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Original Research Article

IMPACT OF FLUORIDE ON YIELD ATTRIBUTE OF *PISUM SATIVUM*

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Abstract: High protein, low fat and various health promoting phytochemicals make *Pisum sativum* (Pea) an important pulse/vegetable. Its production however is below requirement in our country. Pollution further adversely affects its output. In present study, it was convincingly observed that fluoride lead to lower pod setting as well as seeds per pod. Dry mass of seeds also reduced significantly with increase in dose of fluoride.

Key Words: *Pisum sativum*, fluoride, dry weight, yield.

INTRODUCTION

After independence, we have achieved remarkable success in food production. But our agricultural success story has been lopsided- there being too much emphasis on cereals, and pulses have been neglected to some extent. Because of this fact Indian population is facing a condition of "protein hunger", although our carbohydrate intake is enough. Ramchandran (2007)[1] has prescribed an alarming report. He has reported that protein intake is actually going down, from 65g/person/day to 54g/person/day since last decade while fat intake is increasing form 24 g/person/day to 35 g/person/day. This undesirable change in nutritional uptake is being manifested in various life style related diseases like-diabetes, hypertension and cardiovascular compositions. Agricultural productivity of legumes is presently low by 66% as compared to its demand (FAO. 2013[2]). It is therefore urgent to strengthen production of legume and cultivation of *Pisum sativum* is a good option.

Pisum sativum, commonly known as pea is protein rich (5%) and low fat pulse cum vegetable. Recent investigations have further enhanced its importance as food item. Hernandez (2009) [3] has reported that pea contains various important phytochemicals, one significant being coumestrol which a health protecting polyphenol and it plays an important role in prevention of stomach cancer. Ismail and Tan (2009) [4] has reported that that pea contains antioxidants which lowers oxidation of free radicals. Sievenpiper (2009) [5] has published a paper highlighting low glycemic index and high fibre in pea, making it suitable for diabetics. India's share to global pea production is nearly 5.6% of global output whereas it should be 18.3% (FAO 2012) [6]. Keeping above production scenario and usefulness in mind is urgent to strengthen production of pea. In this respect, it is also important to consider impact of pollutants on productivity. Out of different pollutants, fluoride is a significant one and is added to the soil by industries as well as because of geo-chemical activities.

Present study was aimed at investigative yield attribute of pea in fluoride contaminated condition.

MATERIAL AND METHODS

Layout of Field

Simple randomized block design was followed. The length and breadth of pea field was kept 53 x 20 meters = 1060 Sq. meters for two varieties.

1. Number of Replications 4
2. Number of treatments 6
3. Total number of plots 48+48=96
   24+24=48 for 2 var. of Pea
   48 for 2 var. of Barley
4. Total field area 1060 + 1060 = 2120 sq. meters including channels, blocks and plot boarders.

Sowing of Pea

The seeds of pea (*Pisum sativum*) of uniform size were directly sown in the field at the distance of 40 x 15 cm. row to row and plant to plant. The sowing of seeds of pea and barley was done on 5th Nov. 1999. The barley seeds were sown at the distance of 40 cm x 15 cm as above.

The treatments of sodium fluoride were given at every 15th day interval (i.e. spraying of NaF solution of different concentrations fortnightly) starting with the 30 days old plants.

Concentration and Application of NaF Solution

C: 0 ppm
F1: 10 ppm
F 2: 25 ppm
F3: 50 ppm
F4: 100 ppm
F5: 200 ppm

Different concentrations of NaF solution were fortnightly by 'Back Sack' sprayer over the above ground plant.

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Sampling of Plant

Random plants were sampled in four replications at different ages of the plant. In pea (*Pisum sativum*) the first spraying of NaF solution and sampling was done at the age of 30 days after sowing into the field and the subsequent samplings were done at 45, 60 75,90, 105 and 135 clays of plant age. The average of 3 plants per treatment in each replication was taken for study. Thus 12 plants for each variety were studied as sampling in four blocks. +

The plants were kept under close observation with respect to changes in their pigmentation, foliar injury, necrosis, burning of tips and margins of leaves, chlorosis and growth behavior before and after NaF treatments of plants.

