



Impact of Ozone and α -Tocopherol on Plant Height and Leaf Area of *Withania somnifera*

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ABSTRACT

The impact of ozone and α -tocopherol on *Withania somnifera* has been assessed with reference to plant height and leaf area. The control plants of *Withania somnifera* attained a height of 21.43 cm in 30 days. Their fully expanded leaves attained 37.74 cm² area (per leaf). Ozone exposure resulted in a sharp decline in plant height and leaf area. The percentage decline was 70.14 % and 52.60 % respectively. The simultaneous application of α -tocopherol with ozone exposure nullified the ozone impact. In 200 ppm α -tocopherol, the plant height mounts to 22.47 cm which is even more than that of control. Similarly, the negative impact of ozone on leaf area was almost neutralized by 200 ppm α -tocopherol.

INTRODUCTION

Ozone is an allotropic form of oxygen and exists as a triatomic molecule having molecular formula O₃. Ozone is a major air pollutant that adversely affects the growth and produce of agricultural crops (Burkey & Eason 2000). α -tocopherol is a widely distributed naturally occurring vitamin. It is soluble in fat. It is found in cotton seed oil, corn oil, orange peels from plants, while meat, butter milk and fish liver oil are the sources from animals.

Withania somnifera is locally known as "Ashwagandha". This is also an accepted source of a rasayana drug, Ashwagandha, which is prescribed in all cases of general debility. Ashwagandha roots are referred to as "Indian ginseng." Roots of this plant are bitter with putrid smell and are beneficial in treating impotency, cough, dyspepsia, rheumatism, fever and ulcer, as well as used as a tonic. The major alkaloid is 'withanie', which is mainly present in roots. Withanolids like withferin-A, Withandine-D and Withanolide-E mainly occur in leaves. The present paper deals with the effect of an air pollutant ozone alone and with various concentrations of α -tocopherol on plants of *Withania somnifera*.

MATERIALS AND METHODS

The plant species used in the present investigation is *Withania somnifera*, a medicinal plant of family Solanaceae. Experiments were set up to find out the effect of ozone alone and with various concentrations of α -tocopherol on plants of *Withania somnifera*. The seeds of the plants were sown in the earthen pots and fifteen days old plants of almost equal size were exposed to ozone singly and with α -tocopherol. α -tocopherol was applied as spray treatment. The first treatment was given on fifteen day old plants and later on treatment was done after every week. A total of four sprays were done. The exposure of ozone was given for two hours/day (10 a.m. to 12 noon) for 30 days.

RESULTS AND DISCUSSION

The results of the study are presented in Tables 1 and 2, and Figs. 1 and 2. The control plants of *Withania somnifera* at the set of experiments were 9.31 cm tall and gained 130.18 percent increase in 30 days reaching 21-43 cm. The percent increase in plant height in ozone exposed plants was minimum (91.58%) which resulted only 18.43 cm tall plants. Ozone exposure given combination with 50 ppm α -tocopherol showed an increase of 120.11 percent in plant height in 30 days. Maximum tall plants were obtained in Ozone + 200 ppm α -tocopherol. Here the height after 30 days of treatment was 22.47 cm showing an increase of 138.54 percent over their initial height. In this plant species, the leaf area in O_3 exposed plants dipped to as low as 17.89 cm² against 37.74 cm² in control showing 52.60 percent reduction. However, leaf started to expand when ozone exposure was followed by α -tocopherol spray. Leaf gained an area of 20.08 cm² in ozone + 50 ppm α -tocopherol. The upsurge in leaf area over that of ozone exposed one continued in ozone + 100 ppm and ozone + 200 ppm α -tocopherol. Leaf attained an area of 36.94 cm in ozone + 200 ppm α -tocopherol, which was almost equal to that of control.

