Fluoride

Title	**Impact of fluoride on agriculture: A review on its sources, toxicity in plants and mitigation strategies**
Author Name	Saroj Choudhary, Mukta Rani, O Siva Devika, Abhik Patra, Rajesh Kumar Singh and Saroj Kumar Prasad
Journal Name	International Journal of Chemical Studies
Year	2019
Volume and Issue	7, 2
Pages	Pages 1675 - 1680
Abstracts	Fluorine is a very reactive element that does not occur naturally in its state. It is present as fluoride (F) and corresponds to about 0.3 g kg^{-1} of Earth's crust. Generally, it is found in the form of a number of minerals like fluorspar, Cryolite and Fluor-apatite and it is also discharged into the atmosphere through brick production plants, production of phosphate fertilizers (with an average of 3.8%), cement and other industrial processes. Fluoride has both positive and negative effects on plant health. Hydrogen fluorides (HF) in gaseous form accumulated in the leaves of sensitive plants against a concentration gradient and therefore, considered as a most phytotoxic air pollutant, which affects plants at extremely low concentration. HF mainly damages the plant by entering into its body in the form of gas and affects a variety of plant physiological processes. As HF accumulated in the leaves of plants which could endanger the health of humans and animals through the food chain.
Keywords	Fluorine; fluoride; water and soil contamination; human health; plant stress; remediation

Title	**Fluorine in vegetation due to an uncontrolled release of gaseous fluorides from a glassworks: A case study of measurement uncertainty, dispersion pattern and compliance with regulation**
Author Name	Dona Stepec, Gsper Tav car & Maja Ponikvar-Svet
Journal Name	Environmental Pollution
Year	2019
Volume and Issue	248
Pages	Pages 958 - 964
Abstracts	This study was initiated after the appearance of chlorotic and necrotic lesions on vegetation in the vicinity of a glassworks. The aim was to establish whether the cause was an uncontrolled release of gaseous fluorides. Five different plant species (Norway spruce, peach, common hornbeam, common bean, common grape vine) were collected in the influenced area, and the fluorine (F) content was determined by a fluoride ion selective electrode after prior total sample decomposition by alkaline carbonate fusion. The measurement results were reported together with their measurement uncertainties (MUs), which were evaluated according to the Guide to the Expression of Uncertainty in Measurement. The F contents at comparable distances from the emitter and in a clean area, free from natural or anthropogenic fluoride emissions, were 87e676 and 10 mg g1 , respectively, thereby confirming the release of gaseous fluorides from the glassworks. The F contents in samples of Norway spruce taken at various radial distances from the emitter suggest that the emitted gaseous fluorides were spread about evenly in all directions from the source following an inverse-power function. Estimated distances at which the F content would decrease to 50 mg g1 (allowed maximum content of F in feeding stuffs) and 21 mg g1 (maximum fluoride content in vegetables and fruits in relation to the upper limit of fluoride intake for humans) were 378 m and 571 m, respectively, from the emitter. Evaluation of our results for compliance with specification revealed a lack of regulation on fluoride content in the diet of humans and animals as well as a lack of guidelines on how to take into account MU.
Keywords	Chlorotic; necrotic; carbonate fusion; anthropogenic; compliance; fluoride content

Title	Distribution and pollution evaluation of fluoride in a soil–water–plant system in Shihezi, Xinjiang, China
Author Name	Li Yu, Jianjian Zhang, Chunfeng Du, Hongbing Yang & Bang-Ce Ye
Journal Name	Human and Ecological Risk Assessment: An International Journal
Year	2018
Volume and Issue	24(2)
Pages	Pages 445-455
Abstracts	Fluoride (F) pollution is a serious environmental problem in some areas of China, but it has yet to be reported in a soil–water–plant system in Shihezi, Xinjiang. This study was undertaken to investigate the distribution and migration rule of F in soil, water, and plants, and to evaluate F pollution of soil. Results showed that the average concentration of total F (T-F) in the topsoil in the northwest, north, and southeast of Shihezi was higher than the national average T-F (478 mg/kg), while it was lower in southwest. The highest T-F contents of the soil profile were detected in the depth of 20 cm. The F content in groundwater in the northwest region was higher than the GB/T 14848–93 (1.0 mg/L), whereas the F contents in other water samples were within the standard. The F contents (1.75−2.81 mg/kg) in plant leaves were higher than the food limits (1.0 mg/kg). The obtained comprehensive pollution index of the soil was 1.86, which means a mild concentration of F in Shihezi. This research has reference value for the study of F pollution and comprehensive control in the northwest oasis with the typical arid and saline conditions.
Keywords	fluoride pollution; soil F; water F; plants F; risk evaluation

