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RESEARCH ARTICLE

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

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SUMMARY

The effect of fluoride toxicity has been studied on growth and yield characters *i.e.* plant height (cm)/plant, number of tillers/plant, leaves/plant, leaf area (sq.cm.)/plant, fresh weight (g)/plant, dry weight (g)/plant, number of ears/plant, yield of seeds/m^2 and 1000 seeds weight (g) of wheat (*Triticum aestivum* L.) cv. HD. 2009 and cv. PBW-226. The experiment was conducted for two years in simple Randomized Block Design at C.C.R. (P.G.) College, Muzaffarnagar. Five treatments of NaF such as 10, 25, 50, 100 and 200 ppm along with control for four replications were taken. The results were recorded on an average basis taking three plants for each treatment in each block. The reduction in all characters in treated plants was found in higher concentrations *i.e.* 100 and 200 ppm. NaF in wheat (*Triticum aestivum* L.) in comparison to control 10 ppm showed threshold limit in few characters studied.

Key Words : Growth, Yield, NaF, Fluoride toxicity, Wheat CV.HD-2009, PBW-226

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Wheat (*Triticum aestivum* L.) ranks second in area and production in India. The yield of dwarf wheat varieties varies from 40-55 q/ha in India. In national demonstration yield trails, an average on whole India basis varies from 35-54 q/ha. Thus with the help of advanced cultural practices and improved methods, farmer can increase the yield to the great extent. Under the national demonstration yield trials at Pantnagar, the production of wheat at Shahjahanpur centre (U.P.) was recorded 50 q/ha. The most popular wheat growing states in India are Uttar Pradesh, Bihar, Madhya Pradesh, Punjab, Haryana, Rajasthan and Uttrakhand. In Muzaffamagar, Saharanpur, Bulandshahar, Ghaziabad, Meerut and Haridwar districts light loam soils and rainfall are favourable for the production of wheat crop. About 74% area and 81% production, photothermotolerant, fertilizers responsive with introduction of high yielding wheat varieties, plant breeders and agronomists have been modifying the phenology and morphology of wheat to different agro-climatic zones in India (Singh, 1997).

The embryo of wheat is relatively rich in protein, fat and several of the B vitamins. Scutellum in wheat, which contains 50 times more thiamin than the whole grain. The outer layers of the endosperm and the aleurone contain a higher concentration of protein, vitamins and phytic acid than the inner endosperm. The inner endosperm contains most of the starch and protein in the grain. As it is gluten that makes bread dough and stick together and gives it the ability to retain gas, the higher the proportion of gluten in the flour, the better for making leavened bread.

Wheat seeds contain moisture 12.2%, protein 12.1%, fat 1.7%, minerals 2.7%, fibre 1.9%, carbohydrates 69.4%, calcium 48 mg, phosphorus 355 mg, iron 11.5 mg, small

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amount of vitamin C and B complex is found. Caloric value 341 (K Cal) per 100g edible portion, (Singh 1997).

Muzaffarnagar, Saharanpur, Meerut, Modinagar, Ghaziabad and Bulandshahar are the industrial cities of Western Uttar Pradesh. There are various industries, located throughout these cities such as sugar mills at Rohana, Morna, Mansoorpur, Khatauli, Titawi, Meerut and Deoband, a number of steel factories and steel rolling mills, paper mills and engineering workshop at Meerut, Muzaffarnagar and Saharanpur. Thus there are severe problems of air and water pollution throughout these cities. It is, therefore, very essential to work out the effect of these poisonous atmospheric gases, which are released from the factories on wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.) crops.

The effect of fluoride pollutant studied by Leone (1980) and Treshow and Pack (1970) suggested the accumulation of fluoride in high concentration in plant parts. The characteristics of fluoride toxicity in plant in recrosis *i.e.* death of tissues of lamina and burning of leaf tips and margins. The necrotic lesions develop chlorosis on leaves due to toxic effect of sodium fluoride (Arya, 1971). Mottling of leaves, bleaching of leaf margins, rolling of leaves are some other characters (Rathore and Agrawal; 1989). Similar symptoms of toxicity have also been found by Arya *et al*. (1979), Agrawal (1979), and Singh (1992) in, various crops.

