International Journal of Geology, Earth and Environmental Sciences ISSN: 2277-2081 (Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jgee.htm
2014 Vol. 4 (1) January-April, pp. 147-149/Mahawar and Chauhan
Research Article

BIOACCUMULATION OF FLUORIDE IN DIFFERENT PLANT PARTS OF BRASSICA JUNCEA (MUSTARD) FROM IRRIGATION WATER

***Neetu Mahawar and Surendra Singh Chauhan**
Indira Gandhi Center for HEEPS, University of Rajasthan, Jaipur - 302004 (Rajasthan) India
**Author for Correspondence*

ABSTRACT
In this study, the growth of, mustard (*Brassica juncea*), was observed to be adversely affected by irrigation with various levels of waterborne fluoride. Its effect on the growth and crop yield was conducted in a pot experiment. Nine different concentrations of F in the water were used for irrigation ranging from 3 to 24 ppm with distilled water as the control. Potentiometric determinations of the F content in different parts of the plant were made 45, 90, and 135 days after sowing the seeds (first, second, and third harvest, respectively). At the third harvest the highest mean plant part concentrations of F were recorded with 24 ppm F in the irrigation water: 19.864μg/g in the roots, 17.250μg/g inthe shoots, 15.114μg/g in the leaves, and 18.427μg/g in the crop (grain).

***Keywords**: Fluoride in Mustard, Bioaccumulation, Fluoride Irrigation Water*

INTRODUCTION
Fluoride ion is wide spread in nature. It is estimated to be thirteenth in abundance among the elements of the earth. Fluoride is a component of most types of soil with the total fluoride concentration ranging from 20 to 1000 µg/g of soil (Greenwood, 1956). Fluoride in soil is primarily associated with the soil colloid or clay fraction. For all soil it is the soluble fluoride content is biologically important to plants and animals.
High fluoride concentration or low pH, clay and/or organic matter concentration increase fluoride level in soil solution, increase the uptake via plant roots and translocation from root to shoot.
Many plants are sensitive to fluoride. Some species such as Gladiolus and Freesia are extremely sensitive to concentration <20µgFg-1 (Jacobson *et al.*, 1966; Istas and Alaerts, 1974). Certain physiological processes are known to be markedly affected by fluoride including plant growth, chlorosis, and leaf tip burn and leaf necrosis (Miller *et al*., 1999; Elloumi*et al*., 2005). Fluoride is absorbed by plant roots (Kamaluddin and Zwiazek, 2003)

MATERIALS AND METHODS
The experiments were conducted in the IGC for HEEPS, University of Rajasthan, Jaipur from November, 2010 to March, 2011 during winter season. The mean ambient temperature during experimental study was 20^0C. Certified seeds of mustard (*Brassica juncea*), were procured from Agricultural Research Station, Durgapura, Jaipur. Its maturity period ordinarily ranges between 110 and 145 days. Mustard seeds were germinated under normal temperature in 27 earthen pots filled with 4 kg of loamy soil. 10 seeds were sown in each pot and then five seedlings were allowed to grow in each pot after15 days of germination. In the experiment, 3 replicates of each pot set *viz*. control 3mg/L, 6mg/L, 9mg/L, 12mg/L 15mg/L 18mg/L 21 mg/L and 24mg/L were taken. The plants were watered with the respective concentration of NaF thrice a week throughout the experimental period (November 2008 to March 2009). The pots were kept in open field conditions and were irrigated regularly with the above F solutions.
Stock solution of 100 mg/L NaF concentration was prepared by dissolving 0.221g of NaF in 1000ml of water. Serial dilution of stock solution was done to get the desired concentration.
Harvesting was done at three stages of growth: pre-flowering (after 45 days), flowering (after 80 days), and post-flowering (after 120 days). Five plants were taken from each harvest Plants were washed to remove any soil particles adhering to them.
For the bioaccumulation study and determination of fluorine contents, all the plant parts were separately packed and oven dried for 24 hours at 800C. Then, the samples were powdered and digested with nitric

International Journal of Geology, Earth and Environmental Sciences ISSN: 2277-2081 (Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jgee.htm
2014 Vol. 4 (1) January-April, pp. 147-149/Mahawar and Chauhan
Research Article

acid, followed by neutralization with aqueous KOH and analysis for fluoride was done by potentiometric method with a fluoride ion selective electrode.