Title	**Accumulation, interaction and fractionation of fluoride and cadmium in sierozem and oilseed rape (Brassica napus L.) in northwest China**
Author Name	Yepu Li, Shengli Wang, Qian Zhang, Fei Zang, Zhongren Nan, Huiling Sun, Wen Huang & Lili Bao
Journal Name	Plant Physiology and Biochemistry
Year	2018
Volume and Issue	127
Pages	457-468
Abstracts	Soil fluoride (F) and cadmium (Cd) pollution are of great concern in recently years, due to the fact that considerable amounts of wastewater, gas and residue, containing F and Cd, have been discharged into the environment through ore smelting. Soil F and Cd contamination may result in their interaction in soil and plant, which affects their fractionation distribution in soil and accumulation in oilseed rape. Oilseed rape, which is widely planted and consumed as a popular vegetable in arid and semi-arid land of northwest China, has been believed to a hyperaccumulator for Cd. However, there is limited information about the accumulation, interaction and fractionation of F and Cd in soil-oilseed rape system under F-Cd stresses. A pot-culture experiment, with single (F or Cd) or double elements (F-Cd) being added to soil, was carried out study the accumulation, interaction and fractionation of F and Cd in sierozem and oilseed rape. We found that soil F applications increased the contents of Cd in exchangeable fraction (EX-Cd), the bound to carbonate fraction (CAB-Cd) and the bound to iron and manganese oxides fraction (FMO-Cd) in soil and also increased plant Cd accumulation. Therefore, we suggest that the permitted level of F should be confined within soil quality standards for farmland of China in order to upset the effect of high F concentration on bioavailability of soil Cd. However, soil Cd applications showed negative effects on the content of F in water soluble fraction (Water-F), hence decreased plant F accumulation. A better understanding of the accumulation, interaction and fractionation of F and Cd in sierozem-oilseed rape system are of great importance for environmental protection and for human health. The present study may serve as a basic understanding of the accumulation, interaction and fractionation of F and Cd in sierozem-oilseed rape system, and provide a suggestion for the environmental management.
Keywords	Sierozem; Oilseed rape (Brassica napus L.); Pot-culture experiment; Biomass; F-Cd

Title	**Soil and Water Pollution with Fluoride, Geochemistry, Food Safety Issues and Reclamation-A Review**
Author Name	Neelam Yadav, Khushboo Rani, S.S. Yadav3, D.K. Yadav, V.K. Yadav & Nagesh Yadav
Journal Name	International Journal of Current Microbiology and Applied Sciences
Year	2018
Volume and Issue	7, 5
Pages	1147-1162
Abstracts	Fluoride (F-) contamination in groundwater has been recognized as a serious problem worldwide. It is estimated that more than 200 million people from 25 countries are under the dreadful fate of fluorosis, among them India and China are the two worst affected countries In India 62 million people (including 6 million children), suffer from dental, skeletal or non-skeletal fluorosis because of consumption of fluoridecontaminated water. Rajasthan is one of the most affected states with fluoride concentration in the range of 0.1-14 mg L-1. The source of fluoride in soil and water is predominantly geogenic and released by weathering of fluoride containing minerals such as fluorite and fluorapatite, while anthropogenic sources include brick industry, aluminium smelters and use of phosphatic fertilisers. The geochemistry of fluoride is mainly governed by two processes i.e. enrichment and leaching. Fluoride mobility in soil is highly dependent on the soil's sorption capacity, which varies with pH, salinity and types of sorbents present in soil. In general, fluorine present in soil as minerals, adsorbed on clay and oxy-hydroxides, while a few amount is present as dissolved form in soil solution. Fluoride normally enters the human body through water, food, industrial exposure, drugs, cosmetics etc. The fluoride levels of food depend upon the nature of soil and quality of water used for irrigation and thus varies from place to place. Prosopis julifora is a hyper-accumulator of F- and has potential to remediate fluoride contaminated soils (Baunthiyal and Sharma, 2012). Fluoride ion concentration in drinking water can be easily detected by ion selective electrode. Various defluoridation techniques have been developed to reduce the fluoride content to the desired level including principally membrane and adsorption processes (Amor et al., 2001). Different bio-sorbents such as chitosan coated silica (Krishnaiah et al., 2009) stalks of sorghum and canola are efficient in removal of fluoride from water. Apart from these technical approaches awareness among the people needs to be created for prevention from fluoride health hazards.
Keywords	East African Rift Valley; Rainwater harvesting; Solar pasteurization;Water defluoridation; Zero-valent iron.

