INJURY TO GLADIOLUS BY FLUORIDATED WATER

by

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SUMMARY: In pursuance of studies on F^- damage to tulips and gladiolus, we determined the effect of fluoridated water on cut flowers.

The "fluoridated" leaves contained up to 5 times more F^- than those in low F^- water. In the injured leaf tips the F^- levels were considerably higher than in the non-injured portions of the leaves.

Single leaves and cut-flowers were placed in artificially fluoridated, and nearly F^- free water. Gladiolus plants of the species 'Snowprincess', were chosen for the experiments since they are known to be sensitive to low concentrations of HF in the atmosphere (1). Leaf tips turned ivory white and became necrotic as the result of an 8 hour treatment with HF at a concentration of 15 mg/m^3 air (15 parts per billion).

Methods

Leaves of gladiolus plants 'Snowprincess' grown in a glasshouse, were cut and placed with their bases in fluoridated water (1 ppm) designated water no. 1 and in water with 0.24 ppm F^-, water no. 2. Cut leaves of the same gladiolus variety grown in the field were treated in the same way with fluoridated water (1 ppm F^-) and with low F^- water (0.08 ppm F^-) water no. 3.

Cut flowers of the varieties 'Snowprincess', 'Oscar' and 'Mary Housley' were placed in fluoridated water no. 1 and in low F^- water no. 3. The results of analyses for certain components of the three types of drinking water are given in Table 1.

The samples for analysis were taken while the flowers remained in the respective water. The F^- analysis of portions of leaves was carried out with the Technicon Auto-Analyzer. The pretreatment was done as follows: The leaf samples were dried for 48 hours at 85°C. After grinding, 0.5 g was weighed and ashed at 500°C for 7 hours. Then sodium hydroxide pellets (2.5 g) were added and the sample fused at 500°C for 8 minutes. After cooling, the mixture was dissolved in de-ionized water. The samples were transferred to test tubes and then put in the Technicon Auto-Analyzer. The suc-

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cessive sampling, digestion with H_2SO_4, colorimetric measuring with lanthanum nitratealizarine mixture at pH 4, and recording were done automatically.

TABLE 1

Components of F^- and "Low F^-" Water

Conductivity (microsiemens)	Water no. 1 (fluoridated) (1 ppm F^-) 160	Water no. 2 (natural) (0.24 ppm F^-) 695	Water no. 3 (natural) (0.08 ppm F^-) 440
pH	8.0	7.9	7.3
Ca mg/l	27.0	93.0	76.9
Mg mg/l	3.0	9.0	5.0
SO_4 mg/l	10.0	68.5	25.0
Cl mg/l	6.5	115.0	43.0

Results

LEAVES: In a preliminary experiment the leaves in fluoridated water no. 1 (1 ppm) and low F^- water no. 2 (0.24 ppm) showed distinct differences after three days (Fig. 1).

In a second more informative experiment, water no. 1 (1 ppm) and low F^- water no. 3 (0.08 ppm) were used. The leaves came from thirty 'Snowprincess' plants grown at Breezand, a small village with little or no HF air pollution. Two days after the experiment started the leaves standing in fluoridated water showed greater damage to the tips than those in low F^- water no. 3 (0.08). After four days the average length of necrotic leaf tips in the fluoridated water no. 1 was 21.2 mm, while the corresponding figure for the leaves in low F^- water no. 3 was 9.5 mm (Fig. 2).