RESULTS

In this study mustard (*Brassica juncea*), accumulation of F in varied in the roots, shoots, leaves, and grain, showing a monotonic trend with increasing concentration of F in the irrigation water. Overall, the F levels were highest in the roots, next highest in the grain, and lowest in either the shoots or leaves.
As seen in Table 1, the accumulation of F at the first harvest was highest in the roots and lower in the shoots and leaves

Table 1: Mean F concentration (µg/g) in three plant parts of mustard (*Brassica juncea*) at the first harvest 45 days after sowing the seeds

Parameters	F concentration in the irrigation water								
	Control	3mg/L	6mg/L	9mg/L	12mg/L	15mg/L	18mg/L	21mg/L	24mg/L
F in roots (µg/g)	0.0	1.145	1.374	2.118	2.752	3.954	4.24	6.120	5.832
F in shoot(µg/g)	0.0	.878	1.171	2.010	2.394	2.452	3.697	5.33	5.59
F in leaves(µg/g)	0.0	.720	1.110	1.119	1.421	1.823	3.195	4.391	5.195

At the second harvest (Table 2), F levels were also highest in the roots with F in the grain crop second and in decreasing order in the shoots and leaves

Table 2: Mean F concentration (µg/g) in four different plant parts of mustard (*Brassica juncea*) at the second harvest 90 days after sowing the seeds

Parameters	F concentration in the irrigation water								
	Control	3 mg/L	6mg/L	9mg/L	12mg/L	15mg/L	18mg/L	21mg/L	24mg/L
F in roots(µg/g)	0.0	2.970	3.023	4.248	6.853	7.283	8.002	9.293	10.608
F in shoot(µg/g)	0.0	2.351	2.483	4.162	4.902	5.616	6.140	8.236	9.293
F in leaves(µg/g)	0.0	1.6502.1 87	4.150	4.608	4.623	4.623	6.125	6.632	7.316

After the third harvest (Table 3), F accumulation was further increased in the same overall patterns except for 12 ppm F in the irrigation water.

Table 3: Mean F concentration (µg/g) in four different plant parts of mustard (*Brassica juncea*) at the third harvest 135 days after sowing the seeds

Parameters	F concentration in the irrigation water								
	Control	3mg/L	6mg/L	9mg/L	12mg/L	15mg/L	18mg/L	21mg/L	24mg/L
F in roots (µg/g)	0.211	3.912	5.468	6.788	8.216	10.961	11.983	18.216	19.864
F in shoot(µg/g)	0.160	3.195	3.971	4.713	5.878	8.215	9.302	13.137	17.250
F in leaves (µg/g)	0.0	2.765	3.129	4.508	6.812	7.458	9.186	12.483	15.114
F in seed (µg/g)	0.0	2.905	2.69	5.120	7.142	10.751	11.610	16.72	18.427

DISCUSSION

Due to relatively low mobility of fluoride,the bioaccumulation of fluoride in different parts of mustard plant at various concentrations of NaF. Bioaccumulation of fluoride was highest in roots and lowest in leaves.in this study than in other plant parts. Similar findings have been reported by others[11& 12].
As seen in Tables (1) during the first harvest, F accumulation was greater in the roots than in shoots and leaves.
In the second harvest, F accumulation increased in the leaves without showing a marked trend with increasing F in the water. During the third harvest, F concentrations increased in the leaves as well as in

the roots with the longer period of exposure. In the third harvest, grain seeds accumulated thehighest F levels, reaching a maximum of 18.427µg/mg from 24 ppm F in the irrigation water.