Title	Distribution and pollution evaluation of fluoride in a soil–water–plant system in Shihezi, Xinjiang, China
Author Name	Li Yu, Jianjian Zhang, Chunfeng Du, Hongbing Yang &Bang-Ce Ye
Journal Name	Human and Ecological Risk Assessment
Year	2017
Pages	445-455
Abstracts	Fluoride (F) pollution is a serious environmental problem in some areas of China, but it has yet to be reported in a soil–water–plant system in Shihezi, Xinjiang. This study was undertaken to investigate the distribution and migration rule of F in soil, water, and plants, and to evaluate F pollution of soil. Results showed that the average concentration of total F (T-F) in the topsoil in the northwest, north, and southeast of Shihezi was higher than the national average T-F (478 mg/kg), while it was lower in southwest. The highest T-F contents of the soil profile were detected in the depth of 20 cm. The F content in groundwater in the northwest region was higher than the GB/T 14848–93 (1.0 mg/L), whereas the F contents in other water samples were within the standard. The F contents (1.75−2.81 mg/kg) in plant leaves were higher than the food limits (1.0 mg/kg). The obtained comprehensive pollution index of the soil was 1.86, which means a mild concentration of F in Shihezi. This research has reference value for the study of F pollution and comprehensive control in the northwest oasis with the typical arid and saline conditions.
Keywords	fluoride pollution; soil F; water F; plants F; risk evaluation

Title	Effect of Fluoride on photosynthetic pigment content and antioxidant system of Hydrilla verticillata
Author Name	Jingqing Gao, Chun Liu, Jingshen Zhang, Songfeng Zhu, Yu Shen & Ruiqin Zhang
Journal Name	International Journal of Phytoremediation
Year	2017
Pages	1549-7879
Abstracts	Fluoride can either inhibit or enhance the growth of aquatic macrophytes, depending upon fluoride concentration and exposure time. To investigate fluoride toxicity, the submerged plant Hydrilla verticillata was treated with various concentrations of fluoride (F) (0, 10, 20 and 40 mg/L) for different lengths of time (7, 14, 21 and 28 days). At exposure to 10 mg/L F, the content of chlorophyll, protein and carbohydrates content increased in leaves of H. verticillata and the activity of guaiacol peroxidase (POD) and superoxide dismutase (SOD) slightly increased in plants compared with the control. When fluoride concentration increased to 20 mg/L, the toxic effect generated by fluoride led to a reduction of chlorophyll, protein and carbohydrates in H. verticillata, but the activity of guaiacol peroxidase and superoxide dismutase and the amount of ascorbic acid (AsA) and glutathione (GSH) was enhanced significantly. As the concentration of fluoride at 40 mg/L continued for a long period, these physiological parameters showed a sharp decrease, and inactivation was observed in H. verticillata. These results suggested that a certain concentration of fluoride induced antioxidant response and excess fluoride induced metabolism imbalance and oxidative damage in H. verticillata.
Keywords	Fluoride; Hydrilla verticillata; Antioxidant system; Toxicity