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SULPHUR IN FOLIAGE AS AN INDICATOR OF AUTOMOBILE POLLUTION A LABORATORY STUDY

Automobile air pollution is important mainly in the effects it can have on the well-being of road users. In the present study three plant species, grown in pots, are exposed to automobile exhaust in the automobile engineering laboratory at varying distances from the exhaust and also for different exposure times. Leaves of the plants from the exposed and unexposed pots are analysed for the sulphur content. The study shows that the exposure time and distance from the exhaust have an effect on the accumulation of sulphur.

1. INTRODUCTION

The conventional methods of air quality monitoring are tedious, requiring considerable amounts of resources and man power. A developing country, like India, requires an easy and economical technique of air quality monitoring. Compared with man, animals or materials, plants are more sensitive to air pollutants. The results of studies on the accumulation of air pollutants by plants provide an important basis for using the plants as indicators of air pollution and for monitoring the effectiveness of air pollution control. Plants make excellent experimental organisms, as they are easily propagated and can be sacrificed in large numbers to obtain cumulative information on a large scale (MANNING and FEDER [5]). It is already established that plant leaves provide a major filtration and reaction surface exposed to the atmosphere. Most of plant sulphur comes from the soil, but herbaceous and woody plants

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also accumulate sulphur from the air via foliar absorption of sulphur dioxide (HILL [1], ROBERTS [8], ROBERTS [9], LINZON et al. [4]). Sulphur accumulates in plant tissues and standard chemical analyses can be used to determine the total sulphur in plant leaves.

Automobiles add to the air pollution situation to a considerable extent in metropolitan areas and in industrialized cities. Though the number of vehicles on Indian roads is much lower than that in developed countries, exhaust emissions in India are significantly large due to low grade fuel and inefficient engine performance. Automobile air pollution is important, as the well-being of road users is adversely affected. Table 1 gives the increase in numbers of motor vehicles in India during one decade, 1961–1972 (SRINIVASAN and SUBRAMANIAM [10]).

Table 1

Growth of motor vehicle numbers in India, 1961–1972
Wzrost liczby pojazdów mechanicznych w Indiach w okresie 1961–1972

Year (as on 31st March)	Motorcycles and autorickshaws	Passenger cars and jeeps	Taxis	Buses	Trucks	Other	Total
1962	116,533	314,024	25,620	59,560	189,096	44,343	749,176
1964	167,793	358,906	25,541	66,513	224,181	59,030	905,964
1966	241,701	420,096	35,725	73,175	258,977	69,369	1,099,043
1968	346,826	480,362	41,990	82,729	284,836	95,609	1,332,352
1970	603,161	567,989	59,737	91,582	322,292	113,361	1,658,122
1972	698,272	672,911	66,954	99,394	363,889	143,461	2,044,881

Almost all fuels contain a small amount of sulphur, and petrol contains about 0.25 % (KUMAR and PRAKASH [3]). In the U.S.A. motor vehicles contributed in the form of sulphur dioxide emissions 2×10^5 tons of sulphur in 1966 and 3×10^5 tons in 1967 and 1968 (PERKINS [7]). Sulphur dioxide has been implicated in the increased occurrence of acute and chronic asthma, bronchitis and emphysema.

Studies have been carried out by the authors to show that the sulphur in foliage can be used as an indicator of automobile pollution. Three plant species were used at two different distances from the exhaust of a laboratory automobile engine.

2. MATERIALS AND METHODS

Three plant species (*Calotropis gigantea* Linn. — Type A; *Hibiscus esculentus* Linn. — Type B and *Phaseolus radiatus* Linn. — Type C) were selected for the present study. The plant species were grown in three sets of identical pots,

with similar soil conditions, for forty days. One set of plants was used as blanks. The other two sets were exposed to an automobile exhaust gases of a Bullet Motor Cycle engine (BHP 18, bore 70 mm, stroke 90 mm) at 2000 RPM, at distances of 50 cm and 100 cm from the exhaust pipe. After 30 minutes and 60 minutes exposure time plant leaves were collected from the maximum exposed area for analysis in plastic bags, in triplicate. Leaves of the control sample plants were collected in the same manner. Sulphur in plant leaves was estimated by the method described by PATTERSON [6].