Analysis of Plant Samples

The plants' of pea were sprayed with different concentrations of NaF salt at the interval of 15 days. Number of pods per plant was recorded after 60 days. Mean of pod setting was calculated. Pods were oven dried at 80 degree Celsius to calculate dry weight.

RESULTS AND DISCUSSION

It is evident form Table No. 1 and 2 that the setting of the pods started after 2 months of sowing in *Pisum sativum* var. Arpana. The maximum number of pods is produced in control followed by other treatments and the minimum number is obtained in 200 ppm in *Pisum sativum* var. Arpana. Similar results were recorded in Var. Arkil. Toxic effect was found similar in Var. Arkil also.

Table 1: Mean Number of pods per plant

	Pisum sativum	
Concentrations	**Arpana**	**Arkil**
Control	70.7	43.0
10 ppm	68.7	39.0
25 ppm	57.7	35.7
50 ppm	50.5	31.2
100 ppm	44.2	28.2
200 ppm	33.2	24.0
C.D at 5 %	10.44	5.11
C.D at 1%	14.26	6.98

Table 2: Summary of analysis of variance of Number of pods per plant

Crop Plants	In Field		
	'F' Value	Table 'F' Value	
		5%	1%
Pisum sativum Var. Arpana	17.27*	2.90	4.56
Var. Arkil	16.70*	2.90	4.56

*Significant at 1%

The treatment differences are significant in the following order: Pisum sativum Var. Arpana
Control 10 ppm > 25ppmm, 50 ppm, 100ppm> 200 ppm
C.D = 10.44
Control 10 ppm > 25> 50>100> 200 ppm
C.D = 5.11

From C.D values it is observed that there is no significant difference between control and 10 ppm in *Pisum sativum* Var. Arpana. Control and 10 ppm produce significantly more number of pods than 25 ppm to 200 ppm. 25 to 100 ppm are similar and they significantly produce more number of pods than 25 ppm in pea Var Arpana. Thus Arpana variety of pea significantly reduces the number of pods per plant in higher concentrations i.e. 200 ppm due to toxicity of NaF. Similar trend was also seed in Var. Arkil of pea. Control plants significantly produced more number of pods.

Effect of Fluoride on Fresh Weight of Pods

The data in Table No. 3 & 4 indicate that the sodium fluoride treatment at 5% and 1% variance ratios reduces significantly the fresh weight of pods per plant in comparison to control (normal) plants. The maximum fresh weight is recorded in control treatment and minimum is obtained in 200 ppm due to the toxic effect of NaF.

Table 3: Mean Fresh weight of pods per plant in g.

	Pisum sativum	
Concentrations	**Arpana**	**Arkil**
Control	105.0	85.7
10 ppm	87.0	77.2
25 ppm	72.0	69.0
50 ppm	60.0	55.0
100 ppm	45.5	46.7
200 ppm	33.0	37.7
C.D at 5 %	10.99	4.90
C.D at 1%	15.17	6.76

Table 4: Summary of analysis of variance of Fresh weight of pods per plant

Crop Plants	In Field		
	'F' Value	Table 'F' Value	
		5%	1%
Pisum sativum Var. Arpana	53.10*	2.90	4.56
Var. Arkil	94.10*	2.90	4.56

*Significant at 1%

The treatment differences are significant in the following order: *Pisum sativum* Var. Arpana
Control > 10 > 25 > 50 > 100 > 200 ppm C.D. = 10.99
Pisum sativum Var. Arkil
Control > 10 > 25 > 50 > 100 > 200 ppm C.D. = 6.76

From C.D. values it is observed that control plants significantly produce maximum fresh weight of pods per plant in Arpana variety of *Pisum sativum*. Other treatments significantly reduce the fresh weight upto 200 ppm and the minimum out turn is noted in highest concentration i.e. 200 ppm in Arpana variety of

pea due to NaF toxicity. Similar response was shown by Var. Arkil.