Chaudhary (2004) studied the effect of fluoride on wheat and chick pea particularly on growth, yield, protein, chlorophyll, and sterility behaviour. 100-200 ppm doses of NaF were found toxic. Tyagi (2004) also found toxic effect of NaF on urdbean (*Vigna mungo* L.).

Sharma (2005) studied the effect of fluoride toxicity on Indian mustard (*Brassica juncea* L.). The best performance of var. Varuna was reported. The effect on growth, yield parameters; biochemical characters and sterility behaviour were found severe of 100-200 ppm doses of NaF. The effect of NaF toxicity was seen very severe on oil content also. Rawat (2005) studied the effect of fluoride on two varieties of mungbean. Toxicity was observed on growth, yield, biochemical character and sterility percentage of pollen and ovules both. Singh (2005) reported toxic effect on soybean and broad bean. The effect was seen on nodule formation, growth, yield, biochemical characters, energy content and sterility percentage of pollen and ovules.

Dhameja (2007) discussed in detail the environmental studies *i.e.* effect of pollution (fluoride and SO_2) on plants and animals. Agarwal and Sangal (2008) reported environmental engineering related to crop physiology and effect of fluoride toxicity on vegetation. Kaushik and Kaushik (2008) studied the environmental factors related to plant and animal lives particularly air pollution.

MATERIAL AND METHODS

The experiment was conducted during *Rabi* seasons of 2009-10 and 2010-11 on the field of Department of Botany, C.C.R. (P.G.) College, Muzaffarnagar (U.P.). The soil of the field was alluvial with 7.26 pH. After sowing the seeds of wheat, agronomic practice e.g. weeding, irrigations, spraying of pesticides and harvesting were done properly. The seeds of wheat variety HD-2009 and PBW-226 were obtained from DWR (Directorate of Wheat Research) Karnal (Haryana). The seeds were sown in the rows at a distance of 20 cm. plant to plant and 30 cm. row to row with a depth of 5 cm. After germination, 30 days old plants were treated with different concentrations of NaF. Spraying of NaF solutions was done regularly at 15 days interval till the maturity of the crop. The data were recorded next day of each spraying *i.e.* fortnightly.

RESULTS AND DISCUSSION

The effect of fluoride toxicity on the growth and yield characters of wheat (*Triticum aestivum* L.) is presented in Table 1 and 2. The maximum values were recorded in control

Table 1 : Effect of fluoride toxicity on the growth of wheat (*Triticum aestivum* L.) (2010-11)

Sr. No.	Variety	Concentrations of NaF	Mean height (cm)/plant	Mean number of tillers/plant	Mean number of leaves/plant	Mean leaf area (sq.cm.)/ plant	Mean fresh weight (g)/plant	Mean dry weight (g)/plant
1.	Wheat CV.HD-2009	Control	65.75	15.00	52.76	1345.81	4364.16	650.31
		10 ppm	63.33	14.23	50.15	1213.43	3884.16	577.45
		25 ppm	60.45	13.41	45.78	1037.88	3592.00	528.33
		50 ppm	56.73	12.26	42.66	895.50	3205.00	468.06
		100 ppm	52.26	10.31	37.28	835.10	2610.66	385.88
		200 ppm	47.45	8.95	32.78	761.16	2061.50	305.86
2.	Wheat CV-PBW-226	Control	63.95	14.40	50.60	1328.71	4354.35	643.08
		10 ppm	60.95	14.01	48.25	1205.23	3707.00	569.76
		25 ppm	57.46	13.25	43.26	1031.45	3584.50	521.36
		50 ppm	52.70	11.96	39.93	887.95	3190.50	461.51
		100 ppm	48.58	10.26	34.83	822.46	2601.83	379.51
		200 ppm	44.10	8.98	30.55	753.43	2053.16	298.80