Here high concentrations of F in the irrigation water caused necrosis and chlorosis of leaves, reduction in growth of root and shoots, and ultimately reduced the yield of mustard. These observations are similar to those of other workers for other plants[8&9]. Results reported in this study show that fluoride treatment is detrimental to the growth and yield of mustard especially at higher concentrations (15mg/L and 21mg/L and 24mg/L NaF concentrations). Bioaccumulation of fluoride in mustard seed creates secondary source of fluoride to human population resulting in food-borne fluorosis, primary source being water.

Overall, our study shows varied tolerance toward NaF in the plant species tested and provides information about how F can affect their germination and growth. Such knowledge is potentially useful for farmers to help them avoid excessive application of F-containing fertilizers to enhance crop growth, especially when it is F stress inhibiting it. This information is also important to help farmers select the best type of crop that can thrive.

ACKNOWLEDGEMENT

The authors are grateful to the Director Dr. Surendra Singh Chauhan of the Indira Gandhi Centre for Human Ecology, Environmental and Population Studies University of Rajasthan, forproviding necessary facilities.

REFERENCES

Bhargava Devika and Bhardwaj Nagendra (2011). Phytotoxicity of Fluoride on a Wheat Variety (*Triticumaestivum*var. Raj. 4083) and its Bioaccumulation at the Reproductive Phase. *Asian Journal of Experimental Sciences* **25**(1) 37-40.

Delbert A Greenwood (1956). Some Effects of Inorganic Fluoride on Plants, Animals, and Man; Utah State University

Elloumi N, Abdallab FB, Mezghani I, Rhouma A, Boukhris M and Tunisia S (2005). Effect of fluoride on almond seedling in culture solution. *Fluoride* **38** 193-198.

Gautam R and Bhardwaj N (2010). Bioaccumulation of fluoride in different plant parts of *Hordeumvulgare*(Barley) var. RD – 2683 from irrigation water. *Fluoride* **43** 57-60.

Istas JR and Alaerts G (1974). The effect of fluorine and its compounds on plants. *Revue de L' Agriculture* **27** 487- 496.

Jacobson JS, Weinstein LH, Mcune DC and Hitchcock AE (1966). The accumulation of fluoride by palnts. *Journal of the Air Pollution Control Association* **16** 412-417.

Jain Nisha (2006). Effect of high fluoride content on flora and fauna in and around Padampura area [dissertation]. Jaipur: University of Rajasthan.

Joshi Manisha and Bhardwaj Nagendra (2012). Effect of fluoride on *Triticumaestivum*var. Raj 3675. *Fluoride* **45**(3 Pt 2)297–30.

Kamaluddin M and Zwiasek JJ (2003). Fluoride inhibits root water transport and affects leaf expansion and gas exchange in aspan (*Popular tremuloides*) seedlings. *Physiologia Plantarum* **117** 368-375.

Miller ER, Bei X and Ulrey DE (1991). *Trace Elements in Animal Nutrition*. 2nd edition (Soil Science Society of America Book Series) **4** 593-662.

Pant Sudhakar, Pant Prabhakar and Bhiravamurthy PV (2008). Effects of fluoride on early growth of typical crop plants of India. *Fluoride* **41**(1)57–60.

Sakuntala Chakrabarti and Pulak Kumar Patraa (2013). *Effect of Fluoride on Superoxide Dismutase Activity in Common Crop Plants*. Research report Fluoride 46(2)59–62

Shivekumar Sunita (2004). Effect of high fluoride content on flora and fauna in and around Shivdaspura area [dissertation]. Jaipur: University of Rajasthan.

Yadav Rajesh Kumar, Sharma Shipra, Bansal Megha, Singh Ajay, Panday Vivek, Raaz (2012). Effects of Fluoride Accumulation on Growth of Vegetables and Crops in Dausa District, Rajasthan, India 14-16.