EVALUATION OF LIMING MATERIALS AND PFIZER FS KILN DUST

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Tests have been conducted on behalf of the Pfizer Chemical Company to determine the agricultural merit of a kiln dust product that was previously thought of as a waste material. Similar to conventional agricultural limestone, the product is primarily calcium carbonate and calcium oxide. The Pfizer Chemical Company has been marketing a 'KFS Dryer dust' as a calcite aglimestone. Pfizer FS kiln dust differs from this because it comes from the screenings after a high temperature kiln drying process. For this reason some of the calcium carbonate has been converted to calcium oxide. What follows is a summary of many of the studies involving this material as tested by the Department of Plant & Soil Sciences at the University of Massachusetts.

1. Liming ability of Pfizer FS kiln dust

Similar quantities of three liming materials, Pfizer FS kiln dust, Pfizer KFS Dryer dust and Dolomite Aglime were fully mixed with several soils, brought to 25% moisture and incubated for several weeks. The results of one such soil incubation (other soils showed similar results) are shown in Figure 1. Soil reaction was very rapid under these conditions where the limestones were fully mixed with the soil. Slower reaction times are evident under field conditions because of less thorough mixing and because of variations in soil moisture and temperatures. The 'Dryer dust' and 'kiln dust' both calcite materials, raise soil pH a half pH unit above the dolomite material.

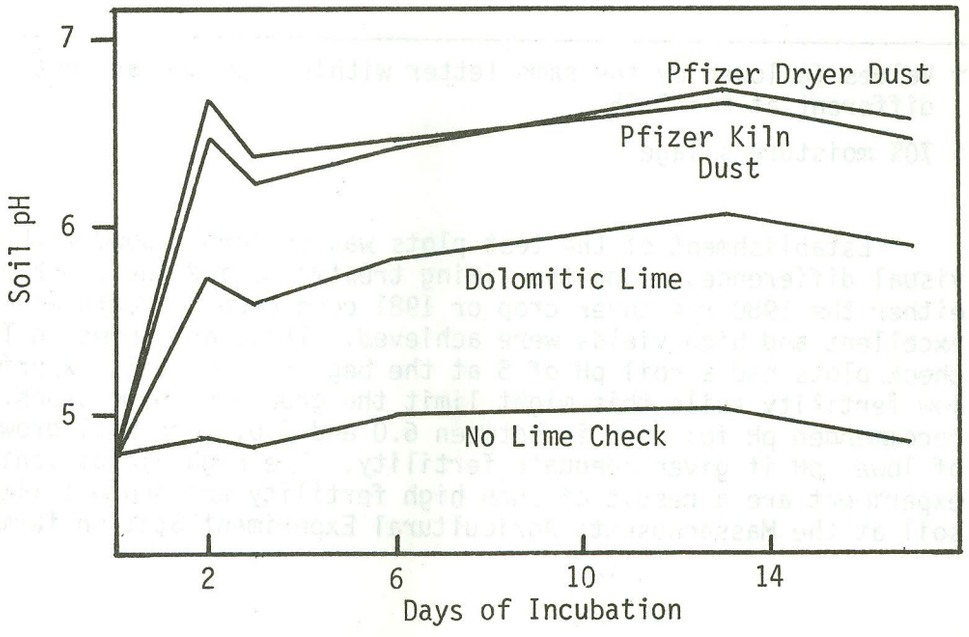
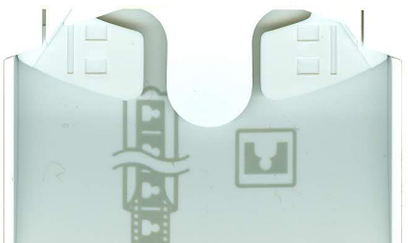


Figure 1. Soil pH change with time and liming material under laboratory incubation.



2. Field studies of liming characteristics

The experimental site had limestone applied on September 12, 1980 for treatments 2, 3 and 4. Kiln dust in Treatment 5 was spring applied 1 week prior to planting corn in mid-May 1981. The corn variety used in this study was Agway 584S. Soil pH changes in response to the limestone additions are shown in Table 1. The Pfizer Dryer dust was a finer material than the other limestones and this probably was the reason for the faster liming characteristics.

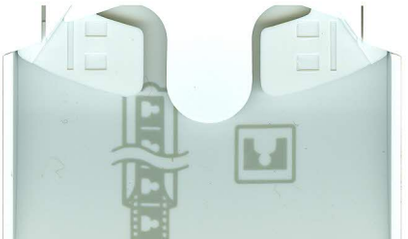
Table 1. Soil pH correction and yields of a rye cover crop and corn silage.

