Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 03, Issue: 06 (NOV-DEC, 2023)
Available online at http://www.agriarticles.com

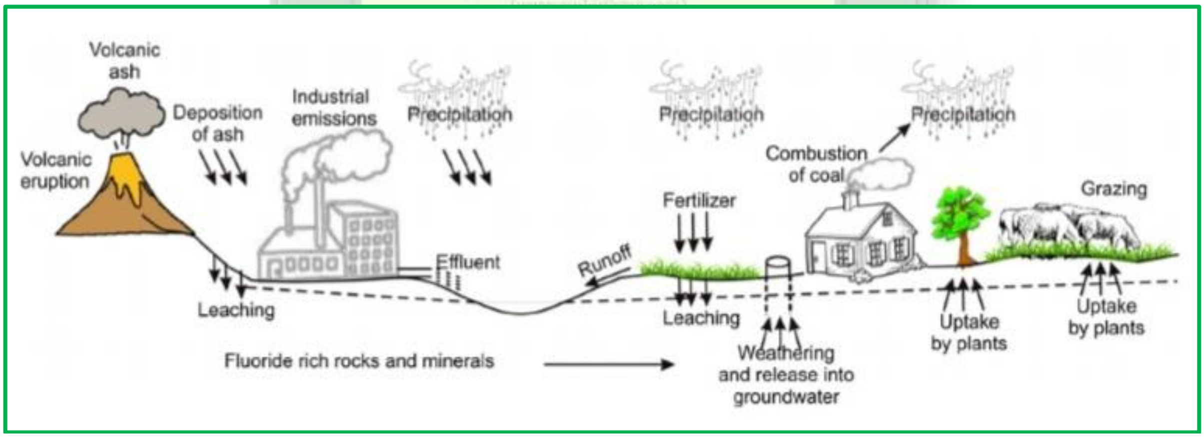
The Impact of Fluorine on Horticultural Crops: Understanding its Effects on Growth and Productivity

(*Vasanthkumar SS[1] and Gokulapriya M[2])
[1]Department of Plantation, Spices, Medicinal and Aromatic Crops, Horticultural College and Research Station, TNAU, Periyakulam
[2]Department of Agricutural Environmental Sciences, TNAU, Coimbatore
*Corresponding Author's email: kalaivasanth17@gmail.com

Fluorine is a halogen element that has been widely distributed in nature. The efficiency of indigenous natural agents may be enhanced, improved and selected over the hazardous chemicals in agriculture. The concentration of fluorine has been very high which has been reported in many parts of the Indian states. The F is an essential component of the fluorite and apatite which are the rock forming minerals that has been widely present in the lithosphere.

Introduction

Fluorine, the lightest halogen and most electronegative element, is formed in the Earth's crust as fluoride compounds and minerals like apatite, cryolite, fluorite, and topaz. Its content depends on soil materials and can combine with native elements to produce stable fluorinated compounds. Fluorine is essential for humans and animals, but excessive exposure can be harmful. Due to its low bioavailability, fluorine is less toxic than metallic salts and other halogens. Chronic exposure can cause adverse effects on bones, skeletal systems, teeth, and organs, as well as decreased photosynthesis efficiency and flower production. Fluorine, a halogen element, is found in various environmental components such as air, soils, rocks, plants, and water. Its presence is primarily due to geogenic and anthropogenic activities, with China being the world's largest producer. Punjab and Haryana are at high risk of contamination, according to a GSI survey. Fluoride is primarily derived from natural weathering processes, volcanic activity, windblown dust, and marine sources. Anthropogenic activities, such as fertilizer application, also contribute to the contamination of these systems. Overall, fluorine's presence has both positive and negative impacts globally.



