Effects of Sodium Fluoride Water on Growth and Some Biochemical Parameters of Triticum Aestivum VAR. RAJ. 3077

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Abstract

Contamination of fluoride in water, soil and plants has been a continuing issue worldwide. When polluted ground water fluoride is used for irrigation, crop growth is adversely affected, particularly at the beginning of seedling growth. It's *Tritium AestivumVar Raj. 3077* seeds were subjected to four separate diffusions of Sodium Fluoride with distilled water. Effects of 5, 10, 15, 20 mg/L sodium fluoride (NaF) were studied in *Triticumaestivum var. It's Raj. 3077* Seeds and development of seedlings. After 10 days of controlled therapy, 100% germination occurred, but at 20 mg of NaF/L, germination was significantly reduced. Physiological parameters i.e. root length, shoot length and dry weight decreased with increasing concentration of NaF. At 20 mg NaF/L, the average root length, shoot length and dry weight decreased by 40.3,52.3,59.3 and 29.5 % respectively. Higher concentrations of sodium fluoride resulted in a substantial reduction in the root and shoot length of the Tritium seedlings, including their dry weight, chlorophyll, protein and carbohydrate content. Thus our study concludes that sodium fluoride has a major impact on wheat seed germination and seedling development.

Introduction

Increase in the world population and the decreasing trend of arable land has led to a marked decrease in food security with abiotic stresses, salinity being one of the major contributors in decreasing the crop productivity. Nearly 800 million hectares of land all over the world (6% of the world's total land area) are salt affected [FAO, 2009]. Fluoride (F) from groundwater has been shown to not only pose health effects to humans, but also to be lethal to irrigated plants at high concentrations. Fluoride, the ion of the chemical element fluorine, is frequently found in groundwater, and has become one of the most important toxicological environmental hazards globally (Gosselin, R.E. et.al.,1984).Inorganic fluorine compounds are used in industries for different purposes.In industries, fluoride used in aluminium production and as a flux in the steel and glass fibre industries

and the waste material discharge in water, soil and environment. They can also be released to the environment during the production of phosphatic fertilizers, bricks, tiles and ceramics manufacturing (IPCS 2002). Sodium fluoride, fluorosilicic acid and sodium hex fluorosilicate are used in municipal water fluoridation schemes (Baselt, R.C., 1984). Fluoride is often mentioned as one of the pollutants among compounds that create pollution in the environment, as it is ranked fifth in the hierarchy of environmental poisons (Dutkiewicz, T., 1995). The problem of environmental pollution with fluoride compounds has been noticed relatively recently and is mainly related to industrial activity, production of artificial fertilizers (superphosphates), and the emission of fluoride compounds into the atmosphere in the form of dust and gas from aluminium smelters (Gautam, R. et. al.,2010). Currently, about 25% of herbicides contain at least one fluoride atom, or fluoride in the form of difluoromethyl and trifluoromethyl groups, which has significantly contributed to the developmentof agrochemical industry products [Fujiwara, T. et al., 2014]. The introduction of fluoride into organic molecules increases the lipophilic properties of herbicides, the rate of penetration of plant cells, and the blocking of active enzyme sites. This element is one of the most toxic elements for plants and, so far, it has not been reported to have a positive effect on these organisms. Fluoride reduces agricultural harvests by up to 50 percent because most plants are highly sensitive to fluoride. F− compounds have been shown to be highly toxic to cereals and, in particular, wheat [Kumar, T.S. et al., 2013]. Wheat (Tricitumaestivum L.) is the world's second-most important crop after rice. Wheat produces a high yield and is one of the most important food crops for the majority of the world's population. Wheat is also a good source of protein, fiber, carbohydrates, minerals, and B-group vitamins [Kumar, P. et al.,2011].

Germination is one of the most important criteria for crop seed quality assessment [Filho, J.M., 2015]. This process is the initiation of the first developmental phase in the life cycle of plants and is followed by the growth of the seedling. Biochemical analysis is widely used for monitoring seeds during germination, but it is often focused on the final phase of germination (the start of seedling growth), and that is paid the most attention. However, the initial phase of germination, imbibition, also exhibits interesting behavior [Lev, J. et.al, 2017]. The imbibition phase is divided into three defined parts [Rathjen, J.R; et. al., 2009]. The first one (imbibition) lasts approximately one hour and consists mainly of the swelling of the embryo part of the seed. The second one, also known as main imbibition, consists of spatial expansion caused by water adsorption in the other parts of the seed. The third one is the growth phase, in which radicle protrusion commences, followed by continued root and seedling growth [Ruttanaruangboworn, A. et. al, 2017].

The present paper describes the result of a laboratory experiment to study the effect of Sodium Fluoride on various parameters such as root and shoot length, root and shoot dry weight, chlorophyll, carbohydrate and protein content of Triticumaestivumvar Raj. 3077.

Material and Methods

To study the impact of sodium fluoride (NaF) on Triticumaestivum, a laboratory experiment was

conducted on ***Triticum aestivumvar Raj. 3077***. The various levels were treated with 0, 5, 10, 15, and 20 mg/l NaF prepared from a stock solution. After treatment the experiments were terminated and the shoot and root length and their dry weight were determined. Biochemical parameters i.e., chlorophyll (Aref A. Abdul-BakiJames D. Anderson,1973) nitrogen (Anon,2002) and protein (Applegate, H.G.,1960) content were also analyzed. Fluoride was analyzed by Selective Ion Meter.