Limestone Material	Application Date	Soil pH Nov 3 1980	Soil pH Feb 2 1981	Rye Yield % of Check	Corn Silage§ ton/acre
No Lime Check	-	5.01 c†	5.15 c	100 a	32 a
Pfizer Kiln Dust	Sept.1980	5.60 b	5.94 b	105 a	29 a
Pfizer Dryer Dust	Sept.1980	6.25 a	6.21 a	95 a	32 a
Dolomite Lime	Sept.1980	5.62 b	5.87 b	96 a	30 a
Pfizer Kiln Dust	May 1981	4.94 c	5.25 c	100 a	30 a

† Values followed by the same letter within a column are not significantly different at P = 0.05.

§ 70% moisture silage.

Establishment of the test plots was uniformly good with no noticeable visual differences among the liming treatments and the check plots for either the 1980 rye cover crop or 1981 corn crop. Growth of the corn was excellent and high yields were achieved. These are shown in Table 1. The check plots had a soil pH of 5 at the beginning of this experiment and in low fertility soils this might limit the growth of some crops. Although the recommended pH for corn is between 6.0 and 7.0, corn will grow well in soils of lower pH if given adequate fertility. The high yields achieved in this experiment are a result of such high fertility and productivity of this soil at the Massachusetts Agricultural Experiment Station farm.



3. Liming and plant response in a greenhouse soil

In this experiment soil was amended with sand and liming materials were fully mixed prior to potting in the greenhouse. Eight plant species and one unplanted check were grown under greenhouse conditions using the three liming materials, Pfizer kiln and Dryer dusts and a dolomite aglime, and an unlimed check. Initial amended soil pH was 4.7 on March 19. Table 2 shows soil pH characteristics at three sampling times during the experiment.

Table 2. Soil pH of unplanted check.

Treatment	March 19	April 1	June 19
No lime check	4.71	4.63	4.86
Dolomitic Lime	5.46	5.37	5.57
Pfizer Dryer Dust	6.22	5.90	6.22
Pfizer Kiln Dust	5.49	5.31	5.68

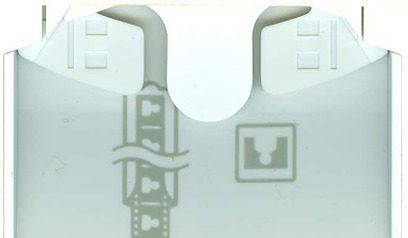
Growth varied in response to liming treatments among the differing crop species. However, the Pfizer kiln dust performed as a soil amendment with respect to plant growth equal to any of the other liming materials evaluated (Table 3).

Table 3. Crop yield as a percentage of unlimed check.

Treatment	Beet	Spinach	Sweet Corn	Beans	Alfalfa	Bent-grass	KBG*	Red Fescue
No Lime Check	100b†	100b	100b	100b	100a	100a	100a	100a
Dolomitic Lime	147a	593a	108ab	112b	125a	86a	88a	100a
Pfizer Dryer Dust	117ab	598a	80c	148a	120a	68a	82a	91a
Pfizer Kiln Dust	155a	698a	134a	150a	132a	96a	93a	81a

* Kentucky Bluegrass

† Values followed by the same letter within a column are not significantly different at P = 0.05.



4. Liming soils with an established forage

This investigation into phytotoxic (plant injury) effects of the Kiln dust was performed on an established 80 percent alfalfa stand. The liming treatments comparing the kiln dust to a commercially available Aglime were applied in mid-August. Early observations showed no phytotoxic effects from applying the Kiln dust or the Aglime on dry forage, on forage following a heavy dew, or on dry forage followed by rain. Soil pH changes and the effect of these liming materials and treatments on alfalfa yields are shown in Table 4. Liming increased yields and no treatment caused a lasting decline in vigor.

Table 4. Limestone phytotoxicity to forage alfalfa.

Treatment	Limestone Material	Soil pH (spring)	Fall Forage† % of check	Spring First Cut % of check
No lime check		6.56	100	100
Lime on dry forage	Kiln dust	7.36	118	108
	Crushed dolomite	7.02	120	117
Lime on wet forage	Kiln dust	7.26	82	135
	Crushed dolomite	6.91	96	115
Lime on dry forage washed in	Kiln dust	7.30	108	109
	Crushed dolomite	7.02	104	112

† Fall harvest taken 25 days after applications.

