pre-study fairway soil fertility status, Sept. 2010 (0-6" depth).

Soil chemical/nutritional property, units	Value ± standard error (SE)
Soil pHw, 1:1 DI H ₂ O	6.8 ± 0.1
Soil organic matter, % by mass	1.8 ± 0.2
<u>Mehlich 3 extractable</u>	
Phosphorus (P), lbs / acre	201 ± 18
Calcium (Ca), lbs / acre	2033 ± 57 (61% of CEC)
Potassium (K), lbs / acre	398 ± 21 (6% of CEC)
Magnesium (Mg), lbs / acre	555 ± 26 (28% of CEC)
Total CEC by summation, meq / 100 g	8.3 ± 0.2

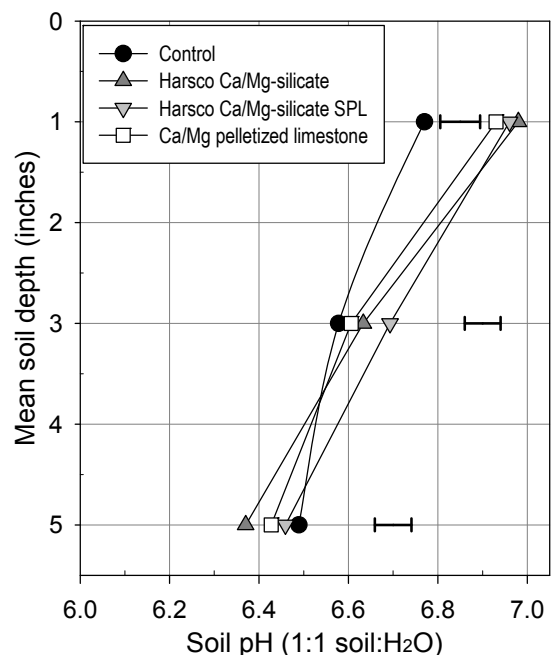


Table 3. Creeping bentgrass fairway mean canopy quality (pooled over wear treatments and weeks); and mean clipping yield (CY) and leaf/shoot concentration of nutrients (pooled over months).

Treatment / soil amendment	All plots mean (n=350)		Non-wear/trafficked plots mean (n=25)						
	Canopy color	Canopy density	CY	Leaf Si	Leaf P	Leaf Ca	Leaf K	Leaf Mg	Leaf S
	DGCI units	NDVI units	g/plot	% dry tissue					
Control	0.395	0.741	4.17	0.611	0.762	0.554	2.192	0.305	0.536
Harsco Ca/Mg-silicate	0.398	0.744	4.39	0.765	0.738	0.584	2.106	0.309	0.519
Harsco Ca/Mg-silicate-SPL	0.397	0.742	3.94	0.784	0.742	0.574	2.128	0.304	0.520
Ca/Mg pelletized limestone	0.399	0.744	4.28	0.600	0.743	0.596	2.143	0.296	0.524
LSD ($\alpha=0.05$)	NS	NS	NS	0.094	0.019	0.020	0.057	0.009	0.015

Soil amendment did not interact with wear/traffic treatment to significantly influence mean canopy color or density of the creeping bentgrass fairway (graph right). As expected, wear treatment significantly reduced mean canopy density, and to a lesser extent, canopy color. Canopy density (NDVI) levels of wear plots were observed in a 0.545 to 0.810 range, whereas non-trafficked plot NDVI levels ranged from 0.588 to 0.842.

SUMMARY

Ca/Mg-silicate-based amendments are liming agents with calcium carbonate equivalency (CCE) ranging from 55-90%. Field results showed all amendment applications raised surface soil pH. Described rates of Ca/Mg-silicates also increased mean leaf Si 0.15–0.18%, yet the observed increase in mean leaf Si content had no influence on mean vigor/growth, canopy density, canopy color, or wear/traffic tolerance of a creeping bentgrass fairway over a 2-year period.

Despite optimal soil fertility conditions over the study duration, mean leaf K, P, and S concentrations were significantly-reduced by Ca/Mg-silicate application. While levels of P and S remained sufficient in Ca/Mg-silicate treated plots, K levels neared the critical leaf threshold of 2%. Over-assimilation of Ca or Si by turfgrass, at the expense of K or P and S, may be a consequence of the Ca/Mg-silicate application rate imposed. This response is likely to be exacerbated in turfgrass maintained on less-fertile (lower CEC) soils and/or sand rootzones.

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DISCLAIMER

Mentioned trade and/or manufacturer's names are for information only and do not constitute endorsement, recommendation, or exclusion by the authors or PSU. Above-mentioned turfgrass responses resulted from treatment applications to specific sites as described and allowed by regulations governing agronomic use of such materials.

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