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# Effect of different concentrations of sulphur dioxide fumigation on growth parameters of *pisum sativum*

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***Abstract - Sulphur dioxide ($SO_2$) is a toxic gas and a major component of air pollution. It interferes with the metabolic and physiological functions of plants, leading to a decline in growth and productivity (Black and Unsworth, 1979). This research was conducted to examine how varying levels of $SO_2$ (0.1 ppm, 0.2 ppm, 0.4 ppm, and 0.6 ppm) affect the growth of Pisum sativum (pea plants).The findings revealed that the impact of $SO_2$ exposure depends on its concentration. A minimum reduction in growth was observed at a low concentration (0.1 ppm), while higher levels (0.6 ppm) caused a significant decrease in growth attributes. The study highlights the detrimental effects of $SO_2$ on plants and underscores the importance of controlling air pollution to safeguard agricultural productivity and plant health.***

***Keywords: Air pollution, Growth Attributes, $SO_2$ Exposure, Variable Concentrations of sulphur dioxide, Pisum sativum.***

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## INTRODUCTION

Environmental pollution, which significantly impacts plants and animals, has become a pressing issue at both national and international levels. In the past, its severity was relatively low, but it has now reached alarming proportions. The unplanned exploitation of natural resources to meet the demands of a growing population has led to an increase in air pollution. Other contributors to environmental degradation include rapid industrial growth and unregulated urban expansion. Air pollution, in particular, is a major threat to both vegetation and wildlife. Among its harmful components, sulphur dioxide ($SO_2$) is especially destructive.

The primary sources of $SO_2$ include emissions from vehicles (Dwivedi and Tripathi, 2007) and the burning of fossil fuels like coal and petroleum (Ramadan *et al*., 2008). Additionally, industrial processes such as smelting of sulphur-containing ores and refining activities (Shang *et al*., 2008) contribute significantly to $SO_2$ emissions. Natural phenomena such as volcanic eruptions and oceanic activity also release $SO_2$ into the atmosphere. Addressing this issue is critical to mitigating the negative effects of air pollution on ecosystems and ensuring environmental sustainability.

## REVIEW OF LITERATURE

Sulphur dioxide ($SO_2$) is a significant pollutant known for its harmful effects, leading to notable declines in plant growth and productivity. $SO_2$ enters leaves through the stomata and accumulates in the mesophyll cells, where it disrupts physiological processes and causes visible foliar damage in the form of patches (Majernik and Mansfield, 1971). This accumulation triggers metabolic changes, which ultimately reduce plant growth, as reported by Costonis (1971), Chaphekar et al. (1974), and Reinert and Handerson (1980).Various studies have highlighted similar effects across different plant species.

Singh, L.P. (2002) observed a significant reduction in growth and yield in *Oryza sativa* upon $SO_2$ exposure. In *Zea mays*, Chaudhary and Srivastav (2005) documented declines in biomass and net primary productivity. Bhardwaj, M.K. *et al.* (2009, 2010)

reported similar findings in *Tegete erecta*, and Anil Bhushan (2018) identified growth and yield limitations in various vegetable crops under $SO_2$ pollution. Poonam Yadav *et al.* (2019) studied the impact of $SO_2$ and particulate pollution on *Triticum vulgare* and *Hordeum vulgare*, noting a reduction in growth and yield.

## MATERIALS AND METHODS

For this study, seeds of *Pisum sativum* (Pusa Pragati) were sourced from the certified seed agency IARI, Pusa, New Delhi. Polythene bags of suitable size were prepared, and 5–6 seeds were sown in each bag. Once the seedlings were well established, only one seedling per bag was kept, while the others were carefully removed. The plants were exposed to sulphur dioxide ($SO_2$) at regular intervals. The gas was generated using the method described by Rao and Le Blanc (1966), and the required concentrations were prepared following Singh and Rao (1986). Four chambers, each measuring $1m^3$, were constructed using perspex sheets to facilitate fumigation. The plants were fumigated for 4 hours daily until they were 60 days old. Observations were taken periodically, starting at 20 days, on five plants from each treatment group, including the control and $SO_2$ concentrations of 0.1 ppm, 0.2 ppm, 0.4 ppm, and 0.6 ppm, to evaluate the effects on growth parameters.

## RESULTS AND DISCUSSION

The results of this study clearly demonstrate that exposure to varying concentrations of sulphur dioxide (0.1, 0.2, 0.4, and 0.6 ppm) led to a significant decrease in several growth parameters of *Pisum sativum*. As presented in Table-1, the data show considerable reductions in root and shoot length, fresh weight, dry weight, net primary productivity, and phytomass when plants were exposed to sulphur dioxide. The decline was more pronounced in plants exposed to higher concentrations (0.4 and 0.6 ppm) compared to those exposed to lower concentrations (0.1 and 0.2 ppm). Additionally, older plants exhibited more severe reductions in growth than younger plants. These findings are in agreement with previous studies. For example, Kumar and Singh (1986) reported a decline in growth in *Pisum sativum* and *Vigna sinensis* when subjected to higher levels of sulphur dioxide. Likewise, Khalil M.S. *et al.* observed significant growth reductions in *Oryza sativa* under sulphur dioxide stress. According to Bharadwaj and Singh (2021), the plants (*Vigna radiata*) showed a slight decrease in morphological and growth attributes under low doses (0.1 ppm) of $SO_2$ while a considerable decrease was reported when the plants were exposed to higher doses (0.6 ppm) of sulphur dioxide. The reductions in fresh and dry weight observed in this study were notable, and the results are consistent with those of other researchers in the field.

