The Concern Over Fluorides

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During the past 5-10 years much concern has been expressed over the amount of fluoride contained in certain aggregates used for making artificial mixes for plant growing. The concern has been mostly with foliage plants and has been centered around the use of perlite as a cornponent of many mixes.

This is a report of work we carried out and published (Sheidrake, Doss, St. John, and Lisk) in 1978. The reason for the concern by growers in the 1970's stemmed from work in Florida that was much publicized and possibly misinterpreted. They reported tip necrosis that progressed down the margins of the leaves on a few kinds of plants grown in moderately acid mixes. The horticultural world took this to mean that everything that went wrong with plants (that could not be explained any other way) was fluoride toxicity.

Fluoride Not New

Is the presence of fluoride in horticulture new? No; the element fluorine (F) is widely distributed in nature, and is a common constituent of most soils and rocks. It has been shown conclusively that the amount of fluoride which is taken up from the soil by plants is usually unrelated to the flouride content of the soil. Soil type, calcium and phosphorus content, and soil reaction (pH) seem to be the predominant controlling factors. Even after substantial additions of soluble fluoride compounds to well-limed soils, the uptake of fluoride in plants did not increase. The mechanism involved here is that the fluoride (F) combines with the calcium (Ca) to form a very unsoluble calcium fluoride and the fluoride is no longer available in the soil solution for plant uptake.

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Fluoride injury has always been a problem to vegetation growing in the vicinity of super-phosphate plants and the literature carries such reports back to 1890. The rock mineral (Apatite) from which super-phosphate is made is high in fluorides; and acids containing fluoride are, in fact, made from these same mines.

Calcium Compounds are Answer

There is a general agreement throughout most of the literature that the answer to fixation of fluoride is the addition of calcium containing compounds to a soil or "artificial mix." Liming acid media to pH 6.5 will insure almost complete fixation of soluble F compounds present in the substrate.

What did we do? We had good evidence from the literature that the answer to fluoride problems was to get calcium into the system and naturally limestone seemed to be the answer. (Calcium sulfate could be used where a low pH is desired.)

We used a mix of 50-50 peat and perlite (volume) and used rates of dolomitic limestone of 0,10, 20, and 30 pounds per cubic yard. We direct seeded three crops in 6-inch pots of these mixes (lettuce, spinach, and ryegrass). The peat had a pH of 3.5 and the perlite 7.5. To a cubic yard of the peat-perlite were added 1 pound of granular super-phosphate (0-20-0), 1.5 pounds of calcium nitrate, 1 pound of slow release nitrogen (31-0-0) and 1.5 ounces of FTE 503. Potash was added in the liquid feed as KNO_3 at 1 pound per 100 gallons.

What happened? Well, we got a lot of data and published a paper in the Journal of the American Society for Horticultural Science, Vol. 103(2). March 1978. Since few growers may have seen this, I will popularize the findings here.

As expected, when we increased the limestone the pH went up and the fluoride in the "soil" solution went down. We analyzed the leaves and the fluoride pick up went down.

I will list the pertinent data below and will use only the leaf analysis data for spinach because it is known to be a good accumulator of fluoride.

The Effect of Limestone Additions to Peat and Perlite Mix

Limestone lbs/yd^3	pH	Fluoride in Media Solution, PPM	Fluoride in Leaves, PPM
0	5.0	44.1	30.8
10	7.5	7.4	10.2
20	7.3	5.1	7.2
30	7.2	3.8	5.7

In an attempt to ascertain where fluoride might come from in a peat-perlite mix we analyzed many components and some of the levels are presented.

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Releasable Fluoride and pH of Individual Constituents of Growing Media

Constituent	pH	Fluoride, PPM
Sphagnum peat moss	3.5	1.4
Perlite	7.5	9.1
Superphosphate	3.2	1254.0
Calcium Nitrate	5.6	19.0
Slow release 31-0-0	7.5	0.4
FTE 503	9.1	91.2
Limestone	9.3	2.9
Activated Charcol	9.9	0.1

Summary and Conclusion

This article is a popular version of an interesting research project. Scientific colleagues are urged to read the paper in the journal.

The data from the research indicate clearly that the addition of limestone to a media will decrease the uptake of fluoride in plants. One of the large carriers of fluoride is superphosphate and where one is concerned about fluoride toxicity, this should be considered.

Many symptoms of injury on plants that have been blamed on fluoride toxicity may, in fact, be caused by something entirely different such as stress from many other causes. This has been clearly shown by other workers.

Reference

Sheldrake, Raymond, George E. Doss, Leigh E. St. John, Jr., and Donald J. Lisk
Lime and Charcoal Amendments Reduce Fluoride Absorption by Plants Cultured in a Perlite-peat Medium.
J. Amer. Soc. Hort. Sci. 103(2): 268-270,1978.