

# Impact of road traffic near the roads on the cypress in the region of Annaba Algeria

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**Abstract :** Air pollution especially of lead has steadily evolved over time, due to the increase in the number of vehicles on the market. Our research is based primarily on the use of a species phanérogamique "*Cupressus sempervirens*" as bioindicator of air pollution on the three major highways serving the city of Annaba. An appropriate sampling strategy, a spatio-temporal monitoring and measurement of physiological parameters by the combined determination of lead allowed us to assess not only the state of air quality but also the impact of this pollution generated by heavy traffic in this region.

Statistical analysis of results brings up correlations ranging from significant to very highly significant between the measured parameters and lead levels in the bio indicator by site and months of experimentation..

**Key words:** pollution, lead (shot), *Cupressus sempervirens*, bio indication, bio accumulation, road traffic, Annaba.

## Introduction

The air pollution arouses since a few years an interest growing as well among the leaders as within the population. The technological progress and the development of the branch of industry by way of the fast push of the urbanization are at the origin of a ceaselessly increasing infringement towards the air quality. Among the sources (springs) of pollution, we can quote the means of transportation, in particular the motor vehicles.

In Algeria and especially in the region is from the country, there is for several years a progressive problem of atmospheric pollution in particular plombique bound to important road networks (Semadi et Decormis, 1986 ; Maizi, 2006). In the region of Annaba, it is easy (well-to-do) to notice that we have a real problem of pollution on one hand because of the existence of a very important motor vehicle population (car fleet) with regard to the crossed distances, and on the other hand certain topographic and climatic characteristics which create a climate convenient to the development of the pollution (Alioua, 2001 ; Bouregghda, 2004). Since the seventies of numerous searches (researches) were led on the use of the indicator and organic vegetables as the bio accumulators of the pollution in particular that some heavy metals (Semadi et Deruelle, 1993; Alioua et al., 2008). Our search on the study of the pollution plombique of automobile origin in the region of Annaba by using in a relevant way bio-indicators, in particular cypress in the objective to characterize the environmental state of the environment studied by bringing to light a plombique pollution bound to the road traffic, to study the impact of this last one on the morphology and the physiology of the used vegetable and to propose bio relevant indicators of this pollution.

## Materials and methods

The city of Annaba is considered as being one of the cities the most polluted on the national territory and in the North of Africa, the main broadcasting(issuing) source(spring) of the lead(shot) is the road traffic which evolves in a disturbing rhythm.

The problem of the atmospheric pollution to Annaba bound(connected) to the presence of several industrial units and to the intense road traffic is deteriorated(aggravated) by its geographical position (in basin), factor(mailman) which favors the accumulation and the stagnation of atmospheric pollutants and exposes(explains) consequently the inhabitants to a sanitary risk.

The city is structured around a main center, the city center. This last one desired by the citizen, as well as by the planner is the space the most frequented by the city. The central space of the city does not take care only of the population of Annaba but also the populations of the bordering urban areas (conglomerations), all the activities are there present of businesses, presence of markets (walked/worked) El Hattab) presence of offices (desks), presence of stations (resorts) of taxis, presence of station (resort) of public transportation (Hacini-Chikh, 2008).

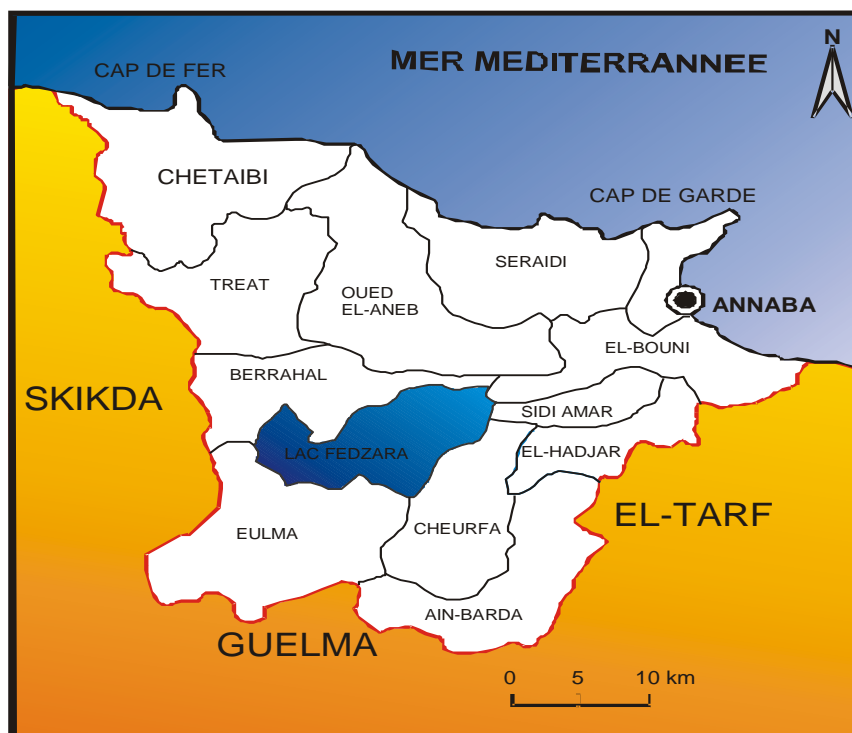
The population of the wilaya of Annaba did not stop increasing during these last years to reach (affect) 650 000 inhabitants where we register (record) moreover an annual average of growth closely 1,01 % and an irregular distribution of the population with a variation of the density from a municipality to the other one. The axis Annaba - Sidi Amar and El Bouni represents the sites where the majority of the population are concentrated (44, 65 % to Annaba, 20, 04 % to El Bouni and 12, 80 % to Sidi Amar).

