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EFFECT OF SULFUR-DI-OXIDE ON CHLOROPHYLL, pH AND GROWTH OF LEGUMES

Ecology

Asha Tiwari Department of Botany, M.B.P.G. College, Haldwani, Uk. India.
Smriti Rawat* Department Of School Education Uk. India. *Corresponding Author

ABSTRACT

Air pollution is the major problem now days due to industrialization. Many harmful gases are affecting our environment, and SO2 is one of them. This paper studied the effect of sulfur dioxide (1ppm) fumigation in two leguminous crops *Macrotyloma uniflorum* (Lam.) Verdc. and *Lens culinaris* Medik and plant response against SO2 stress at different age (40, 55 and 70days). The shoot length and physiochemical analysis like chlorophyll a, b and carotenoid content was studied at different age of the plants. SO2 fumigation to the plants reduces the shoot growth, chlorophyll and carotenoid contents, pH shifted to more acidic side. Both plants were found to be susceptible against 1ppm SO2 fumigation.

KEYWORDS

sulfur-di-oxide, fumigation, chlorophyll, pH, legumes.

INTRODUCTION

Pollution is the major problem now a day. The industrialization and heavy use of fuel emits harmful gases around us and sulfur dioxide is one of them. Air pollutants are emitted from various sources into the atmosphere. During winter, greenhouses are heated by the burning of fuel in heating system, which creates sulfur dioxide that can be detrimental to plant growth and human health [1]. SO2 can cause leaf injury, reduce photosynthetic activity, destroy pigments, cause stomatal damage, interfere with membrane permeability, and reduce plant growth and yield [2,3,4].

The present study was carried out in college campus of Berinag in Uttarakhand. The aim of present study is to analyze the effect of sulfur dioxide in two leguminous crops *Macrotyloma uniflorum* (Lam.) Verdc. and *Lens culinaris* Medik.

Macrotyloma uniflorum (Lam.) Verdc. and Lens *culinaris* Medik are major leguminous crop of Uttarkhand. Common name of *M. uniflorum* (Lam.) Verdc. is *Gahat.* It is annual herb, climber, 50-80 cm in height. It used in traditional medicine is well known for its healing properties. Its seeds are majorly used in treatment of various ailments besides used as tonic, astringent, and diuretic [5]. The medicinal uses of this plant date back to the Vedic period. This is a pulse crop of great potential values and is commonly designated as the 'poor man's pulse.' [6].

Lens culinaris Medik is commonly called Masoor dal. It is a widely growing pulse in Uttarkhand. It is a potential functional dietary ingredient which as polyphenol-rich content. Several studies have demonstrated that the consumption of lentil is immensely connected to the reduction in the incidence of diseases such as diabetes, obesity, cancers and cardiovascular diseases due to its bioactive compounds [7].

MATERIALS AND METHODS

Berinag is located at 29.80° N latitude and 80.07° E longitude 1860 m elevation in central Himalaya range. The investigation was carried out during 2021 at college campus. 25 days old plants were given 1ppm exposure of SO2. The duration of exposure was 1 hr. for 25 days. Plants samples were collected for biochemical analysis, when plants were 40, 55 and 70 days old. 1ppm sulfur dioxide prepared according to the method adopted by Swain et.al. [8]. pH of leaf extract was measured by the method proposed by Adamsab et.al. [9]. Chlorophyll-a and chlorophyll-b and total carotenoids were determined by the method adopted by Lichtenthaler and Wellburn (1983) [10].

RESULTS AND DISCUSSION

Growth (shoot length): The shoot length of control and fumigated plants after 40, 55 and 70 days were recorded 18.3, 26.4, 38.8 cm and 15.7, 19.2, 24.1 respectively in *Macrotyloma uniflorum and* 9.7, 14.5,16.9 cm and 7.2, 10.6, 14.3 respectively in *Lens culinaris* plants (Table-1). Reduction in shoot length was observed significantly in both plants. This is due to the adverse effect of the SO2 on plants. SO2 interfered with nutrients uptake and plant growth leading to reduction in lengths of root and shoot [11].

