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Research Article

Effect of fluoride toxicity on the growth and yield of wheat (*Triticum aestivum* L.)

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ABSTRACT : The effect of fluoride toxicity has been studied on the morphological parameters i.e. height / plant (cm.), number of leaves / plant, leaf area (sq. cm.) / plant, dry weight / plant (g), yield of seed / plant (g) and test weight (1000 seeds weight in gm.) of wheat (*Triticum aestivum* L.). Four varieties were selected for the experiment i.e. WH-711, HD-2932, PBW-502 and DBW-17. The experiment was conducted for one year in simple randomized block design and was followed by five treatments of NaF such as 10, 25, 50, 100 and 200 ppm along with control and four replications were taken. The results were recorded on an average basis taking three plants for each treatment in each block. Reduction in all characters was noted in higher concentrations of NaF *i.e.* 100 and 200 ppm doses of NaF in wheat in comparison to control.

KEY WORDS : Fluoride toxicity, Growth, Yield, Test weight (1000 seeds weight)

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INTRODUCTION

The chief goal of farmers, plant breeders and commercial producers is to get maximum output of their crops. The fluoride pollution has two principal aspects, first direct injury to agronomical crops by producing typical necrotic lesions and chlorosis on the leaves of sensitive plants (Thomas and Hendricks, 1956, Zimmerman and Hitchcock, 1956; Maclean *et al*., 1969 and Guderian, 1969) and second raising the fluoride level of these crops above 50 ppm, which is hazardous to the life of men and animals.

Chaudhry (2004) studied the effect of fluoride toxicity on the growth, productivity and sterility behavior of wheat and gram. The effect of NaF toxicity on growth and yield characters was recorded. 100-200 ppm doses were found harmful to the plants. The effect of fluoride on biochemical characters (chlorophyll, Nitrogen, Protein % and phosphorus %) were also found toxic from 100-200 ppm doses of NaF. Sharma (2005) reported the effect of fluoride toxicity on physiological response of *Brassica juncea* varieties Varuna and RH-30. The best performance of Varuna was observed. Malik *et al*. (2008) studied the effect of NaF on growth and yield characters of Urd bean and Mung bean. 100-250 ppm doses of sodium fluoride were found toxic to all morphological and yield characters. Malik and Arya (2008) reported the effect of fluoride toxicity on chlorophyll content in green leaves on 60th day of urdbean var. T9 and mungbean var. P.S.-16 for two years.

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EXPERIMENTAL METHODS

The experiment was conducted in Randomised Block Design with six treatments and four replications. The concentrations of NaF solution were taken 10, 25, 50, 100 and 200 ppm along with control. The seeds of wheat was obtained from I.A.R.I., New Delhi. The seeds were presoaked in water for 24 hours and then sown in the rows at a distance of 30 cm. and 10 cm. plant to plant with a depth of 5 cm. After germination of 30 days old plants were treated with different concentrations of NaF. Spraying was done fortnightly (15 days interval) till the maturity of the crop. The data were recorded after each spraying of the crop. Three plants were tagged in each treatment and in each block. The observations were also recorded fortnightly.

EXPERIMENTAL RESULTS AND ANALYSIS

The effect of fluoride toxicity on the growth characters of wheat is presented in Tables 1 and 2. The maximum data were recorded in control of the seeds and the minimum was found in highest concentration (200 ppm) in all the characters. The maximum height (cm.), number of leaves / plant, leaf area (sq. cm.) / plant and dry weight (gm.) / plant was found in control plants while minimum results were found in 200 ppm dose of NaF. The maximum yield / plant and test weight (g.) *i.e.* 1000 seeds weight (g) was also found in control treatment

Table 1: Effect of NaF on growth and yield of wheat (*Triticum aestivum* L.)

