

<https://doi.org/10.46344/JBINO.2021.v10i06.39>

## RESPONSE OF TWO CULTIVARS OF SUNFLOWER TO SULPHUR DIOXIDE POLLUTION ON SEED GERMINATION ASPECTS

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### ABSTRACT

Rapid industrialization is responsible for the increase in pollution that subsequently threatens the food production and its quality. Among various air pollutants, sulphur dioxide (SO<sub>2</sub>) is one of the principal contaminants, emitted by the burning of fossil fuels--coal, oil and diesel – or other materials that contain sulphur which is also a natural by-product of volcanic activity. Sulphur dioxide also acts as a secondary pollutant like sulphate aerosols, particulate matter and acid once released into the air. In the present study, the seeds of two oil-yielding cultivar cv. PAC-36 and cv. KBSH-1 of *Helianthus annuus* L. (family Asteraceae) on fumigation with four cumulative doses 2612, 3265, 3918 and 4571 µg m<sup>-3</sup> of SO<sub>2</sub> manifested a decline in the germination percentage and seed vigour along with the adversely affected derived values like relative seed germination percentage and relative seed vigour percentage. However, the reduction observed was more in concentration 4571 µg m<sup>-3</sup> of SO<sub>2</sub> in comparison to 2612 µg m<sup>-3</sup> of SO<sub>2</sub>.

**Keywords:** Aerosols, Germination, *Helianthus*, Seed vigour, SO<sub>2</sub>.

## INTRODUCTION

Environmental pollution is defined as the presence of any solid, liquid or gaseous substance in such concentration as may be or tend to be injurious to environment. The National Academy of Sciences, USA (1966) defined pollution as “an undesirable change in physical, chemical or biological characteristics of air, water and soil which affect human life, living conditions or cultural assets.” Among the various air pollutants, the oxides of sulphur (SO<sub>x</sub>) are probably the most widespread and intensively studied. And among these, sulphur dioxide (SO<sub>2</sub>) is one of the principal contaminants of air emitted by the burning of fossil fuels- coal, oil and diesel- or other materials that contain sulphur. Sulphur dioxide is also a natural by-product of volcanic activity. Sulphur dioxide can create secondary pollutants such as sulphate aerosols, particulate matter and acid once released into the air. The growth and development of plants can be directly related to air quality. Plant could be valuable biological tools for indirectly measuring our pollution if a sound statistical relationship between plant injury and the quality and duration of exposure to pollutants could be established (Le Blanc and De Sloover, 1970). In the present study short term effects of different concentrations of SO<sub>2</sub> were studied on various seed germination parameters of oil yielding cultivars cv. PAC-36 and cv. KBSH-1 of *Helianthus annuus* L.(family Asteraceae). The aim of the present study was to compare seed germination aspects of two oil-yielding cultivars of sunflower as these cultivars are raised for the extraction of oil from their seeds.

## MATERIAL AND METHODS

Seeds of *Helianthus annuus* cv. PAC-36 and KBSH-1 were procured from IARI, New Delhi. The experiments were carried out in Petri dishes (15 cm in diameter) to study the germination and early seedling growth behaviour. For germination trial, uniform and healthy seeds were selected, then surface sterilized with 0.01% mercuric chloride solution for 2 minutes. After this the seeds were rinsed 2-3 times with distilled water. The set with 100 seeds was exposed to different concentrations of SO<sub>2</sub> (2612, 3265, 3918 and 4571 µgm<sup>-3</sup>) for 2h a day and allowed to germinate in Petri dishes lined with Whatman no. 40 filter paper discs, associated with an underline of a thin uniform wad of sterilized cotton. Seeds were arranged equidistantly in concentric ring over the filter paper. The experiments were repeated five times. The emergence of radicle (1-2 mm) was considered as successful germination. Observations to seed germination were made daily till last germination. From the data thus obtained germination percentage, relative germination percentage, seed vigour and relative seed vigour were calculated by using following formulae:

$$\text{Seed germination percentage} = \frac{\text{number of seeds germinated}}{\text{Total number of seeds sowed}} \times 100$$

$$\text{Relative seed germination percentage} = \frac{\text{Seed germinated in individual conc.}}{\text{Sum of seeds germinated in all conc.}} \times 100$$

(Concentration-based)

Seed vigour (Agarwal, 1980)

$$\text{Seed vigour} = \frac{\sum \text{Quotients of daily counts}}{\text{Number of days of germination}}$$

$$\text{Relative seed vigour} = \frac{\text{Seed vigour in individual conc.}}{\text{Seed vigour in all conc.}} \times 100$$

(Concentration-based)