The socioeconomic characteristics (commercial, industrial, university pole and the quality of the services are factors limiting some distribution of the population (P.D.A.U., 2008).

Nowadays we find an automobile city, the annual growth rate of car registration documents is only increasing year by year especially between year 2002 and 2003 or the rate increases considerably 0,92 it passes in 3,57 (Hacini-Chikh, 2008). In 2005, the vehicle of tourism is 68 % with regard to the other ways of transportation. Compared with the other Algerian wilayas Annaba is classified second after the capital with a park automobile reaching (affecting) 100 000 vehicles (P.D.A.U., 2008), With 94 passenger cars for 1000 inhabitants and exceed (overtake) widely Constantine and Oran which (who) are respectively 79 and 81 cars for 1000 inhabitants (Semaly – Transurb in Hacini-Chikh, 2008).

Since 2003 we would have an acceleration of motorization (+ 9 %), this acceleration rose during the last years when we registered respectively an increase (+ 14 %) in 2004 and (+ 42 %) between years (on 2004 and 2008).

### 1- Presentation of the zone of study:



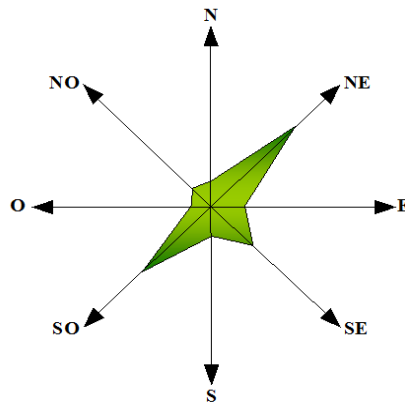
The city of Annaba is situated east of Algeria between the latitudes (36 30) the North and (37 30) the North, and the longitudes (07 20) is and (08 40) is, with 12 municipalities of a total surface of 1411.98 Km<sup>2</sup>. She is limited by the Mediterranean Sea to the North, the wilaya of Skikda on the West, that of Guelma to the South and El Tarf in the East (Figure 1).

**Figure 1:** Geographical localization of the region of study ( Annaba).

### 2- The climatic parameters::

Certain climatic parameters are considered in our study because they have a role particularly mattering in the distribution and the dilution of the impurities.

- The city of Annaba presents in general Mediterranean features of type with bioclimatic floors sub humid and wet.
- She(it) is characterized by soft temperatures in winter, warm in summer with an annual average temperature of 17.89°C, an annual average maximal temperature of 23.78°C and finally an annual minimal temperature of 12.76°C and plentiful precipitation, the annual pluviometry is of 654,64mm.
- The wind rose allowed us to bring to light a dominant direction of the Southwest North-East wind (**Figure 2**).



