LS.6.P172
Accumulation of fluoride in plants and crops after hydrogen fluoride explosion in Gumi industrial area - Korea

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Fluoride content was determined in plants near explosion accident region (Gumi, South Korea). A lot of plants have been found to contain high levels of fluorides, which were suddenly death within 24 hours.

Accumulation of fluoride in the leaf tissue of rice, melon, red pepper, corn and some fruit trees occurred after fatal hydrogen fluoride explosion. Severe injury of epidermal tissues of exposed plants was observed following cytosolic leakage and finally cell death. Using SEM-EDAX, fluoride was semi-quantitatively detected in some fruits and cereal crops.

Most of the samples were collected during October, 2012 according to the following procedure: plant samples were first taken from paddy field and upland near accident area, i.e. areas most remote from the sources of accident site and then from areas closer to fluoride explosion site.

For analyses of plant materials, samples were oven-dried in paper sacks at 80°C for at least 48 hours, finely ground in a Wiley mill, and stored in a dry place until used. A potentiometric method outlined by the Association of Official Analytical Chemists was followed in preparing the various samples for fluoride determinations and in making fluoride standard curves [1]. Small fragments of the leaves examined as above were treated for light and electron microscopy as follows: they were kept in 0.1 M phosphate buffered 3% glutaraldehyde pH 7 for 3 h at 4 °C, post fixed in aqueous 1% osmium tetroxide, dehydrated in acetone series and embedded in araldite. The cytosolic leakage on epidermal surface tissues was observed (Figure 1). A lot of plants were severely injured and fluoride distribution on epidermal surface tissues was analysed by SEM-EDAX (Figure 2). Typical symptoms, attributable to fluoride pollutants, consist in tip and margin necrosis by sudden membrane oxidation following cytosolic leakage (Figure 3). Particularly chlorophylls were severely damaged by Mg complex so called ‘metal-fluorine’ compounds [2, 3]. Fluoride distribution was able to be detected by SEM-EDAX compared to other mineral ions as calcium and phosphorus. Anthocyanin accumulating plants were relatively tolerant than crops only with green leaves as early observation [4].

1. Association of Official Analytical Chemists. *Official Methods of Analysis*. 13th ed. Horwitz W. editor. Washington DC, 1980
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5. We kindly acknowledge the financial support by Agenda Project (No. PJ009220005 to T. W. Kim) from Rural Development Administration.

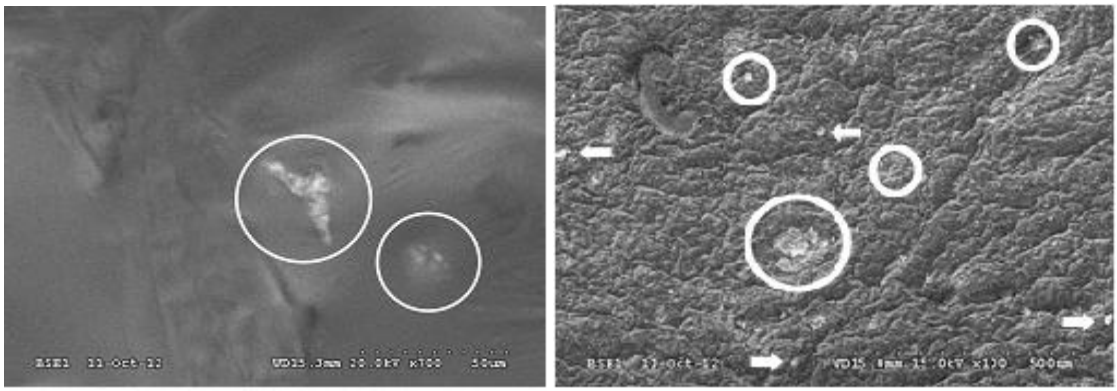

Figure 1. Cytosolic leakage (circle and arrow) on epidermal surfaces of red pepper leaf (left) and persimmon fruit (right) after HF explosion.

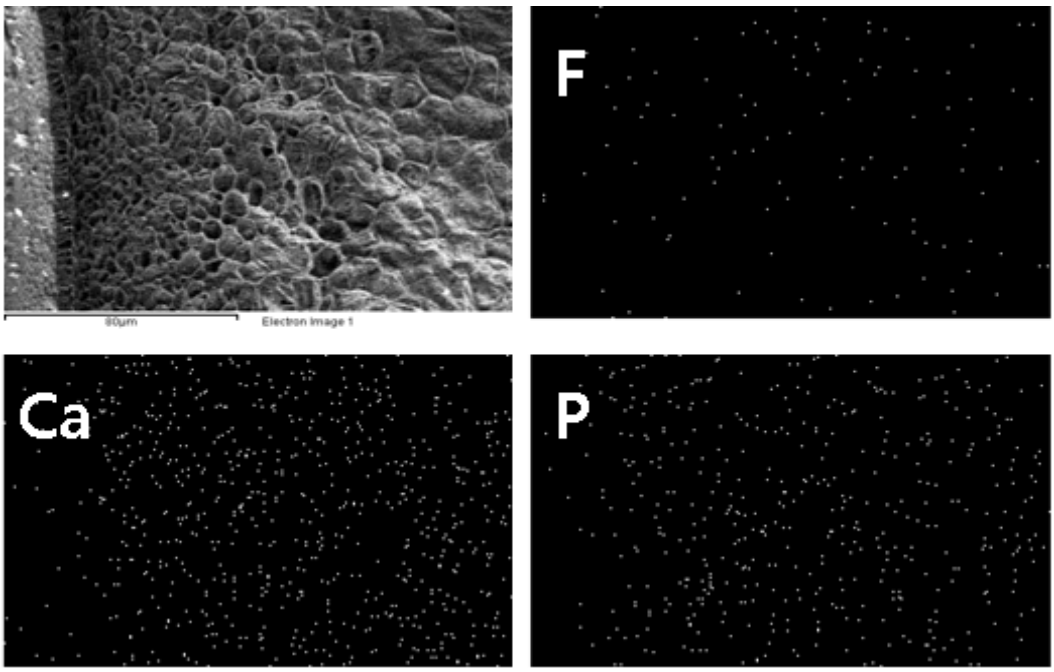

Figure 2. .Distribution of fluoride, phosphorus and calcium on epidermal surface of melon fruit (upper left) after HF explosion. Field emission SEM-EDAX analysis was conducted after cryo-SEM preparation.

Figure 3. Severe damaged crops (A: red pepper, B: pumpkin, C: peach, D: jujube)