EFFECT OF ACID RAIN ON THE CONTENTS OF LEAVES OF *SOLANUM MELONGENA*

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Abstract: The acid rain causes damage to vegetation is true beyond any doubt. Therefore , as a part of study the effect of acid rain on plants , the effect of acid rain on chlorophyll , sulphur and ascorbic acid contents of solanum melongena was investigated .

Keywords: *Solanum melongena,* Acid rain, Chlorophyll

INTRODUCTION

Acid rain" is a broad term referring to a mixture of wet and dry deposition (deposited material) from the atmosphere containing higher than normal amounts of nitric and sulfuric acids. The precursors, or chemical forerunners, of acid rain formation result from both natural sources, such as volcanoes and decaying vegetation, and man-made sources, primarily emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) resulting from fossil fuel combustion. Acid rain can harm other plants in the same way it harms trees. Although damaged by other air pollutants such as ground level ozone, food crops are not usually seriously affected because farmers frequently add fertilizers to the soil to replace nutrients that have washed away. They may also add crushed limestone to the soil. Limestone is an alkaline material and increases the ability of the soil to act as a buffer against acidity. Acid rain causes acidification of lakes and streams and contributes to the damage of trees at high elevations and many sensitive forest soils. In addition, acid rain accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our nation's cultural heritage. Prior to falling to the earth, sulfur dioxide (SO_2) and nitrogen oxide (NO_x) gases and their particulate matter derivatives—sulfates and nitrates—contribute to visibility degradation and harm public health.

MATERIAL AND METHODS

The seedling of *Solanum melogena* (Pusa purple cluster) were obtained from Circuit house of Meerut. One to two seedlings were sown in each polythene bag filled with equal amounts of garden soil and compus compost. When seedlings were one week old, they were thinned to one plant in each polythene bag. Four sets of plants were prepared with 60 plants in each set. Acid water solutions of different pH (3.0, 4.0 and 5.0) were prepared with the help of pH-meter by adding mixture of H_2SO_4 and HNO_3 of the ratio 7:3 to the distilled water.

Out of the four sets one set was used as control and this was subjected to distilled water simulated acid rain (pH 7.0). The three sets were subjected to acid rain of the pH 3, 0, 4.0 and 5.0. A plastic hood was placed around the base of each plant to cover the soil and only foliage was exposed to simulated acid rain. Plants were exposed to simulated acid rain twice a week till the harvest. 10 ml of acid solution of water was used for each plant each time. Regular harvests of 10 plants each were made at 15 days intervals till the harvest of the crop. Chlorophyll contents, sulphur contents and ascorbic acid concentrations were determined at each harvest.

Chlorophyll contents

Chlorophyll estimation of plant leaves was done at each harvest to asses the loss in chlorophyll a , chlorophyll b and total loss of chlorophyll due to acid rain exposure (Table – 1) . For this 100 mg fresh leaves were homogenised with 80 % acetone and a pinch of sodium carbonate. Then homogenate was centrifuged at 4,000 rpm for 5 minutes. The final volume of supernatant was made to 10 ml by adding 80 % acetone .The optical density of extract was read at 645 and 665 nm on spectrophotometer. The amount was calculated according to following formulae (Duxburg and Yentch, 1965 and Maclachian and Zalik, 1963).

Chlorophyll a (mg/g F. Wt)

$$= \frac{12.3\ \mathrm{D}\ 663 - 0.86\ \mathrm{D}\ 645}{\mathrm{d\ X\ 100\ X\ W}} \times \mathrm{V}$$

Chlorophyll b (mg / g F.wt)

$$= \frac{19.3\ \mathrm{D}\ 645 - 3.6\ \mathrm{D}\ 645}{\mathrm{d\ X\ 1000\ X\ 10}} \times \mathrm{V}$$

Total chlorophyll (mg / g F. wt) = Chlorophyll a + Chlorophyll b +

V = Volume of chlorophyll solution in acetone

D = length of light path in cm.

W = Fresh weight (g) of leaves

Sulphur contents

Sulphur contents in the leaves were determined by turbidimetric method described by Patterson (1958) [table-2]. 300 mg of dried and powdered material was digested with 10 ml of selenium dioxide solution. The solution was filtered and volume was made up to 100 ml with distilled water. The sulphur in digested was precipitated as barium sulphate ($BaSO_4$) by the addition of 2.0 % $BaCl_2$ solution. The optical density of the sulphate containing mixture was measured at 420 nm. From optical density value the percentage of sulphur in leaves was determined from a standard curve prepared with potassium sulphate solution.

Ascorbic acid

Fresh leaf sample of .5 gm was homogenized with 20 ml of extracting solution prepared by dissolving 0.5 gm oxalic acid and 0.015 gm of EDTA in 100 ml distilled water kept in ice-bath. The homogenate was centrifuged at 6000 rpm for 15 minutes. To 1.0 ml of supernatant liquid, 5.0 ml of (20 gm/ml) 2, 6-dichlorophenol indophenol solution was added with constant shaking and the optical density (O.D.) of pink coloured solution (Es) was determined at 520 nm. One drop of 1.0 % ascorbic acid solution was added in order to bleach the pink colour of the dye completely and O .D. of the so obtained solution (ET) was measured at 520 nm. For this blank solution (Eo) 1.0 ml of distilled water, 5.0 ml of 2, 6-dichlorophenolindophenol solution was mixed and the O.D. was measured . A calibration curve was prepared by using the formula given by Keller Schwager (1977). Ascorbic acid contents are given in Table-2.

