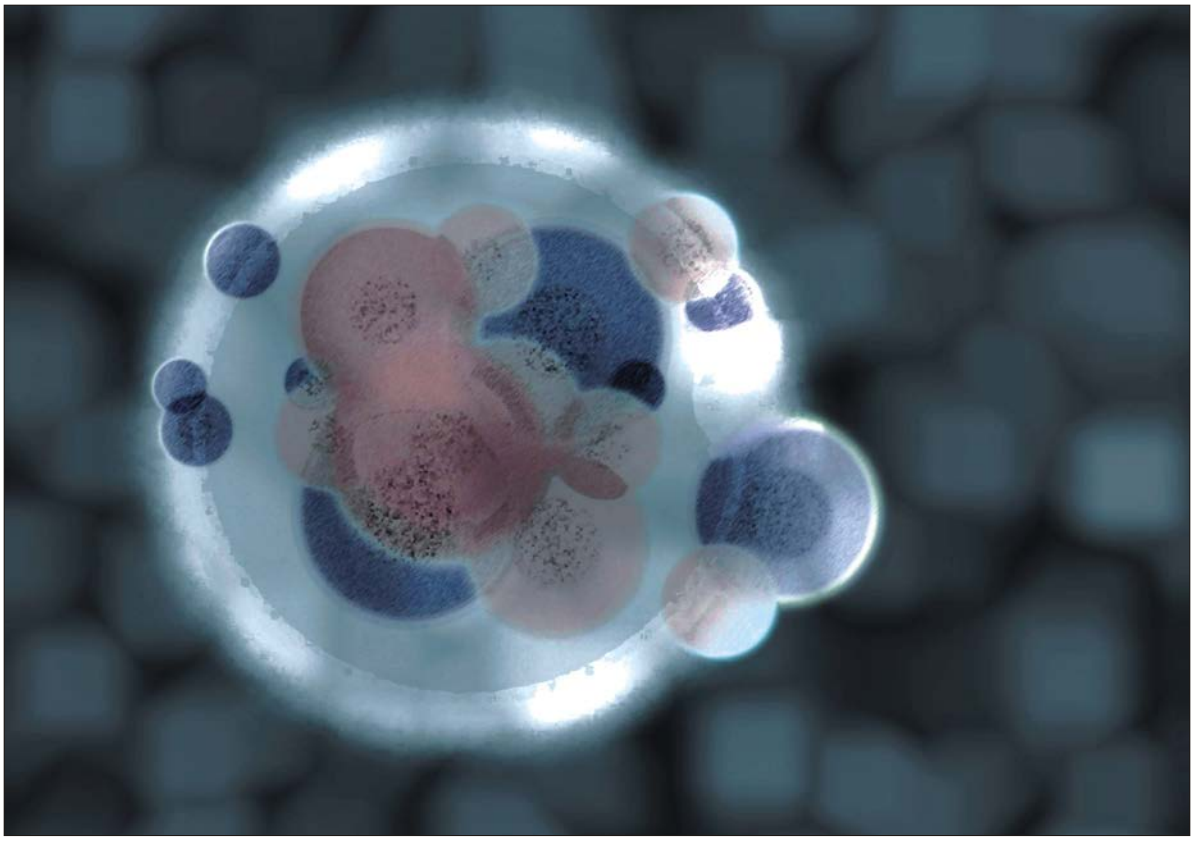

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A Study of Lead Contamination in Tobacco Leaves Sampled from Alongside Motor Roads in the Rapidly Industrialising City of Manisa, Turkey

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Abstract: This research was carried out on 5 August 2002 to determine the lead concentrations in tobacco leaves growing by roads in the vicinities of Akhisar-Gökçeahmet, Akhisar-Süleymanli, Soma-Turgutalp (Turkey). The research was made with special care given to the location of the plant, which had to be on the sides of roads. The leaf samples from these fields were picked from 0-10-20-50-100 m off the road and total of 60 leaves were sampled from the 1st, 4th, 8th, 12th rows at these distances. The lead concentrations of these samples were read by ICP (Inductively Coupled Plasma) after all the required analyses were performed. The results have shown that lead concentrations on sample tobacco leaves show a significant fall with increasing distances from the road due to, decreasing exhaust fumes. The leaves picked at the crossroads have the highest lead concentration, where there is more exposure to exhaust fumes. This research has also proved the effects of the Soma Thermal Plant. The results from Turgutalp showed a high concentration of lead on leaves although the area is not effected by heavy traffic during summer months.