Ref: Environ chem lett, 2015

Anthropogenic activities of fluoride production: Urban growth in emerging countries like India, Pakistan, and Bangladesh has led to overexploitation of fluorocarbon components, including brick making, coal combustion, phosphatic fertilizer, and aluminium smelting. Unregulated brick kilns, coal combustion, phosphatic fertilizer, and aluminium smelting also contribute to the emission of fluorocarbons into the environment. Degradation of fluorocarbon compounds, pyrolysis of fluoropolymers, and continuous burning of household refuse have resulted in the accumulation of organofluoride compounds like trifluoride-acetic acid in the surrounding environment.

Essentiality of fluorides: Fluorine, a vital element with physiological functions, is resistant to dental caries but may be classified as potentially toxic, despite having some essential functions at low risk levels, despite its physiological importance.

Effects of fluorine on horticultural crops

Fluorine can have both beneficial and detrimental effects on horticultural crops, depending on its concentration and how it is applied.

1. Beneficial Effects:

a. Fluorine is considered an essential micronutrient for some plants, including several horticultural crops like tea, coffee, and tobacco. These plants require small amounts of fluorine for proper growth and development.

b. Fluorine, when applied correctly, can enhance plant resistance to certain diseases and pests, acting as a natural defense mechanism.

2. Detrimental Effects:

a. Excessive fluorine levels can be toxic to many horticultural crops. This toxicity can manifest in several ways, such as reduced growth, leaf damage, and even plant death.

b. Fluoride toxicity is often associated with air pollution, as certain industrial processes release fluorine compounds into the atmosphere. These compounds can deposit on plants and soil, leading to fluorine accumulation.

3. Environmental Impact: Excessive use of fluorine-containing fertilizers can lead to soil buildup, causing long-term harm to crop health and the environment, and can also negatively impact surface and groundwater quality, potentially affecting aquatic ecosystems and human health.

Impact of fluoride in soil and water: Long exposure to fluorine leads to toxic compounds accumulation, negatively impacting agricultural production. Soil fluoride content ranges from 150-400 mg/kg, exceeding which results in toxic effects. Fluorine reacts with water to form hydrogen fluoride and ozone, causing environmental harm.

Impact of fluoride in plants and animals: Fluoride, a small element found in plants, is absorbed by roots and enters plant systems due to its high solubility. This creates barriers to photosynthetic processes and starch production. Fluoride components accumulate in leaves, causing marginal and tip necrosis, the first symptoms of fluoride injury. This impacts the food chain and has a significant impact on the ecosystem.

Impact of fluoride on human health: Excessive fluoride exposure can lead to skeletal fluorosis, a bone-related issue, causing pain and joint damage. The hardened bones increase the risk of fractures, while thickened bones accumulate bone tissues, impairing joint mobility. Fluorine content can also cause dental fluorosis, a condition where the bone's elasticity is reduced.

Bioremedial assistance: Fluoride removal methods include Nalgonda techniques, synthetic tri-calcium phosphate, Florex, activated carbon, lime, lime stones, special soils, clay, fly ash, and natural minerals. Bioremediation approaches have gained prominence in recent years, with fluoride-resistant microbes playing a significant role in bioremediation. Microbial techniques aid in mineralization, enzymatic oxidation, reduction, and efflux of xenobiotics using ionospheres. Environmental issues, genomic, and proteomic levels can help formulate bioremediation technology for fluoride contamination areas. Bacterial morphotypes show optimum growth in fluoride concentrations, making them suitable for treating fluoride contaminants.

Conclusion

The information on total fluoride exposure and uptake by the body is insufficient, limiting conclusions on dosage and response in future studies. Excessive fluoride exposure poses risks to terrestrial and aquatic environments. There is a need for improved knowledge on fluoride accumulation in organisms and how to manage and control it. The biological effects associated with different levels of fluoride exposure need to be characterized.