Table 2 : Effect of fluoride toxicity on yield of wheat (*Triticum aestivum* L.) (2010-11)

Sr. No.	Variety	Concentrations of NaF	Number of ears per plant	Yield of seeds (grains) g./ m^2	Test weight (1000 seeds weight) g./plant
1.	Wheat CV.HD-2009	Control	21.00	1485	61.3
		10 ppm	20.18	1392	60.4
		25 ppm	18.40	1248	59.5
		50 ppm	17.45	950	59.3
		100 ppm	14.62	781	58.0
		200 ppm	12.97	660	54.8
2.	Wheat CV-PBW-226	Control	20.38	1472	60.9
		10 ppm	20.00	1385	60.1
		25 ppm	18.08	1241	59.2
		50 ppm	17.10	941	58.3
		100 ppm	14.36	774	56.1
		200 ppm	12.21	640	54.2

treatment and minimum were found in the higher concentration (200 ppm) in all the characters in both years (2009-10 and 2010-11).

In cv. HD-2009, the maximum height 65.75 cm, number of tillers/plant 15, number of leaves/plant 52.76, leaf area (sq.cm.) 1345.81 were found in control while height 47.45 cm, number of tillers 8.95, leaves 32.78 and leaf area 761.16 (sq.cm.) were found in 200 ppm dose of NaF in 2009-10, 2010-11. The maximum fresh weight 4364.16 (g), and dry weight 650.31 (g) was found in control and minimum fresh weight 2061.50 (g) and dry weight 305.86 (g) was found in 200 ppm dose of NaF. Similarly maximum number of ears/ plant 21.00, yield of seeds/m^2 1485 (g) and 1000 seeds weight 61.3 (g) was found in control, minimum data were recorded in 200 ppm dose of NaF e.g. number of ears 12.97, yield of seeds/m^2 660(g) and 1000 seeds weight 54.8 (g). The results of all the nine characters were significant at 5% level of significance.

The above results have been shown of wheat CV.HD-2009. Similar results have been illustrated of cv. PBW-226 in Table 1 and 2. The performance of HD-2009 was found better than PBW-226 in all the nine characters studied.

It is suggested that the accumulation of Frows was more in seeds due to inhibition of NaF solution. Growth suppression was widest at higher concentration. The reduction in height was due to decrease in number and the size of the cell (Yamozoe, 1962). Variation in total leaf area of the plant is supposed to be due to toxicity of NaF which brought about great change in leaf. Variation in leaf size from the effect on cell division resulting differences in cell number and on cell extension (Watson, 1952 and Watson, 1958). In general the reduction in all the nine characters was noted. The reduction in yield due to fluoride toxicity was due to less number of ears/plant and less number of seeds per spike let. Similar work has been done by several scientists (Arya, 1971; Singh, 1992; Chaudhary, 2004; Neeru 2011 and Singh, 2013).

REFERENCES

Agarwal, R.K. and Sangal, V.K. (2008). *Environmental Engineering*: 4th Ed., Krishna Prakashan Media (P) Ltd., 11 Shivaji Road, Meerut, U.P. (INDIA)., 135-235.

Agrawal, Meera (1979). Ecophysiological effects of sodium fluoride (NaF) and sulphur dioxide (SO_2) on *Hordeum vulgare* L. under modified conditions of N, P and K nutrition. Ph.D. Thesis (Botany), Meerut University, Meerut, U.P. (INDIA).

Arya, K.P.S. (1971). Ecophysiological and cytogenetical response of certain crop plants to sodium fluoride and sulphur dioxide toxicity, Ph.D. Thesis (Ag. Botany), B.H.U., Varanasi, U.P. (INDIA).

Arya, K.P. S., Rao, D.N. and Sunita Kumari (1979). Effect of sodium fluoride on growth and productivity of certain crop plants. *Proc. Symp. Environ. Biol*. : 273 - 280. Academy of Environmental Biology, India.