**Figure 2:** The wind rose of Annaba established on an average of 10 years (on 1999 - 2008).

### 3- Choice of the sites of surveillance and the bio accumulators of the pollution:

#### 3.1- Choice of sites

Generally, for better connaitre the levels of pollution, it is important to set up networks of taking, by trying to choose well exposed sites, in number sufficient(self-important). The analysis of the built-up area of Annaba allows to distinguish in the global scale three expanding main trunk roads of growths and development and which converge on the city center of Annaba:

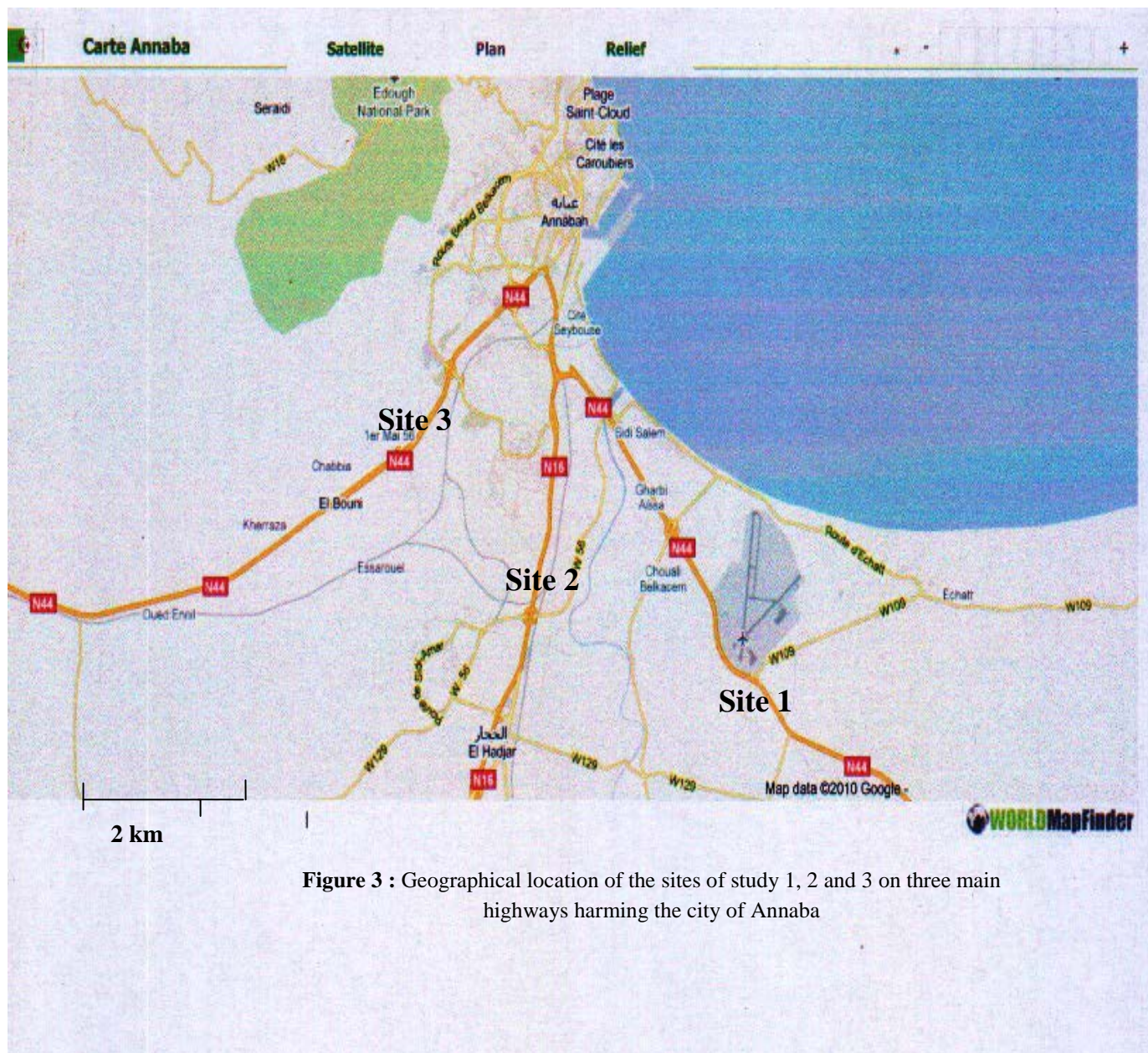
- The axis RN 16 which connects the big and former(ancient) two poles Annaba and El Hadjar,
- The axis RN 44 - is connecting Annaba with El Tarf,
- The axis RN 44 - the West connecting Annaba to Constantine.

The road stich of the urban area is marked by three radial roads, the RN44 is which goes on the scale of the city center by penetrating the West and the RN 16 which goes on by the North-south axis and The RN 44 - is.