NaF	Height / plant in cm. of wheat varieties			
Concentrations	WH-711	HD-2932	PBW-502	DBW-17
Control	46.5	45.3	60.2	62.8
10 ppm	45.0	44.0	58.7	60.7
25 ppm	43.0	41.7	55.7	58.0
50 ppm	40.6	39.0	53.0	55.5
100 ppm	38.0	36.5	49.5	50.1
200 ppm	35.2	34.0	46.1	48.3
NaF	Number of leaves / plant of wheat varieties			
Concentrations	WH-711	HD-2932	PBW-502	DBW-17
Control	17.0	16.88	16.83	17.30
10 ppm	16.20	16.61	16.53	17.08
25 ppm	15.60	15.48	15.41	16.35
50 ppm	14.93	14.85	14.73	15.65
100 ppm	14.11	13.96	13.81	14.78
200 ppm	13.06	12.90	12.71	13.55

Table 2: Effect of NaF on growth and yield of wheat (*Triticum aestivum* L.)

NaF	Leaf Area / plant in sq. cm. of wheat varieties			
Concentrations	WH-711	HD-2932	PBW-502	DBW-17
Control	434.66	434.50	434.10	435.36
10 ppm	434.06	433.70	433.15	434.83
25 ppm	431.90	431.63	431.13	432.91
50 ppm	429.63	429.28	428.91	430.26
100 ppm	425.40	425.10	424.61	425.95
200 ppm	399.00	401.50	399.40	400.20
NaF	Dry Weight / plant in g of wheat varieties			
Concentrations	WH-711	HD-2932	PBW-502	DBW-17
Control	207.66	207.28	207.03	208.00
10 ppm	190.01	189.76	189.48	190.53
25 ppm	166.03	165.58	165.25	166.58
50 ppm	145.73	145.23	144.86	146.23
100 ppm	126.11	125.66	125.31	126.80
200 ppm	103.88	103.50	103.15	104.36

Table 3: Effect of NaF on growth and yield of wheat (*Triticum aestivum* L.)

NaF Concentrations	Yield / plant in g of wheat varieties			
	WH-711	HD-2932	PBW-502	DBW-17
Control	19.8	19.7	19.6	21.0
10 ppm	19.4	19.1	19.2	20.5
25 ppm	18.7	18.4	18.4	19.7
50 ppm	17.5	17.1	17.0	18.4
100 ppm	15.2	14.8	14.7	16.0
200 ppm	13.0	12.5	12.3	13.8
NaF Concentrations	Test Weight (1000 seeds weight) in g of wheat varieties			
	WH-711	HD-2932	PBW-502	DBW-17
Control	52.0	51.7	51.5	52.3
10 ppm	51.3	50.8	51.0	52.0
25 ppm	49.6	49.3	49.0	49.9
50 ppm	48.8	48.0	47.7	49.2
100 ppm	47.9	47.3	46.2	48.1
200 ppm	44.8	44.1	43.6	46.1

while minimum data were obtained in highest concentration i.e. 200 ppm of NaF in yield characters (Table 3). The results of all the above six characters were significant at 5% level of significance C > 10 > 25 > 50 > 100 > 200 ppm.

It is suggested that the accumulation of 'F'-ions was more in seeds due to inhibition of sodium fluoride solutions. Growth suppression was evident at higher concentration. The reduction in height was due to decrease in number as well as size of the cells (Yamazoe, 1962). Higher doses of NaF also had significant effect on all growth and yield characters. Variation in total leaf area of a plant is supposed to be due to toxicity of NaF which brought about great change in leaf.

Variations in leaf size arise from the effect on cell division resulting differences in cell number and on cell extension (Watson, 1952). Significant reduction in yield of grain (seed) of wheat (*Triticum aestivum* L.) was desired due to NaF toxicity in the present investigation. The data in Table 3 indicated the fall in the yield of seed. Maximum reduction in the seed yield and test weight (1000 seeds weight) was observed in 200 ppm NaF dose. The reduction due to fluoride toxicity in yield and test weight (g) was due to less number of ears / plant and less number of spikelets / plant. Similar work has been done by several scientists (Arya, 1971, Kuldeep Kumar 1992, Singh, 1992, Chaudhry, 2004 and Singh, 2013).

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