5. Soil pH correction for establishing lawns

The site was prepared in mid-August with the liming materials and fertilizer incorporated 2 weeks prior to seeding a 50/50 Kentucky bluegrass, fine fescue mix on September 3. Results of this study are presented in Table 5. All liming materials increased soil pH and although there was an indication of a growth response this was statistically non-significant.

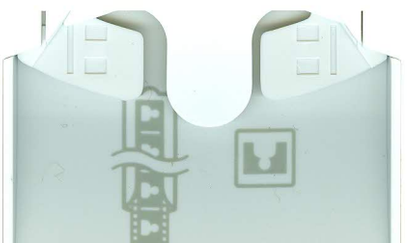


Table 5. Soil pH correction for lawn establishment and maintenance.

Limestone Material	Lawn Establishment			Lawn Maintenance		
	Soil pH Sept 3 '81	Soil pH June 3 '82	Herbage Yield % of Check	Site 1 July 1982	Site 2 June 1982	Q.R.
Check	4.92b†	5.53b	100a	5.70b	5.29b	4.82a
Kiln Dust	5.17a	6.84a	145a	6.56a	5.86a	4.84a
Dryer Dust	5.35a	6.75a	110a	6.63a	5.85a	4.79a
Dolomite	5.31a	6.46a	104a	5.85b	5.66a	4.86a

† Values followed by the same letter within a column are not significantly different at P = 0.05.

6. Maintenance liming program on turf

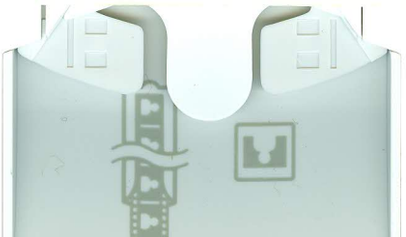
Two maintenance liming studies of turf have been implemented. The first site was with a mostly fine fescue turf where the three liming materials, Pfizer's Kiln dust, Pfizer's Dryer dust and a Dolomitic Aglime were applied then followed by sprinkler irrigation. Growth response has been similar among the three materials and no phytotoxic symptoms were noticed compared to the check plots (Table 5).

Similar results were found in the second maintenance liming study. This study differed from the previously described study since we used a Kentucky bluegrass based turf and did not follow the lime application with sprinkler irrigation. In this situation, where there was a longer period of contact between the liming materials and the plant leaf tissue, there were still no observed phytotoxic symptoms.

7. Screening for foliar injury

The objective of this study was to observe if Pfizer FS kiln dust causes phytotoxicity (foliar injury to plants) upon contact or application. An array of plants was exposed to the following three treatments:

(1) dust over dry foliage,
(2) dust over dry foliage, followed by misting, and
(3) misted foliage, followed by dusting.



These three treatments were selected to simulate field conditions where:

(1) drift might occur during a dry day,
(2) drift might occur followed by a shower, fog, mist or due; and
(3) drift might occur immediately after a shower, fog, mist or dew.

Under each circumstance plants were exposed to Aglimestone (dolomite), Kiln dust, or no dust (check). Misting was accomplished by hose using a "Fogg-11" nozzle, and liming materials were dusted on plants using a hand duster. Plants exposed to treatment in each case were potted roses (several varieties but including white cultivars in each case), rhododendron (roseum, elegans), tomatoes (Jet Star), egg plant (Black Knight), green peppers, marigolds and petunias (varieties unknown).

Liming material applications were made on the afternoon of June 8, 1981, a clear, bright day. Temperature in the greenhouse was 98°F. Individual plants were observed closely for foliage and blossom color, necrosis and any abnormality. Plants were observed daily during subsequent weeks. Watering was accomplished by an open-nozzle hose to avoid washing off any lime residue. The weather continued to be hot, but a few cloudy days occurred.

Under none of the conditions or treatments was phytotoxicity observed. Liming material residues were clearly visible on both the mist-dust and dust-mist treatments. A number of the roses passed through bloom during the observation period and displayed no necrosis or off-color. It was concluded that neither Pfizer FS kiln dust nor the Aglimestone caused phytotoxicity under the concentrations and conditions imposed,which were designed to simulate conditions of natural drift. These results are similar to those found where these limestone materials were topdressed on forage crops and turf.

To briefly summarize the results from all experiments, we have not found any negative growth responses or phytotoxic effects from applying Pfizer FS Kiln dust. Thus, the Kiln dust appears suited as a liming material. The Kiln dust does not appear to be a better liming material than the others evaluated but does have a liming capability of similar value.