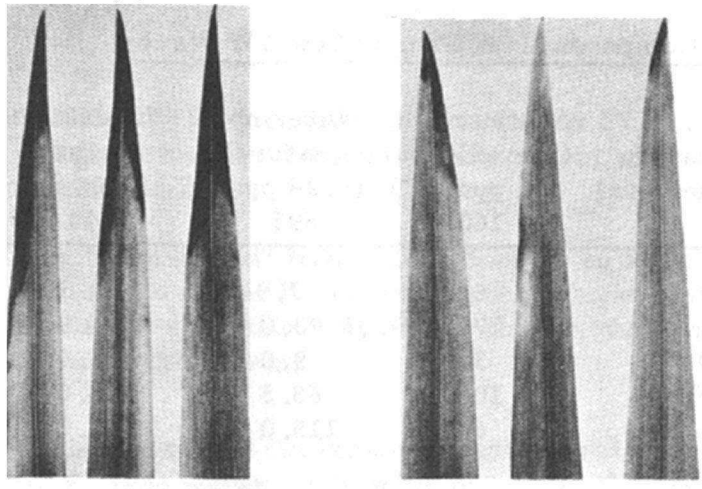
The leaves were then analyzed for their F^- content. Their top sections (0-4 cm) and the next section (4-10 cm) were assayed separately since F^- was found to accumulate in the tips. Table 2 gives the results.

FLOWERS: The third experiment was carried out with flower stalks of the three gladiolus varieties, 'Snowprincess', 'Oscar', and 'Mary Housley'. All plants were grown at Breezand and cut just above soil level The two oldest leaves were removed. Nine of the flowering stalks were placed in fluoridated water no. 1 and nine in low F^- water no. 3. The flower bracts of 'Snowprincess' in water no. 1 were injured after 4 days. The injured portions of the upper 10 cm of the 6th, 7th and 8th leaves (top three leaves) of both lots were then measured. In fluoridated water they averaged 36 mm, in low F^- water 12 mm.

Fig. 1

Leaf Tips of Variety 'Snowprincess'

(a) (b)



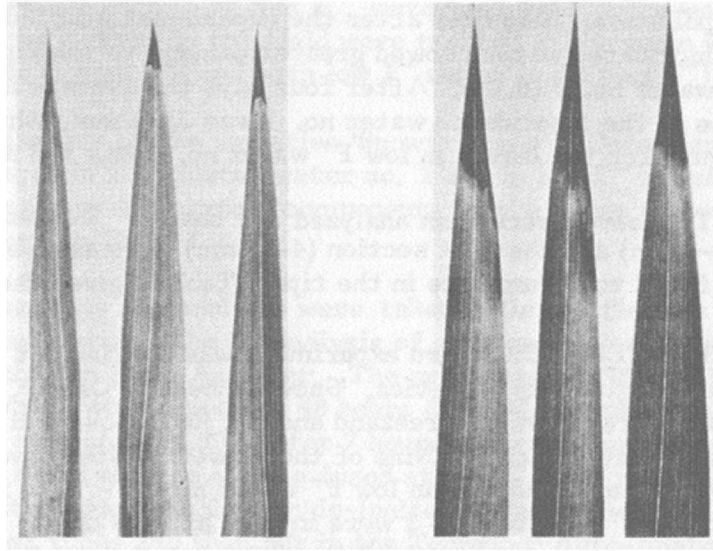
After 3 days in fluoridated water no 1 (1 ppm)

After 3 days in low F^- water no 2 (0.24 ppm)

Fig. 2

Leaf Tips of Variety 'Snowprincess'

(a) (b)



After 4 days in fluoridated water no. 1 (1 ppm)

After 4 days in low F^- water no. 3 (0.08 ppm)

The injuries to the leaf tips of the other varieties were measured after 9 days, when flowering had almost ceased. In the variety 'Oscar', they measured 25 mm in fluoridated water and 12 mm in low F⁻ water. The corresponding figures for the variety 'Mary Housley' were 29 and 14 mm.