The ozone exposure to the plants of *Withania somnifera* exhibited a marked decline on plant height. This decline was 70.14% percent. Such a decrease in plant height in plants of Asteraceae and Fabaceae families due to ozone exposure has also been reported by Franzaring (1998). Ordin (1965) correlated it (decreased plant height) with retarded cell elongation because ozone caused a marked inhibition of cellulose synthesis and subsequent cell wall formation. The α -tocopherol at 200 ppm concentration not only completely negated the inhibitory effect of ozone on plant height but also showed a faster growth rate in plants. In this treatment (O_3 + 200 ppm) the increase in plant height in 30 days was 138.54 percent as against 130.18 percent in the control in *Withania somnifera*. Ozone exposure also resulted in smaller leaves in *Withania somnifera*. These findings corroborate with the findings of earlier investigations like King et al. (2001) and Shredner et al. (2001) who working on paper birch and *Populus* species also reported the reduction in leaf area due to regression in develop-

Table 1: Effect of ozone singly and with various concentrations of α -tocopherol on plant height of *Withania somnifera*.

Treatment	Concentration (ppm)	Plant height (cm)		
		Before treatment	After 30 days of treatment	Percent growth in 30 days
Control	0	9.31 \pm 0.43	21.43 \pm 0.64	130.18
Ozone	O_3	5.62 \pm 0.63	18.43 \pm 0.77	91.58
Ozone + α -tocopherol	O_3 + 50 ppm	8.80 \pm 0.39	19.37 \pm 0.95	120.11
	O_3 + 100 ppm	9.14 \pm 0.39	20.64 \pm 0.83	125.82
	O_3 + 200 ppm	9.42 \pm 0.58	22.47 \pm 1.32	138.54

Table 2: Effect of ozone singly and with various concentrations of α -tocopherol on leaf area of *Withania somnifera*.

Treatment	Concentration (ppm)	Leaf area	
		Area cm ²	% change over control
Control	0	37.74 \pm 1.49	-
Ozone	O_3	17.89 \pm 0.18	- 52.60
Ozone + α -tocopherol	O_3 + 50 ppm	20.08 \pm 0.47	- 46.79
	O_3 + 100 ppm	24.11 \pm 1.21	- 36.12
	O_3 + 200 ppm	36.94 \pm 1.98	- 2.12

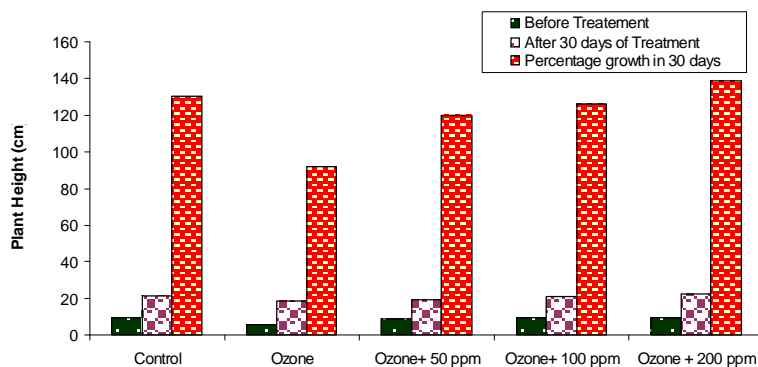


Fig. 1: Effect of ozone singly and with various concentrations of α -tocopherol on plant height of *Withania somnifera*.

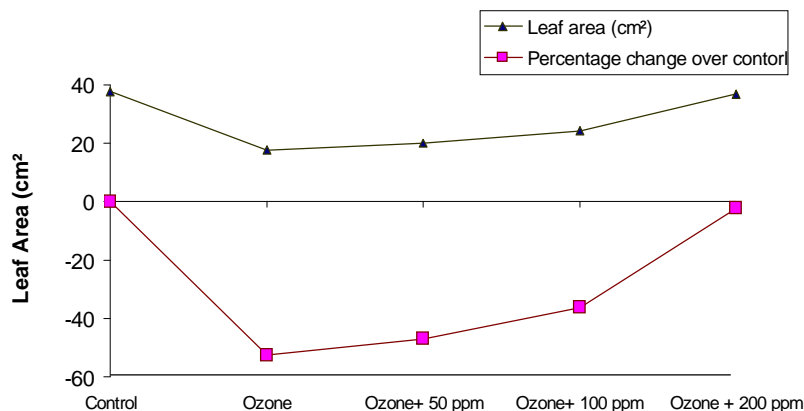


Fig. 2: Effect of ozone singly and with various concentrations of α -tocopherol on leaf area of *Withania somnifera*.

ment of leaves, as a result of ozone pollution. However, the exogenous spray treatment of α -tocopherol almost nullified this regression in leaf growth and restored the normal leaf size.

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