**Table-1 Effect of different concentrations of sulphur dioxide on growth parameters of *Pisum sativum* (Pusa Pragati)**

| Age of Plants | 20 Days | | | | | 40 Days | | | | | 60 Days | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $SO_2$ Concentration (ppm) | 0 | 0.1 | 0.2 | 0.4 | 0.6 | 0 | 0.1 | 0.2 | 0.4 | 0.6 | 0 | 0.1 | 0.2 | 0.4 | 0.6 |
| **Parameters** | | | | | | | | | | | | | | | |
| Root Length (cm) | 21.60± 0.48 | 20.58± 0.28 | 19.77± 0.24 | 18.97± 0.68 | 18.25± 0.72 | 34.61± 0.28 | 31.68± 0.68 | 29.21± 0.75 | 27.76± 0.82 | 26.35± 0.68 | 38.50± 1.26 | 34.46± 0.96 | 31.39± 0.48 | 28.42± 0.72 | 25.50± 0.84 |
| Shoot Length (cm) | 26.48± 0.9 | 26.02± 0.86 | 25.21± 0.85 | 24.39± 0.84 | 23.83± 0.74 | 36.14± 0.48 | 35.35± 0.15 | 33.28± 0.19 | 32.35± 0.24 | 31.37± 0.83 | 40.10± 1.03 | 38.17± 1.28 | 36.43± 1.26 | 33.90± 1.20 | 31.33± 1.24 |
| Fresh weight of root (g) | 3.89±0 .65 | 3.49±0 .75 | 3.32±0 .53 | 3.21±0 .45 | 3.03±0 .22 | 8.14±0 .33 | 6.63±0 .68 | 6.27±0 .78 | 6.01±0 .71 | 5.82±0 .18 | 12.11± 0.32 | 9.99±0 .15 | 9.34±0 .19 | 8.72±0 .16 | 7.40±0 .21 |
| Fresh weight of shoot (g) | 12.36± 0.26 | 11.31± 0.59 | 10.93± 0.78 | 10.69± 0.12 | 10.32± 0.85 | 20.89± 0.49 | 17.32± 0.58 | 16.19± 0.18 | 16.02± 0.79 | 15.34± 0.88 | 30.86± 0.82 | 25.46± 0.85 | 24.22± 0.89 | 23.18± 0.16 | 22.32± 0.20 |
| Dry weight of root (g) | 1.01±0 .78 | 0.927± 0.94 | 0.893± 0.72 | 0.875± 0.58 | 0.843± 0.64 | 2.04±0 .15 | 1.70±0 .28 | 1.61±0 .45 | 1.56±0 .17 | 1.52±0 .71 | 3.48±0 .93 | 2.97±0 .15 | 2.83±0 .19 | 2.76±0 .69 | 2.67±0 .21 |
| Dry weight of shoot (g) | 4.04±0 .12 | 3.73±0 .45 | 3.61±0 .52 | 3.59±0 .65 | 3.50±0 .68 | 6.91±0 .48 | 5.90±0 .88 | 5.72±0 .78 | 5.55±0 .84 | 5.47±0 .18 | 10.21± 0.52 | 8.93±0 .85 | 8.62±0 .19 | 8.43±0 .16 | 8.31±0 .21 |
| Phytomass (g) | 5.05±0 .78 | 4.65±0 .94 | 4.50±0 .72 | 4.46±0 .58 | 4.34±0 .64 | 8.95±0 .15 | 7.60±0 .28 | 7.33±0 .25 | 7.11±0 .17 | 6.99±0 .41 | 13.69± 0.33 | 11.90± 0.15 | 11.45± 0.29 | 11.21± 0.14 | 10.98± 0.21 |
| Whole plant fresh weight (g) | 16.25± 0.86 | 14.80± 0.98 | 14.25± 0.86 | 13.90± 0.43 | 13.35± 0.32 | 29.09± 1.43 | 23.95± 0.62 | 22.46± 0.58 | 22.03± 0.91 | 21.16± 0.68 | 42.97± 0.83 | 35.45± 0.95 | 33.56± 0.71 | 31.90± 0.56 | 29.72± 0.72 |
| Length of whole plant (cm) | 48.08± 0.46 | 46.60± 0.45 | 44.97± 0.84 | 43.36± 0.48 | 42.08± 0.45 | 70.75± 1.24 | 67.03± 0.98 | 62.49± 0.68 | 60.11± 0.66 | 57.72± 0.54 | 78.60± 1.38 | 72.63± 0.94 | 67.82± 0.46 | 62.32± 0.44 | 56.83± 0.48 |
| Net primary Productivity | 0.252± 0.18 | 0.232± 0.11 | 0.225± 0.16 | 0.223± 0.13 | 0.217± 0.17 | 0.223± 0.09 | 0.190± 0.11 | 0.183± 0.07 | 0.177± 0.10 | 0.174± 0.09 | 0.228± 0.16 | 0.198± 0.14 | 0.190± 0.06 | 0.186± 0.09 | 0.183± 0.10 |

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