3. RESULTS

Table 2 gives the sulphur accumulation in the leaves of the blanks and in the leaves of plants which were exposed to the exhaust gases. The table also gives the percentage increase in the sulphur concentration after exposure.

Table 2

Sulphur accumulation in plant leaves (values given are mean ± S.E.)
Akumulacja siarki w liściach roślin

Number of sample	Details	Sulphur concentration in ppm			
		Exposure time 30 min	Percentage increase	Exposure time 60 min	Percentage increase
1	Type A				
	blank 3040 ± 23.0				
	at 50 cm	4960 ± 69.3	63	5320 ± 46.2	75
	at 100 cm	4360 ± 92.4	43	5120 ± 51.9	68
2	Type B				
	blank 2000 ± 34.6				
	at 50 cm	3200 ± 57.7	60	3840 ± 40.4	90
	at 100 cm	2840 ± 43.3	42	3320 ± 49.1	66
3	Type C				
	blank 2160 ± 28.9				
	at 50 cm	2800 ± 54.8	30	3200 ± 46.2	48
	at 100 cm	2520 ± 37.5	17	2840 ± 43.3	31

4. DISCUSSION

From table 2 it can be observed that there are differences in the accumulation of sulphur by the three plant species. With an increase in the exposure time, there is an increase in the accumulation rate, though the percentage increase is different for different specimens. Also there is a reduction in the

sulphur accumulation with the increasing distance between the exhaust pipe and the plant. The accumulation varies from specimen to specimen. Khoshoo and Ahmad [2] also felt that differences in response depended on the kind of plant and its genetic make-up, together with factors like the stage of growth, proximity to the pollution source, the concentration of pollutant and the duration of exposure.

Surprisingly the accumulation is very low in Type C plant. Though comparable values are not available, the high percentage accumulation may be due to the fact that the plants directly face the exhaust pipe. It would be interesting to find out the limiting values. Further work in this direction is in progress.

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SIARKA W ULISTNIENIU JAKO WSKAŹNIK ZANIECZYSZCZENIA SPALINAMI SAMOCHODOWYMI BADANIA LABORATORYJNE

Zanieczyszczenie powietrza spalinami samochodowymi stanowi poważny problem, gdyż wpływa ono na samopoczucie użytkowników dróg. Zbadano w laboratorium trzy rosnące w doniczkach gatunki roślin, które były wystawione na działanie spalin w różnych

odległościach od ich źródła i przez różny czas. W liściach roślin z doniczek wystawionych na działanie spalin i tych nie narażonych na nie badano zawartość siarki. Wykazano, że czas ekspozycji i odległość od źródła spalin wpływa na akumulację siarki.

SCHWEFEL IM LAUB ALS UNMITTELBARES MAß FÜR DIE LUFTVERUNREINIGUNG DURCH ABGASE EIN LABORVERSUCH

Die Luftverseuchung durch Abgase hat einen ungünstigen Einfluß auf das Wohlgefühl des Straßenbenützers. In dem besprochenen Laborversuch werden drei Gattungen von Topfpflanzen dem Einfluß der Abgase bei verschiedener Entfernung von der Verseuchungsquelle und bei verschiedener Einflußdauer ausgesetzt. Nach der Aussetzung werden die Schwefelkonzentrationen in den Blättern gemessen. Die Meßwerte zeigen an, daß die Schwefelakkumulation im Laub von der Entfernung der Abgasquelle sowie von der Zeitdauer der Aussetzung abhängt.

СЕРА В ЛИСТЬЯХ РАСТЕНИЙ КАК ПОКАЗАТЕЛЬ ЗАГРЯЗНЕНИЯ АВТОМОБИЛЬНЫМИ ВЫХЛОПНЫМИ ГАЗАМИ ЛАБОРАТОРНЫЕ ИСПЫТАНИЯ

Загрязнение воздуха автомобильными выхлопными газами представляет собой серьёзный вопрос, так как оно влияет на самочувствие пользователей дорог. В лаборатории были исследованы три растущих в цветочных горшках вида растений, которые были подвергнуты действию выхлопных газов на различных расстояниях от их источника и в течение различного времени. В листьях растений из цветочных горшков, подвергнутых действию выхлопных газов и тех, которые не были подвергнуты этим действиям, исследовалось содержание серы. Доказано, что время экспозиции и расстояния от источника выхлопных газов влияет на накопление серы в листьях.