Biochemical parameters: Following formula will be used to calculate the amount of chlorophyll a and b:
Chlorophyll a mg/l=12.7 × A663-2.69 × A645

Chlorophyll b mg/l=22.9 × A6454.68 × A663

Chlorophyll (a+b)mg/l=8.02 × A663+20.20 × A645

The protein content was be calculated as follows

%Protein=%nitrogen × 6.25

For carbohydrate estimation 50mg of plant material was ground in 80% acetone and centrifuged. The solution was then diluted to make the final concentration as 100 μg/ml. To 1ml of this solution 2ml anthrone reagent was added and the O.D. at wavelength 650 nm was recorded.

Results and Discussion

The observed effects of different doses of F on seed germination and growth, shoot length, root length, shoot weight, root weight on Triticum aestivumvar Raj. 3077 are given in Tables 1-3.

Table 1: Root and shoot lengths (cm) and percent reduction of Triticum Aestivum Seedling (mean ± SE).

Level	Root length	%reduction	Shoot length	%reduction
Control	9.7±0.9	-	18.7±3.3	-
5PPM	6.7±1.1	39.3	15.5±3.2	14.1
10PPM	5.6±1.1	51.3	12.4±2.0	28.2
15PPM	4.4±0.9	55.3	10.8±2.5	35.4
20PPM	3.6±0.7	27.5	09.0±2.5	39.2

Table 2: Root and dry weights (mg) and percent reduction of Triticum Aestivum seedling (mean ± SE).				
Level	**Root weight**	**%reduction**	**Shoot weight**	**%reduction**
Control	148±1.5	-	95±1.9	-
5PPM	127±1.6	9.7	77±2.0	14.2
10PPM	122±1.7	13.2	72±2.9	18.6
15PPM	119±1.9	16.6	65±2.5	25.2
20PPM	91±1.6	36.8	63±2.8	28.5

Table 3. Chlorophyll, carbohydrate and protein contents in seedlings growing in sodium fluoride (NaF) and distilled water (control)					
Level	**Chl. a (mg/g)**	**Chl b (mg/g)**	**Total Chl (mg/g)**	**Carbohydrate (mg/g)**	**Proteins (mg/g)**
Control	6.8780	1.8550	8.7330	700	3.96
5PPM	5.8230	2.1420	7.9650	450	3.67
10PPM	5.6560	1.9340	7.5900	300	3.64
15PPM	5.3810	1.7823	7.1663	280	3.34
20PPM	3.9230	1.1938	5.1168	240	3.86

Fluorine is not considered as an essential element for plants. Previous studies describe that most cases of acute fluoride intoxication have resulted from the ingestion of large doses of fluoride compounds. The severity of the symptoms depends upon the irritating properties and to the amount of the compound that has been ingested [Gadi B.R. et.al, 2012]. Total fluoride was greater than inorganic fluoride. More "organic" fluoride was present generally in the roots than in the aerial parts. Solutions of sodium fluoride were found to cause inhibition of growth at lower concentrations. Uptake of fluoride, as well as growth and yield of plants vary with both plant species and plant varieties within a species. Exposure of seeds to solutions of sodium fluoride and hydrogen fluoride during germination was used as a guide to establish the nature of the inhibiting effects of the

inorganic fluoride oxidizing agents. In contrast, even very low concentrations of ClF3 or BrF5 in air are very damaging. The damage appears to result from a rapid reaction between the interhalogens and the plant or seed surfaces. Fresh weight of seedlings decreased monotonically with increasing fluoride concentration due to reduction of metabolic activity in presence of fluoride, because germination is a one kind of metabolism and fluoride acts as a metabolic inhibitor [Anderson, J., Abdul BAS, 1973,Gupta, S. et.al, 2009,Kaur, J., Duffus, C., 1989]. As shown in the Table 3 chlorophyll - a, chlorophyll-b, total chlorophyll content of leaves decreased monotonically at 20 ppm, concentration of NaF/L both chlorophyll a, and chlorophyll b decreased, reduction in total chlorophyll content may be due to the breakdown of chlorophyll during stress or due to inhibition of chlorophyll biosynthesis which is a primary symptom of fluoride induced chlorosis. While, in some studies inhibitory effect of fluoride on chlorophyll accumulation was noticed in cereals [Kaur J, Duffus C., 1989] sunflower [Peters RA,et. al 1965], Triticumaestivum [Abdallah F.B.,2005], Pisumsativum [Anderson J.,1973] and Oryzasativa [Gupta S., 2009], while in case of wheat there is increase in chlorophyll content due to initial treatments of sodium fluoride and then decreases the chlorophyll content as fluoride treatments goes on increasing [Princi F.,1960 & WHO, 2004]. Thus, the effect of fluoride on chlorophyll content is obscure. In the present study NaF concentrations disturbs the seed germination and early growth of seedlings further it was also reported that in addition to morphological features such as root, shoot length and weight and some biochemical features such as photosynthetic pigments such as chlorophyll a and b, %nitrogen and protein content were also adversely affected by increased NaF concentration.

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