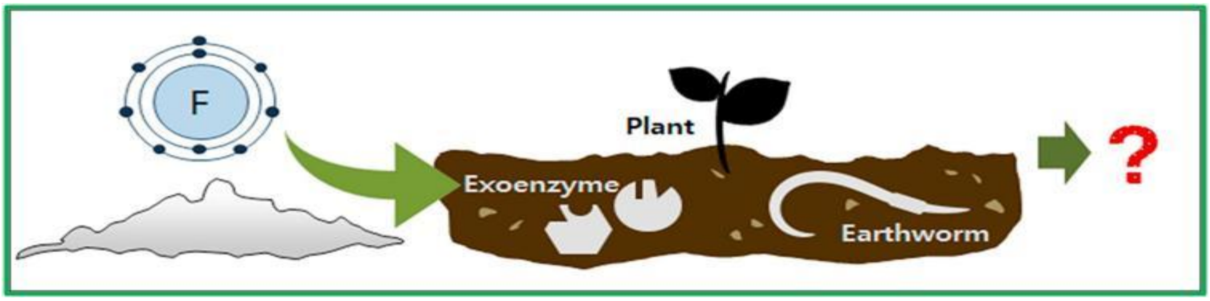


Figure 1 (Chae, Y *et al.*, 2018)

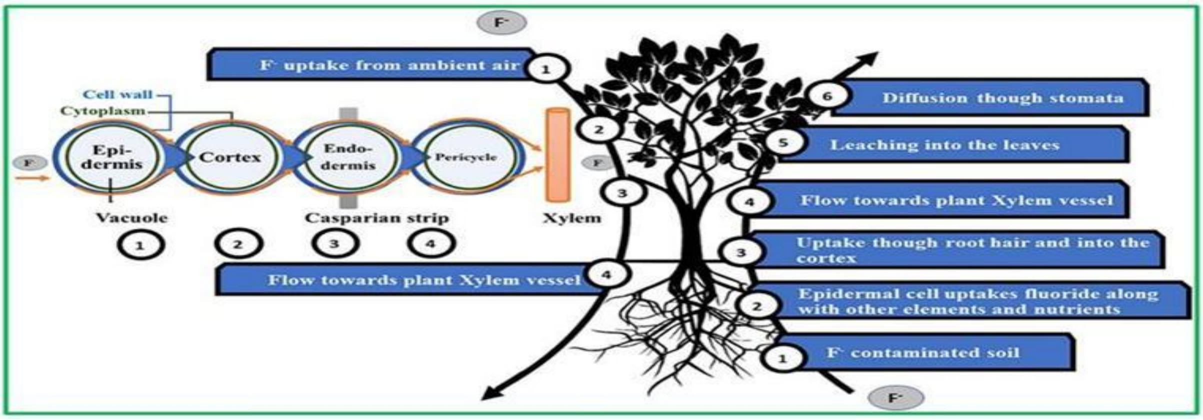


Figure 2 (Chae, Y *et al.*, 2018) -*(Weerasooriyagedara et al., 2020)*

References

1. Chae, Y., Kim, D., & An, Y. J. (2018). Effects of fluorine on crops, soil exoenzyme activities, and earthworms in terrestrial ecosystems. *Ecotoxicology and environmental safety*, *151*, 21-27.

2. Li, H., Ma, X., Huang, X., Ji, W., Chen, K., Xu, S., & Gao, P. (2023). Fluoride contents in commonly used commercial phosphate fertilizers and their potential risks in China. *Environmental Monitoring and Assessment*, *195*(9), 1051.

3. Rad, A. K., Zarei, M., Astaikina, A., Streletskii, R., & Etesami, H. (2022). Effects of microbial inoculants on growth, yield, and fruit quality under stress conditions. In *Sustainable Horticulture* (pp. 1-38). Academic Press.

4. Seymen, M., Kurtar, E. S., Erdinc, C., & Kumar, A. (Eds.). (2022). *Sustainable Horticulture: Microbial Inoculants and Stress Interaction*. Academic Press.

5. Weerasooriyagedara, M., Ashiq, A., Rajapaksha, A. U., Wanigathunge, R. P., Agarwal, T., Magana-Arachchi, D., & Vithanage, M. (2020). Phytoremediation of fluoride from the environmental matrices: A review on its application strategies. Groundwater for sustainable development, 10, 100349.