Chaudhry, P.K. (2004). Effect of fluoride toxicity on the growth, productivity and sterility behaviour of wheat (*Triticum aestivum* L.) and chickpea (*Cicer arietinum* L.) Ph.D. Thesis (Botany), C.C.S. University, Meerut, U.P. (INDIA).

Dhameja, S.K. (2007). *Environmental studies* : 3rd revised Edition published by S.K. Kataria & Sons, 4424 / 6, Guru Nanak Market, Nai Sarak, Delhi pp. 233 - 257.

Kaushik, A. and Kaushik, C.P. (2008). *Environmental studies* : 3rd Edition, New Age International (P) Limited, Publishers, New Delhi : 142 - 189.

Leone, I. A. (1980). The effects of atmospheric pollution vegetation. Progress in Ecology, Vol. : 5 - 7 proceedings of International Symposium on Environmental Pollution and Toxicity held at H.A.U. Hissar (Haryana) with National Science Academy Nov. 28 - 30, 1977 : 1 - 9.

Neeru (2011). Ecophysiological response of cowpea (*Vigna sinensis* L.) to fluoride toxicity. Ph.D. Thesis (Botany), C.C.S. University, Meerut, U.P. (INDIA).

Sharma, Shobhit (2005). Effect of fluoride on physiological response of *Brassica juncea* L. Ph.D. Thesis (Botany), C.C.S. University, Meerut, U.P. (INDIA).

Singh, Shweta (2005). Effect of fluoride toxicity on growth, yield and sterility behaviour of soybean [*Glycine max* (L.) Merill] and broad bean (*Vicia faba* L.) Ph.D. Thesis (Botany), C.C.S. University, Meerut, U.P. (INDIA).

Rathore, Sunita and Agrawal, P. K. (1989). Modification of fluoride toxicity in *Vicia faba* through use of nitrogen, phsophorus and potassium nutrition. *Indian Journal Environ. Health*, **31** (4) : 345-353.

Rawat, V.S. (2005). Effect of fluoride toxicity on the growth, yield and sterility behaviour of mungbean [*Vigna radiata* (L.) Wilczek]. Ph.D. Thesis (Ag. Botany) C.C.S. University, Meerut, U.P. (INDIA)..

Singh, R.K. (1992). Effect of fluoride toxicity on growth and yield of wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.) and X-*Triticosecale* Wittmack. Ph.D. Thesis (Agri. Botany), Meerut University, Meerut, U.P. (INDIA).

Singh, R.V. (1997). Effect of planting geometry of *Dalbergia Sissoo* and *Eucalyptus tereticornis* on the growth and yield of different varieties of wheat [*Triticum aestivum* L.]. Ph.D. Thesis (Ag. Botany), C.C.S. University, Meerut, U.P. (INDIA).

Singh, Neetu (2013). Effect of fluoride toxicity on the growth, yield and sterility behaviour of wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.), Ph.D. Thesis (Botany), C.C.S. University, Meerut, U.P. (INDIA).

Treshow, M. and Pack, M. R. (1970). Fluoride In J.S. Jacobson and A.C. Hill. Eds. *Recognition of air pollution in injury to vegetation : A pictorial Atlas Informative Report* I., TR - 7 Agricultural Committee. Pittsburgh. Air Pollution Control Association.

Tyagi, H.K. (2004). Ecophysiological response of urdbean [*Vigna mungo* (L.) Hepper] to fluoride toxicity. Ph.D. Thesis (Botany), C.C.S. University, Meerut, U.P. (INDIA).

Watson, D.J. (1952). The physiological basis of variation in yield. *Advances in Agronomy*. Academic Press Inc. Publishers, New York. IV : 101 - 145.

Watson, D.J. (1958). The dependence of net assimilation rate (NAR) of leaf area index (LAI). *Ann. Bot. N. S.*, **22** : 37 - 54.

Yamazoe, F. (1962). Symptoms and mechanism of injury to crops exposed to Hydrogen fluoride. *Bull. Natl. Inst. Agr. Science, Sec. B. No.*, **12** : 1 - 125.