TABLE 2

F⁻ in Leaf Sections of Gladiolus 'Snowprincess' after 4 days in 1 ppm F⁻ Water and Low F⁻ Water (ppm)*

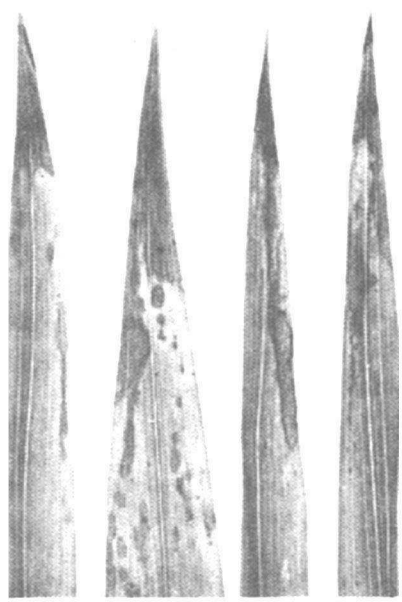
	Length of leaf section (cm)		Fluorine concentration (ppm)	
Water:	no. 1	no. 3	no. 1	no. 3
8/26/68	0-4	0-4	89	13
8/26/68	4-10	4-10	8	0.2

*parts per million on a dry basis (48 hour period at a temperature of 85°C)

Besides injury to the leaf tips, there were isolated or partly isolated patches of injured tissue on the leaf blades adjacent to the abnormal tips (Fig. 3). The above-mentioned figures for injury indicate the total length of injured leaf tissue as if the totally and partly isolated patches were moved upwards to fit together with the injured tip.

Fig. 3

Leaves from Flowering Stalks of the Gladiolus 'Snowprincess' Injured (after the stalks had been placed in fluoridated water no. 1 for 4 days)



Fluoride analysis of the leaves of nine flowering control plants was made before the experiment started and the F^- concentration of the top 10 cm of the three youngest leaves of all three varieties was determined at the end of the experiment. The results are given in Table 3.

TABLE 3

F^- in Leaf Sections of Three Gladiolus Varieties Before and After Stay in Fluoridated and Low F^- Water

Gladiolus Variety	Date 1968	Length of leaf section (cm)	F^- in Leaf Section (ppm)		
				Water	
			Control	no. 1	no. 3
'Snowprincess'	8/29	0-4	12	91	17.5
	9/3	4-10	2	14	4.5
'Mary Housley'	8/29	0-4	10.5	105	29
	9/9	4-10	0.2	8	2
'Oscar'	8/29	0-4	18	72	28
	9/9	4-10	3	4.5	2.5

Discussion

It is known that F^- uptake from soil does not cause plant injury as readily as uptake of HF through the leaves. Roots of plants grown in a water culture supplied with soluble F^- had accumulated and retained more F^- than the parts above the soil (2, 3).

When the roots were cut off, so that this barrier for F^- translocation was eliminated, the aerial parts of the plants often contained a higher concentration. This is in accord with the experience of Jacobson et al. (4), who noted that F^- remains soluble in plant leaves.

When parts of leaves or cut flowers are placed with their bases in fluoridated water they can take up this water freely through the cut surfaces; the water is then transpired from the leaf surfaces and the F^- is retained. Thus the F^- accumulates in the leaves and may reach a toxic concentration.

"Non-fluoridated" tap water contains small amounts of F^- of the order of 0.08 ppm. This explains the presence of F^- in leaf samples taken before and after a stay in "non-fluoridated" water (Table 3).

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A CRITICAL REVIEW ON THE FLUORINE CARIES PROBLEM

by

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SUMMARY: The official statistical data from Grand Rapids, Brantford, Washington D.C., Newburgh and Kingston, concerned with fluoridation's effect on teeth are analyzed. Both eruption of teeth and caries experience occur with definable regularity. From this regular relationship it follows that a higher F^- intake does not represent a genuine inhibition of caries but leads to a disturbance in the development of teeth. With fluoridation, the caries incidence is accelerating at a certain point of time compared with that without fluoridation. The comparison of DMF-indices from different areas with various levels of F^- naturally in water constitutes no proof of a real reduction in caries as a result of the so-called optimum F^- level of water. For these reasons it is necessary to revise the theories concerned with the effect of F^- on enamel, in saliva and in the plaques, if these theories are based upon the reported DMF data following fluoridation.

It has been customary to compare the caries experience of children in "low F^-" areas with that of children of the same age who have a higher

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