## RESULTS

Sulphur dioxide, as a pollutant, showed inhibitory effect on seed germination aspects of the present studied two oil yielding cultivars of sunflower. The seed germination percentage was found to be reduced on exposure with different concentrations of SO<sub>2</sub> in comparison to control (Table 1). However, 2612 µg m<sup>-3</sup> of SO<sub>2</sub> had little effect on KBSH-1 in comparison to cv. PAC-36 on the very first day of germination. Seed vigour was found to be decreased with increasing concentrations of sulphur dioxide. More reduction in seed vigour was observed in cv. PAC-36 on exposure with 2612, 3265, 3916 and 4571 µg m<sup>-3</sup> of SO<sub>2</sub> respectively in comparison to cv. KBSH-1. Relative Seed Germination percentage and relative seed vigour percentage also showed a considerable decrease with increasing concentration of SO<sub>2</sub> in both cv. PAC-36 and cv. KBSH-1 (Table 2). However, the oil-yielding cultivar PAC-36 showed more reductions in comparison to cv. KBSH-1.

## DISCUSSION

Germination, the event associated with the preinitiation of embryo growth in a mature seed of higher plants gets disturbed on the SO<sub>2</sub> exposure. Sulphur dioxide treatment was found to be responsible for reduced seed germination in the presently studied crops. The inhibition of seed germination on exposure with SO<sub>2</sub> may be due to its acidic nature as it forms sulphurous acid with water which enters the seed and reduces the pH. This is responsible for the inhibition of pH dependent enzymatic activities and intern suppress the seed germination. Similar findings were reported by Boralkar and Chaphekar (1981). Prakash et al (1977) studied the effect of sulphur dioxide on seed germination of *Cicer arietinum*, *Dolichos lablab*, *Lens esculentum* and *Pisum sativum* and exhibited reduced germination percentage. Considerable reduction in seed germination, seeding survival and seed vigour percentage was reported by Gupta et al (1993). Exposure of seeds with 14300 µg m<sup>-3</sup> SO<sub>2</sub> exhibited inhibited seed germination (Saxena et al, 2001).

**Table 1:** Seed germination percentage in two cultivars of *Helianthus annuus* L., exposed to different concentrations of SO<sub>2</sub>.

Cultivars	Days to germinate	SO <sub>2</sub> (µg m <sup>-3</sup> )				
		0	2612	3265	3918	4571
cv. KBSH-1	1	75.80	66.00	60.00	52.00	37.20
	2	90.60	81.40	78.00	66.00	56.80
	3	94.40	85.60	81.20	75.00	71.80
	4	95.20	87.60	83.20	78.60	73.80
	5	95.60	88.40	84.20	79.40	76.80
	6	95.80	89.20	87.60	80.20	78.20
	7	95.80	89.40	87.80	80.40	78.60
cv.PAC-36	1	62.60	44.40	40.60	32.20	26.20
	2	89.60	75.80	70.20	66.60	60.20
	3	94.40	80.60	74.60	70.80	65.60
	4	97.20	92.40	86.80	78.80	72.60
	5	97.40	93.60	88.60	80.00	74.40
	6	97.40	94.60	90.00	81.60	75.20
	7	97.40	94.80	90.20	81.80	75.40

**Table 2:** Seed vigour, relative seed germination percentage (RSGP), relative seed vigour percentage (RSVP) and relative seedling survival percentage (RSSP) of two cultivars of *Helianthus annuus* L. (Concentration-based) exposed to different concentrations of SO<sub>2</sub>.

Cultivar	cv. KBSH-1				cv.PAC-36			
Attribute	Seed vigour	RSGP (Conc. Based)	RSVP (Conc. Based)	RSSP (Conc. Based)	Seed vigour	RSGP (Conc. Based)	RSVP (Conc. Based)	RSSP (Conc. Based)
SO <sub>2</sub> ( $\mu\text{g m}^{-3}$ )								
0	14.12	22.17	27.26	23.98	15.68	22.15	32.68	23.92
2612	10.84	20.69	20.92	22.15	9.295	21.56	19.36	21.15
3265	10.19	20.32	19.66	19.13	8.645	20.51	18.01	19.04
3918	9.030	18.61	17.42	18.19	7.617	18.60	15.87	18.30
4571	7.625	18.19	14.71	16.53	6.751	17.15	14.06	17.57

## CONCLUSION

It is being concluded from the above study done that all the four concentrations of sulphur dioxide had an adverse effect on seed germination and its derived values in two oil-yielding cultivars of *Helianthus annuus* L. i.e., cv. PAC-36 and cv. KBSH-1. However, comparative study between the two cultivars exhibit cv. KBSH-1 as more resistant towards SO<sub>2</sub> stress to some extent in respect to seed germination percentage.

## ACKNOWLEDGEMENT

The author is thankful to Prof. G. Prakash, Rtd. Head, Dept. of Botany, C. C. S. University, Meerut, for his guidance and support for this research work. The author is also grateful to Principal, R R Bawa DAV College for Girls, Batala for providing necessary facilities to carry out the research.

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