Key words: Heavy metal pollution, tobacco, lead, thermal plant

INTRODUCTION

Environmental pollution in developing and developed countries has increased dramatically in recent years due to the rise in population. This situation has an impact also on agricultural lands. It has been observed that plants growing particularly alongside the main and minor roads show the effect of heavy motor vehicle traffic and thermal power plant emissions. Akhisar and Soma (townships of Manisa, Turkey) are two major tobacco growing areas. The fact that tobacco is a quality plant which highlights the necessity to examine the effects of these adverse environmental conditions. One of the main factors that has an adverse effect on tobacco is air pollution. Air pollution is the change in environmental conditions as a result of industrial development. This change is brought about by various contaminators such as particles in chimney fumes, thermal plants, radioactive substances, etc...On top of these contaminators are heavy metals such as lead. Air pollution caused by thermal power plants besides motor vehicles forms another threat to plant, animal and human health, with the burning of coal in these thermal plants, toxic trace elements, which are potential pollutants, such as As, Cd, Ga, Ge, Pb, Sb, Se, Sn, Mo, Ti and Zn are transferred into waste (slag, ash, gas). Airborne ash has a significant environmental role due to its content of toxic trace elements. Not only does it contaminate the soil surface and underground waters but also can endanger human health when tiny ash particles in the atmosphere, which are usually smaller than 10 microns, are inhaled. After the examination of the characteristics of the Soma Thermal Plant and its ash, the results have yielded that the Soma ash contains 79.7 mg L^{-1} of lead in its chemical composition[1].

MATERIALS AND METHODS

In this study, tobacco plants growing near motor roads were used. Leaf samples were taken from the two tobacco-growing areas of Akhisar and Soma in order to determine the environmental effects of the Soma Thermal Plant and the increasing vehicular traffic in recent years due to industrialisation; and the levels of lead accumulation in these samples were measured. Lead accumulation depends on many diverse factors such as traffic load of the road, wind direction, topographic features of the area, etc. The sampling locations on 5-8-2002 were; Akhisar-Gökçeahmet (Istanbul Highway), Akhisar-Süleymanli (Kirkağaç-Soma Minor road), Soma-Turgutalp (Junction of Turgutalp and Savaştepe Roads). The samples were collected at distances of 0-10-20-50-100 m from the road and from the 1st, 4th, 8th, 12th rows of each distance. Sixty leaf samples were oven-dried for 24 h at 80°C and then were ground before undergoing

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the process of mineralization. For mineralization the samples were measured to weigh 5 g each and then put into Kjeldatherm tubes mixed with HNO_3 and $HCLO_4$ (Riedel reagent grade) (3:1v/v). This solution was then left overnight. The following day, these samples in kjeldatherm tubes were subjected to the process of burning by gradual heating. Initially, a reddish-brown acid evaporation was observed, which later turned to white and finally became transparent towards the end of the process. Following this, the cooling process took place in the oven. Later, the filtering process was carried out, using 100 mL flasks topped with funnels in which blue filtering paper was placed. The samples were filtered 4 times by rinsing with hot distilled water. Each time, 20 mL of hot distilled water was used for the process. The filtered samples were left to cool down for ~1-1 ½ h to room temperature; and then distilled water was added to form a 100 mL solution[2]. The 60 samples that underwent mineralization were then read at the AES-ICP device (Varian-Libertg-Series II) for the measurement of their lead concentrations.

RESULTS AND DISCUSSION

It was generally observed, according to our findings, that there was a drop in lead concentrations in tobacco leaves with increasing distance from the road. In Akhisar-Gökçeahmet, lead concentrations at 0-10-20-50 m from the road were found to be higher than those at 100 m from the road. In Gökçeahmet, the chosen field location lay 2 m below the road level and had flat topographic features. Here it was observed that lead concentration in leaves decreased with distance from road (Fig. 1).

Along Kirkağaç road (Süleymanli), the tobacco leaf samples collected at a distance of 100 m from road showed higher lead concentrations than expected. This was due to the location of the field. The tobacco field at Süleymanli had flat topography; it was, however, level with road. The highest concentrations here were measured at 10 m from the road. The figures were found to be lower at 50 m however, they went slightly up at 100 m from the road. This rise was attributed to the smoke carried by winds from the Soma Thermal Plant (Fig. 2).

In Soma however, the tobacco field was chosen alongside Turgutalp road at location where the road turned towards Savaştepe. The field is located 4 m below the road. Samples picked at 50 and 100 m from Turgutalp road showed higher lead concentrations due to the increase in vehicular exhaust emissions as the vehicles slowed at the junction of Turgutalp and Savaştepe roads. Therefore, in Turgutalp, the lead concentrations in the leaves sampled at 50 and 100 m from the road (i.e; at the

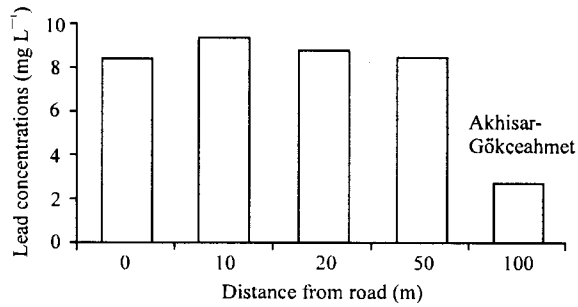

Fig. 1: Lead concentrations (mg L^{-1}) in relation to distance from Istanbul highway in Akhisar-Gökçeahmet

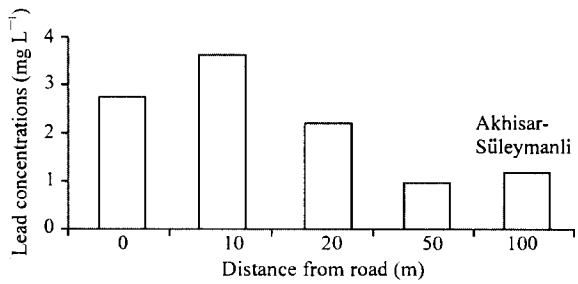

Fig. 2: Lead concentrations (mg L^{-1}) in relation to distance from Kirkağaç-Soma Minor road (In Akhisar-Süleymanli)

junction) were slightly higher than those in the samples picked at 0-10-20 m (Fig. 3).

