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EFFECTS OF LIMING SOURCE AND RATE ON CONTAINER MEDIA pH[1]

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Abstract. **Three experiments were conducted to evaluate effects of pelletized agricultural and dolomitic limestone, ground agricultural and dolomitic limestone, hydrated lime, and calcium sulfate and magnesium sulfate on pH of a medium consisting of 1 pine bark: 1 Canadian peat: 1 sand (v/v/v). Pelletized limestone reacted equally as fast as ground limestone, but ground dolomitic limestone reacted faster than pelletized dolomite. Benefit of hydrated lime was questionable under described conditions when at least 2.4 kg/m³ (4 lb./yd³) of dolomite were incorporated. Calcium sulfate and magnesium sulfate provided calcium and magnesium to the medium without affecting pH.**

Incorporation of ground limestone ($CaCO_3$) in container media is standard practice to increase media pH and supply calcium for plant growth. Dolomitic limestone is often applied instead of $CaCO_3$ to provide magnesium as well as calcium while adjusting pH. The amount of lime necessary to adjust media pH to the desirable range, 5.0 to 6.5 for most plants, depends upon the reserve acidity of media components, growing conditions and particle size of the liming material (1, 2).

Reaction rate of limestone is especially important when liners or rooted cuttings are transplanted into a medium shortly after mixing and when the crop production cycle is only a few weeks long. Rate of limestone reaction is primarily dependent upon particle size, with smaller particles neutralizing acidity faster than coarse particles (2). Temperature, moisture content and media cation exchange capacities also influence reaction rate. General recommendations call for liming materials that pass through a 50 to 60 mesh sieve (300 to 250 μm openings).

Many Florida nurseries irrigate with water high in bicarbonates and a pH greater than 7.5. Therefore, amending media with limestone is not advisable, since media pH would increase above the desired range for most plants (3). Reactive properties of sulfates of calcium and magnesium make them prime candidates to supply elemental calcium and magnesium without increasing media pH.

Consistent, thorough mixing of a small quantity of fine particles into a coarse medium is difficult because particles often adhere to medium particles and resist redistribution within the batch. Pelletized limestone products reduce adhesion problems but their reaction properties in container media have not been reported. Purpose of these experiments was to compare effects of pelletized limestone and dolomite, ground limestone and dolomite, hydrated lime, and calcium and magnesium sulfates on pH change in a peat-sand-pine bark medium.

Materials and Methods

Ampel (American Pelletizing Corporation, P.O. Box 3623, Des Moines, Iowa 50322) pelletized limestone and pelletized dolomitic limestone (dolomite), and ground limestone and ground dolomitic limestone (dolomite) were incorporated at 0, 3, 4.2 and 6 kg/m³ (0, 5, 7 and 10 lb./yd³) in a pine bark, Canadian peat and sand (v/v/v) medium. The medium was placed in 3 liter (1 gal) plastic containers with 12 replicates. The initial pH of the medium was 4.1. Plants were not grown in the containers, but each container was irrigated every 2 days with water of pH 7.7. Media pH was determined daily for the first wk, weekly for the next 7 wk, then monthly for 4 months. Twenty-five ml soil samples were saturated in 50 ml of water for 5 to 6 hr and the pH of the equilibrium solution determined.

In experiment II, dolomite at 0, 1.2, 2.4 and 3.6 kg/m³ (0, 2, 4 and 6 lb./yd³) and hydrated lime at 0, 0.6, 1.2 and 1.8 kg/m³ (0, 1, 2 and 3 lb./yd³) in factorial combination were incorporated in the medium and pH was measured as previously described.

Experiment III compared effects of calcium and magnesium sulfate on medium pH to that of dolomitic limestone. Calcium sulfate and magnesium sulfate were incorporated in a Canadian peat: sand (v/v) medium at 3.9 and 3.4 kg/m³, respectively. These rates supplied an equivalent amount of elemental calcium and magnesium as the 4.2 kg/m³ (7 lb./yd³) rate of dolomitic limestone. The medium was watered every 2 days with deionized water having a pH of 7.0. Twelve replicates were prepared and media pH in 4 containers per treatment was determined every 3 days for 2 wk and every 4 days thereafter for 45 days using methods previously described.

Results and Discussion

There was no interaction between lime source and rate on media pH over time in Experiment I. Pelletized limestone reacted faster and generally resulted in a higher pH throughout the experiment than pelletized dolomite (Table 1). Ground dolomite resulted in a higher pH than ground limestone after 3, 5 and 14 days, but not after 35 days or longer. Pelletized limestone reacted equally as fast as ground limestone but ground limestone resulted in a higher pH at 35 and 63 days. Ground dolomite reacted faster and maintained a higher pH than pelletized dolomite.

Table 1. Effects of lime source on pH change of a pine bark-peat-sand medium[z].