The evaluation of the levels of pollution near the axes of traffic is a complex exercise, considering the numerous factors to be considered in this scale. The concentrations in pollutants registered in border of way indeed depend on local emissions generated by the car traffic (depending themselves on conditions of traffic and on the composition of the motor vehicle population parameters influencing the dispersal of pollutants (local meteorology and configuration of public road network(garbage dump)) and levels of thorough concentration of the surrounding zones.

We chose three sites localized on three main highways harming the urban area of Annaba (**Figure 3**):

- Site 1: (R.N. 44): Annaba-El Tarf, he is approximately 4 km in the Southeast of Annaba.
- Site 2: (R.N. 16): Annaba-EL Hadjar. He was chosen in 5 km in the South of Annaba.
- Site 3: (R.N. 44): Annaba-Constantine: he was realized in 3 km in the Southwest of Annaba.



**Figure 3 :** Geographical location of the sites of study 1, 2 and 3 on three main highways harming the city of Annaba

### 3.2- Choice of the botanical species:

Our choice concerned a phanérogamique sort “in situ “, it is about the cypress (*Cupressus sempervirens*), it is the most representative vegetable of the region.

This vegetable is homéohydre, that is the moisture content of the vegetable remains relatively constant during all its existence, whatever are the variations of the hygrometric state of the air(sight) and the moisture content of the ground (Gorenflot, 1998).

### 4- Appreciation of the road traffic:

The counting of vehicles was made at the level of our three sites of study in the region of Annaba. We chose a site of just counting of vehicles next to the phanérogamique sort chosen, object of our study. This counting was thus made at the rate of three times a day, once quite week, the monthly average being taken into account and it during 07 months as from the month of Mars 2008.

### 5- Technique of takings of samples:

To realize our sampling, we operated at a height varying 1, 50 m and 2 m of the ground. We took, every time 10 in 20 sepals around of the tree at the level of man to have a homogeneous average sample.

The taken samples are placed in plastic labeled bags carrying all the indications (in particular date and place of taking), closed by means of an elastic(rubber band) to limit the losses of water by evapotranspiration until the arrival to the laboratory.

### 6- Analytical techniques:

- After drying of samples in the steam room in 105°C, they are carefully crushed, put in piluliers where they are treated by the peroxide of hydrogen (hydrogen peroxide) until complete mineralization. The recent dosages of the lead were made by using the technique of spectrophotometry of atomic absorption ( S.A.A). The measures were made from the solutions of 20ml of nitric acid for 2 %. For the same solution, three measures are made, the average being considered. Before proceeding to the dosage of the lead in samples, it is necessary to establish at first a curve of calibration from the solutions of lead known concentrations. The results are directly read on the device if it is preset according to the indications of the builder or on the curve of calibration in microgram of lead. The used device is a spectrophotometry (Perkin-Elmer model 400) - For the dosage of the chlorophyll, we used the method proposed by (Rao & Le Blanc, 1965), the used device is the spectrophotometer in two wavelengths 645nm and 663nm (GenesysTM 8).

- The method used for the dosage of the proline is the one (Troll & Lindsley, 1955) Simplified, finalized by (Dreier & Göring, 1974). The used device is the spectrophotometer in the wavelength 528nm (GenesysTM 8).

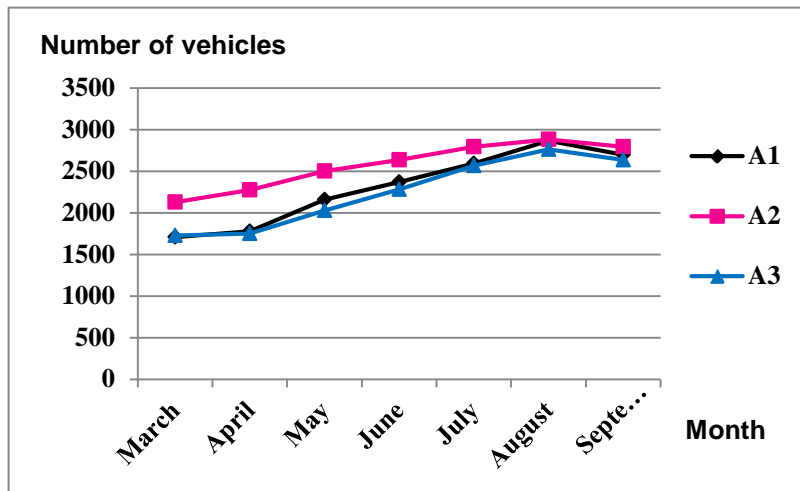
- Having taken the fresh samples, we weighed 1.5gr of fresh material then put in the steam room in 105 °C during 72 hour to determine the dry material. So the report M.F. / M.S. An idea onto the purity of the air of the site in question, more is defined to give us the air is pure is more the development of the vegetable is normal that is the Fresh material is in its optimum on the other hand if the air is polluted it entrained of the demonstrations of chloroses, necroses to the detriment of the Fresh material (Semadi, 1983).