Table 1. Shoot length and pH of control and fumigated *Macrotyloma uniflorum* (Lam.)Verdc. and *Lens culinaris* Medik at different stages of growth

Plants	Experimental condition	Age of the plants in days	Shoot length (cm)	pH
Macrotyloma uniflorum (Lam.)Verdc.	Control	40	18.3	6.8
		55	26.4	6.6
		70	38.8	6.3
	Fumigated (1ppm SO2)	40	15.7	5.5
		55	19.2	5.2
		70	24.1	4.9
Lens culinaris Medik	Control	40	9.7	6.7
		55	14.5	6.5
		70	16.9	6.1
	Fumigated (1ppmSO2)	40	7.2	5.9
		55	10.6	5.4
		70	14.3	4.1

Chlorophyll: Chlorophyll content of the leaves is decreased in both plants which were treated with 1ppm SO2 fumigation in all the age of plants (Table-2,Figure-1). The reduction of chlorophyll-a, chlorophyll-b and carotenoid pigment was higher in *Lens culinaris* plant as compared to the *Macrotyloma uniflorum* plant (Fig-1). The reduction was higher in chlorophyll-a as compared to the chlorophyll-b (Table-2). SO2 stress causes photosynthetic pigment contents to decline in a variety of angiosperm species [12]. Chlorophyll-a, carotenoid, and total chlorophyll contents increased at the pre-flowering stage, and then decreased. The level of chlorophyll b was reduced throughout plant development compared with the untreated controls [13]. Greater damage to the chloroplast machinery due to the SO2 treatment is the main cause of decrease in chlorophyll content in the leaves [8]. SO2-treatment alone did not exercise a significant effect on the total chlorophyll content. It was the interactive effect of the two variables (SO2 treatment and fumigation period) which was important [14]. Chlorophyll content is known to be affected by environmental stress [15], a decrease in chlorophyll content has been proposed to indicate SO2 injury [16].

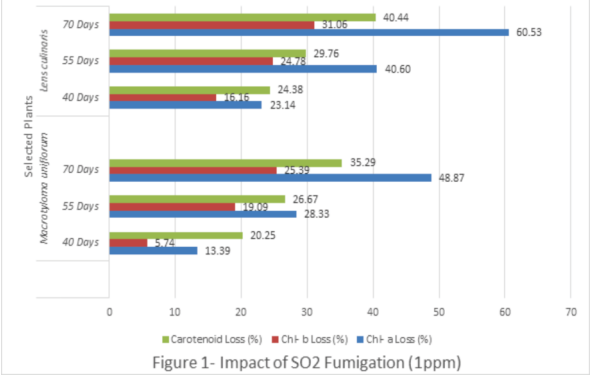

Figure 1- Impact of SO2 Fumigation (1ppm)

Table 2. Effect of Sulfur-di-oxide on chlorophyll content in *Macrotyloma uniflorum* (Lam.)Verdc. and *Lens culinaris* Medik

Plants	Experimental condition	Age of the plants in days	Chl-a (mg/g)	Chl-b (mg/g)	Carotenoid (mg/g)
Macrotyloma uniflorum (Lam.)Verdc.	Control	40	1.12	0.87	1.58
		55	1.20	1.10	1.65
		70	1.33	1.26	1.70
	Fumigated (1ppm)	40	0.97	0.82	1.26
		55	0.86	0.89	1.21
		70	0.68	0.94	1.10
Lens culinaris Medik	Control	40	1.21	0.99	1.60
		55	1.33	1.17	1.68
		70	1.52	1.32	1.83
	Fumigated (1ppm)	40	0.93	0.83	1.21
		55	0.79	0.88	1.18
		70	0.60	0.91	1.09

pH: There was a decrease in the pH of leaf extract in both plants significantly (Table-1). pH shifted to acidic side. This is due to reaction of SO2 with water as a result of which sulfuric acid is formed. It has been reported that higher leaf extract pH values lead to higher plants absorption of SO2 [17]. pH signals the occurrence of detoxification process in plant necessary for tolerance [18]. Low pH value is an indication of sensitivity of the plant species to air pollutants, while high pH could provide tolerance to pollutants [19, 20].

CONCLUSION

The present study demonstrates that the physiological, morphological and biochemical characteristics of plants are considerably affected by SO2 exposure. SO2 fumigation to the plants reduces the shoot growth, chlorophyll and carotenoid contents, pH shifted to more acidic side. Considering the above parameters both plants *Macrotyloma uniflorum* and *Lens culinaris* were found to be susceptible against 1ppm SO2 fumigation. The results indicate that *Lens culinaris* was found to be more sensitive to SO2 fumigation of 1ppm as it shows higher reduction in chlorophyll and carotenoid contents in comparison to *Macrotyloma uniflorum.*

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