Lime source	Days after treatment: 1	3	5	14	35	63	147
Control	4.1 c[y]	5.0 d	5.4 d	5.6 d	6.2 c	6.3 d	7.0 c
Pelletized limestone	4.7 a	5.5 b	6.0 b	6.2 b	6.7 b	7.1 b	7.5 a
Pelletized dolomite	4.2 c	5.2 c	5.6 c	5.9 c	6.5 b	7.0 c	7.3 b
Ground limestone	4.6 ab	5.3 c	6.0 b	6.1 b	7.0 a	7.4 a	7.6 a
Ground dolomite	4.5 b	5.7 a	6.2 a	6.3 a	6.9 a	7.4 a	7.5 a

[z]pH averaged across lime rates because there was no interaction between lime source and rate.
[y]Mean separation within columns by Duncan's multiple range test, 5% level.

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The 10 lb./yd³ rate of lime resulted in the highest media pH during the first few days, but by 14 days pH's were 6.0, 6.1 and 6.2 for the 5, 7 and 10 lb./yd³ rates, respectively (Table 2). Media pH increased to 7.4 or higher in 147 days with all lime rates, but the nonlimed treatment resulted in a 7.0 pH.

Table 2. Effects of lime rate on pH change of a pine bark-peat-sand medium[z].

Lime rate (lb./yd³)[y]	Days after treatment						
	1	3	5	14	35	63	147
0	4.1 c[x]	5.0 b	5.4 c	5.6 c	6.2 c	6.3 c	7.0 b
5	4.4 b	5.4 a	5.9 b	6.0 b	6.7 b	7.1 b	7.4 a
7	4.4 b	5.4 a	5.9 b	6.1 ab	6.7 b	7.2 ab	7.5 a
10	4.6 a	5.5 a	6.1 a	6.2 a	6.9 a	7.3 a	7.5 a

[z]pH averaged across lime sources because there was no interaction between lime source and rate.
[y]One lb./yd³ equals 0.6 kg/m³.
[x]Mean separation within columns by Duncan's multiple range test, 5% level.

Experiment II revealed a significant interaction between ground dolomite rate and hydrated lime rate on media pH. The major influence of the hydrated lime on pH was during the first 14 days. The 4 and 6 lb. rate of dolomite without hydrated lime resulted in a pH of 5.8 in 3 days, 6.0 in 5 days and in 147 days were 6.9 and 7.0, respectively. The 2 lb./yd³ dolomite rate resulted in a pH of 5.4 in 3 days, 5.7 in 5 days, 6.2 in 28 days and 6.8 in 147 days. Benefit of hydrated lime with dolomite rates of 4 lb./yd³ pounds or higher, is questionable. Hydrated lime rates should not exceed 1 to 2 lb./yd³.

In Experiment III calcium sulfate and magnesium sulfate supplied calcium and magnesium to the container media without having an appreciable effect on media pH (Fig. 1). Dolomite resulted in a pH consistently above 6.0 after 3 days while pH of the calcium sulfate and magnesium sulfate treatments did not exceed 4.6. The slight increase in pH with time could be explained by the use of water with a pH of 7.0.

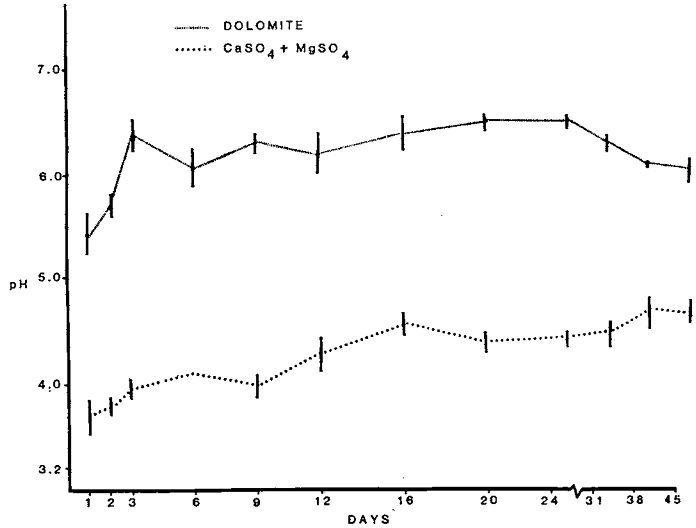

Fig. 1. Change in pH with time as influenced by *dolomitic limestone* and calcium sulfate—magnesium sulfate.

Generally, ground dolomite reacted faster and maintained a slightly higher pH than pelletized dolomite, but all treatments resulted in an acceptable pH within 5 days. Pelletized agricultural limestone reached at least as fast as ground agricultural limestone. Nonlimed controls had a pH of 5.6 by day 15 and 6.2 by day 35 with irrigation water of pH 7.7. Calcium sulfate and magnesium sulfate can be incorporated into container media to supply calcium and magnesium without appreciably increasing pH.

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