### 7- Statistical analysis of the data:

The tests of analysis of the variance in two criteria of classification were used to make a comparison for every characteristic between sites on one hand and between months of experiment on the other hand (Dagnelie, 1999). All the calculations were realized by the command of stepwise of the software MINITAB.

**Results**

**1- Variation of the monthly average of the road traffic during rush hours near 03 main highways.**



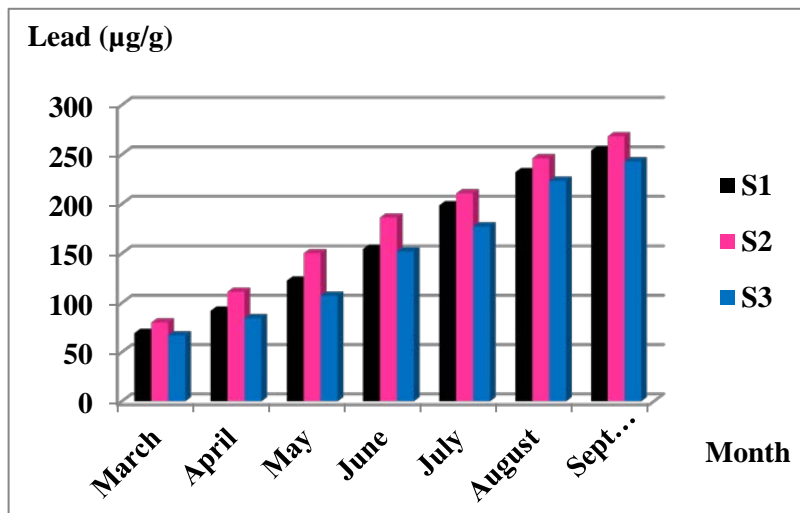
Especially at the level of the axis 2 (Fig. 4). This is bound to the environment of the axis and to its characteristics (surrounded with several important equipment's: commercial, industrial, urban areas etc.), thus the axis 2 seems the most frequented.

The analysis of the variance in two criteria of classification relative to the spatiotemporal variation of the road traffic at the level of three axes harming the urban area of Annaba during rush hours shows that this last one is significant in the space ( $p = 0,000$  \*\*\*) and in the time ( $P = 0,000$  \*\*\*) .

**Figure 4:** Variation of the monthly average of the road traffic at the level of three axes harming the urban area of Annaba during rush hours by *Cupressus sempervirens*

**2- Results obtained to the bio indicator:**

**2-1- Lead**



For the cypress, the accumulation of the lead is very clear some is the site; it increases gradually between June and September (Fig. 5). Although at the level of the site 2 the vegetable seems to accumulate more lead, this is certainly connected to the volume of road traffic as well as has the environment of the site.

The analysis of the variance in two criteria of classification relative to the spatiotemporal variation of the lead(shot) accumulated by *Cupressus sempervirens* show that this last one is very highly significant in the time(weather) ( $p = 0,000$  \*\*\*) but it is only significant in the space ( $p = 0,011$  \*).

**Figure 5:** Spatiotemporal variation of the lead accumulated by *Cupressus sempervirens*

2.2- The chlorophyll:

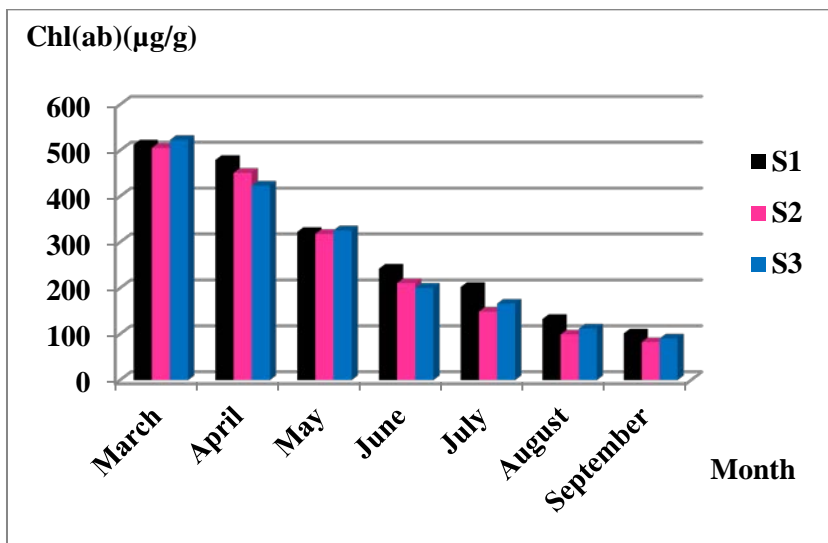


Figure 6: Spatiotemporal variation of the chlorophyll (ab) at Cupressus sempervirens