When all the sampling locations were compared, the highest concentrations were found at Gökçeahmet, where the field was located next to Istanbul Highway (Fig. 4).

The readings at ICP showed lead concentrations varied depending on the distance from road and the impact of the Soma Thermal Plant. The lead concentrations in the samples collected near Akhisar-Gökçeahmet road were higher than those sampled from Akhisar-Süleymanli.

On the other hand, the figures for Soma-Turgutalp were relatively lower because there is little traffic in Soma during summer months when compared with other sampling locations. Yet, Soma is directly affected by emissions from the thermal plant, which are carried even by a soft breeze on a bright and clear day. The ash can be carried as far as Kirkağaç-Akhisar plain which is 60 km distance away[3]. Therefore, it is obvious that at Turgutalp emission from the thermal plant has a greater effect on lead contamination than vehicular traffic. Lead, which is a heavy metal, has adverse effects on plants. It hinders plant growth and causes a decline in agricultural output.

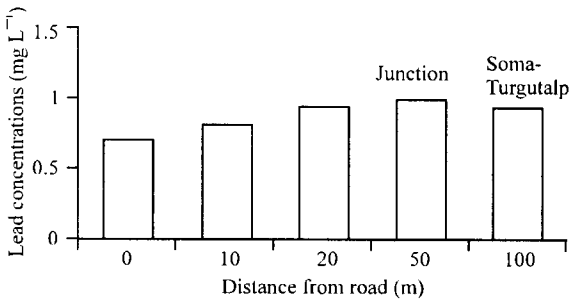

Fig. 3: Lead concentrations (mg L^{-1}) in relation to distance from Soma-Turgutalp road (Turgutalp-Savaştepe junction)

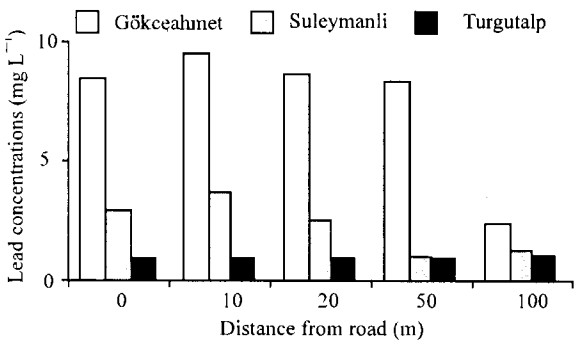

Fig. 4: Lead concentrations (mg L^{-1}) in relation to distance from the road in the towns of Akhisar and Soma

Lead is found to be accumulated more in those plant organs which generally have a wider surface and a more intensive gas exchange with the atmosphere-eg. tobacco leaves. Many studies carried out in Turkey have shown that lead accumulation is more on the leaf blade than in the fruit or the stalk. A study of heavy metal accumulation was carried out in herbaceous plants collected in the vicinity of Kuşunhan settlement, which is located at the 40th km of Konya-Çumra Highway. It was determined that accumulation of heavy metals, such as lead and zinc, varied with the distance from the road, traffic load of the road and wind direction. Maximum heavy metal accumulation was observed in plants growing alongside the road and at junctions[4]. Lead is found to have reached dangerous levels particularly in the immediate surroundings of motor roads and at marshlands where intensive hunting activity takes place. Some of the most-commonly grown plants near the Aydin-Muğla-Denizli Highway were studied during the high tourism season, when motor vehicle traffic is heaviest; and it was found that concentrations in these plants reached 6.5 mg per litre. The same plants sampled at a distance of 100 m from the road showed much lower concentrations[5]. Lead accumulation due to vehicular exhaust was studied in the species of *Gramineae* and *Taraxacum* sp. growing at various road junctions in Ankara; and the lead levels in root and leaf samples were measured. The results from the samples growing at Tandoğan junction showed a lead concentration of 35 mg/1000 g on the leaves[6]. Chicory and sorrel plants from the 16th km of Kayseri-Kirşehir highway were used to investigate heavy metal pollution due to motor vehicle traffic. Lead concentrations were measured in the leaf samples picked at 0-25-50-100-200-400-800-1600 m from the road: The levels of contamination on the leaves sampled at 0 m from the road were 19 mg/1000g in the chicory plant and 13 mg/1000 g in the sorrel. It was observed that the leaves of chicory plant, which have a hairy surface accumulated more lead than sorrel leaves which are smooth[7].

As a result environmental pollution, both in Turkey and the world, is brought about by various factors and this pollution endangers all living organisms.

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