The Concern Over Fluorides

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Editor's Note: Several years ago, work was done in Florida that suggested that tip burn in a few selected types of plants was due to fluoride in the perlite soil mix that was used. This work was widely reported and has been freely quoted. Because of the importance of the horticultural market to the perlite industry and the excellent results obtained by growers throughout the world using perlite mixes, a study was conducted by Raymond Sheldrake and George E. Doss of the

Department of Vegetable Crops and Leigh E. St. John, Jr. and Donald J. Lisk of the Department of Food Science of the New York State College of Agriculture and Life Sciences, Cornell University.

At the request of the Perlite Institute, Inc., Dr. Sheldrake wrote the following summary of the results of this research. It should be noted that calcium nitrate, superphosphate, and FTE 503 (trace element frits) all contain more fluoride than perlite. In addition, for those few plants that do exhibit a tendency toward fluoride injury, the simple addition of lime will greatly reduce fluoride uptake.

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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 in regard to foliage plants and has been centered around the use of perlite as a component of many mixes.

This is a report of work carried out and published (Sheldrake, Doss, St. John, and Lisk) in 1978. The concern by growers in the 1970's stemmed from work in Florida that was much publicized and possibly misinterpreted. It 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 soil by plants is usually **unrelated** to the fluoride content of the soil. Soil type, calcium and phosphorous 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, so that the fluoride is no longer available in the soil solution for plant uptake.

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

Calcium Compounds Are Answer

There is 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 (lettuce, spinach, and ryegrass) in 6 inch pots of these mixes. 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 superphosphate (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? We gathered 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 found that the fluoride pick up had gone down.

The pertinent data is listed below, using 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	Flouride in Media Soln.	Flouride in Leaves
0	5.0	44.1 ppm	30.8 ppm
10	7.5	7.4 ppm	10.2 ppm
20	7.3	5.1 ppm	7.2 ppm
30	7.2	3.8 ppm	5.7 ppm

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 below.

Releaseable Fluoride and pH of Individual Constitutents of Growing Media

Constituent	pH	Flouride - in 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 charcoal	9.9	0.1

Summary and Conclusions

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 researchers.

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.