Ascorbic acid (mg / g) fresh leaf

$$= \frac{\mathrm{Eo - Es\ - \ Et}}{\mathrm{W}} \times \mathrm{E\ factor}$$

Where W = wt of leaf.

RESULT AND DISSCUSSION

Acid rain brought down the chlorophyll content of leaves. Ferrenbaugh (1976) reported reduction in chlorophyll content in the seedlings of Phaseolus vulgaris exposed to simulate of 3.0 pH. Accumulation of SO_4 ions and NO_3 ions may lead to breakdown of chlorophyll and interaction between these acidic ions and chloroplasts result in the inhibition of metabolism of chloroplasts. Hindwai et al. (1980) also observed loss of chloroplast integrity in the injured leaves of Phaelous Vulgaris as a result of acid rain. This decrease in production of photosynthate may lead to reduction in surface area of leaf under the influence of acid rain.

Sulphur contents showed an appreciable increase with the increase in concentration of acid & time . Maximum increase was observed in 65 days old plants. Reason may be inclusion of sulphur from SO_4 ions of acid rain & greater penetration with time.

Maximum reduction in ascorbic acid was observed in 50 days old plants treated with pH 3.0 and minimum in 20 days old plants treated with pH 5.0 simulated acid rain. Decrease in ascorbic acid contents may be decomposition of it by acid rain. However, increase in ascorbic acid contents at 20 days is not easy to explain.

Table 1 : Chlorophyll contents of leaves of *Solanum melongena* at acid rain of different pH at different plant age.

Contents	20 days	35 days	50 days	65 days
Chlorophyll a (mg/g)				
Control	3.715(±0.014)	5.477 (±0.008)	5.170(±0.008)	4.639(±o.007)
pH = 5.0	3.622(±0.006)	4.559 (±0.010)	5.061 (±0.010)	3.256(±0.017)
pH = 4.0	3.634(±0.012)	5.338 (±0.012)	5.535 (±0.014)	4.212(±0.004)
pH = 3.0	5.477(±0.067)	4.551 (±0.004)	4.331 (±0.003)	3.110(±0.006)
Chlorophyll b(mg/g)				
Control	4.044(±0.015)	6.170 (±0.009)	5.817(±0.008)	5.123(±0.007)
pH = 5.0	3.831(±0.008)	4.330 (±0.006)	6.135 (±0.008)	4.987(±0.013)
pH = 4.0	3.452(±0.001)	4.879 (±0.002)	6.236 (±0.007)	5.225(±0.001)
pH = 3.0	3.435(±0.007)	2.739 (±0.007)	4.010 (±0.010)	3.651(±0.012)
Total chlorophyll (mg/g)				
Control	7.759(±0.120)	10.653(±0.074)	10.987(±0.065)	8.756(±0.055)
pH = 5.0	7.452(±0.014)	7.992(±0.123)		7.719(±0.205)

			11.195(±0.660)	
pH = 4.0	7.084(±0.008)	9.332(±0.663)		8.363(±0.169)
			10.769(±0.170)	
pH = 3.0	6.980(±0.017)	6.217(±0.135)		5.675(±0.007)
			8.149(±0.024)	

Table 2. Effect of Simulated Rain (pH 5.0,4.0 and 3.0) on Sulphur content and Ascorbic Acid content in *Solanum melongena*' Var Pusa Purle Cluster

Plant age in Days	**Treatment**	**Sulphur content mg/g**	**Ascorbic Acid content mg/g**
20	Control	0.00019 ± 0.0002	0.00033 ± 0.00010
	pH 5.0	0.00050 ± 0.0012	0.00038 ± 0.0008
	pH 4.0	0.00120 ± 0.00025	0.00041 ± 0.00010
	pH 3.0	0.00348 ± 0.0025	0.00044 ± 0.0009
35	Control	0.00019 ± 0.0002	0.00045 ± 0.0009
	pH 5.0	0.00072 ± 0.00012	0.00039 ± 0.00010
	pH 4.0	0.00136 ± 0.00020	0.00036 ± 0.00008
	pH 3.0	0.0020 ± 0.00034	0.00032 ± 0.00010
50	Control	0.00020 ± 0.00010	0.00046 ± 0.00012
	pH 5.0	0.00079 ± 0.0007	0.00034 ± 0.0009
	pH 4.0	0.00079 ± 0.0001	0.00034 ± 0.00010
	pH 3.0	0.0040 ± 0.00015	0.00030 ± 0.00011
65	Control	0.0002 ± 0.00091	0.00047 ± 0.00090
	pH 5.0	0.00092 ± 0.0034	0.00037 ± 0.00013
	pH 4.0	0.00356 ± 0.00102	0.00033 ± 0.00010
	pH 3.0	0.00450 ± 0.0004	0.00031 ± 0.00080

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