Effect of Fluoride on Dry Weight of Pods:

The data in Table No. 5 & 6 indicate that the dry weight of pods per plant in pea Arpana the variety of *Pisum sativum* varies markedly with the increase of concentration of sodium fluoride. The significant reduction in dry weight of pods is observed in higher concentrations upto 200 ppm. The normal plants produce maximum dry weight of pods and minimum is observed in 200 ppm in Arpana variety. Similar trend has been shown in dry weight of pods by Var. Arkil also.

Table 5: Mean Dry weight of pods per plant in g.

	Pisum sativum	
Concentrations	**Arpana**	**Arkil**
Control	45.7	33.8
10 ppm	40.4	30.7
25 ppm	33.0	27.9
50 ppm	28.1	22.0
100 ppm	20.3	16.4
200 ppm	15.2	13.5
C.D at 5 %	3.29	3.13
C.D at 1%	5.38	4.31

Table 6: Summary of analysis of variance of Dry Weight of pods per plant

Crop Plants	In Field		
	'F' Value	Table 'F' Value	
		5%	1%
Pisum sativum Var. Arpana	83.30*	2.90	4.56
Var. Arkil	55.90*	2.90	4.56

*Significant at 1%

The treatment differences are significant in the following manner: *Pisum sativum* Var. Arpana
Control > 10 > 25 > 50 > 100 > 200 ppm C.D. = 3.29
Pisum sativum Var. Arkil
Control > 10 > 25 > 50 > 100 > 200 ppm C.D. = 3.13

From C.D. values it is observed that control plants significantly produce maximum dry weight of pods per plant in Arpana variety of *Pusium sativum*. Other treatments significantly reduce the dry weight of pods upto 200 ppm. Similar observations were recorded in Var. Arkil.

Outcome of present research clearly demonstrated that fluoride pollution adversely affect pod setting as well as dry weight of pods which ultimately reduces its productivity. Hitchcock (1963) [7] has opined that various leaf parameters are responsible for low rate of photosynthesis this may be true with this study as well. Sunita and Agrawal (1980) [8] have found almost similar results with *Vicia faba.* Kumar and Mishra (2014) [9] have observed marked rduction in nodulation and dry weight of nodules because of fluoride pollution. This leads to retarded Nitrogen fixation and low yield. Bishnoi et.al, (1993) [10] have reported marked reduction in pod setting in pea because of heavy metal contamination. Shrestha (2011) [11] has also observed a decrease in pod number and their dry weight because of impact of industrial pollution and sewage.

CONCLUSION

It can be concluded that like many other pollutants, heavy metals also have deleterious effect on pod setting and dry weight of pod which ultimately reduce the yield of the crop.

REFERENCES

1. www.livemint.com
2. www.fao.org
3. Hemendez R (2008) Dietary intake of phytonutrients and gastric cancer risk. International journal of cancer (7) 1424-1420.
4. Ismail A and Tan ST (2009). Antioxidant property of some non-leafy vegetables. Nutrition and Food science (39) 176-180.
5. Sievenpiper JL (2007) Effect of some nonoil seed pulses on glycemic control. Diebetologia (52), 1795-2001.
6. Hithcock, AE (1963) Effect of fluoride on milo maize. Contribution of Boyce Thompson Institute (22) 175-206.
7. Agrawal, Meera (1979). Ecophysiological effect of NaF on *Hordeum Vulgare* Ph. D. Thesis Meerut University, Meerat. 209 pp.
8. Kumar, Ranjana and PK Mishra (2014). Impact of fluoride on nodulation of Pisum Sativum. International journal of current research. (accepted).
9. Bishnoi NR, Anita Dua and VK Gupta. (1993). Effect of Chromium on Yield of Pea. Agriculture, Ecosystem and Environment. (1). 47-57.
10. Shrestha MK (2011). Effect of sewage and industrial pollution on yield of pea. Bibechana. (9). 70-75.

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