Further to the results obtained as regards the average content of the chlorophyll ( ab ) at Cupressus sempervirens and represented by the fig. 6, we notice a fluctuating variation during the months of study by all the sites. It's the same for the comparison of the spatiotemporal variation of the chlorophyll (ab) at Cupressus sempervirens who shows that there is a very highly significant variation in the space (p = 0,000 \*\*\*) and in the time (0,000 \*\*\*). That is the content in chlorophyll to the vegetable depends on the position of the site and on the time of exposure although the more the time of exposure is long and the more the content in chlorophyll is less.

2.3- La proline :

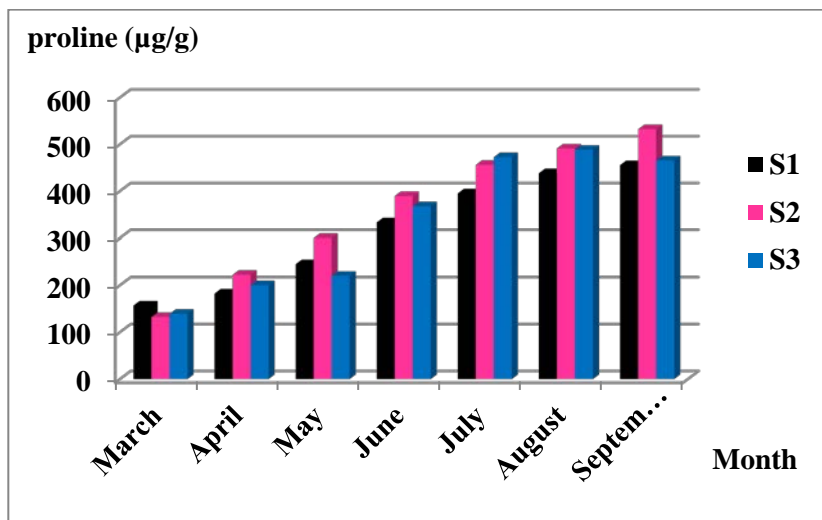
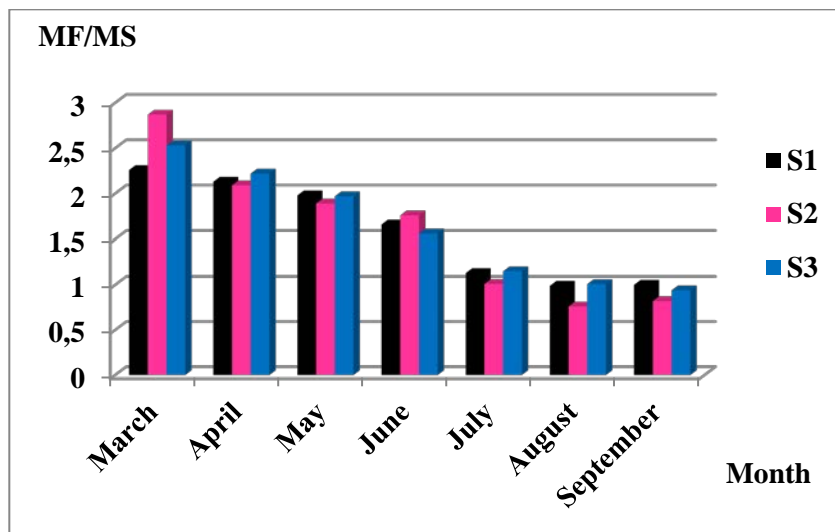


Figure 7 : Variations spatiotemporal of the proline at Cupressus sempervirens

According to the results illustrated in the fig. 7, we notice that the rate of the proline at Cupressus sempervirens increases from the first taking, this increase persists until the seventh taking; this is probably due to the stress of the vegetable provoked by the accumulation of pollutants. The comparison of the content average of the proline at Cupressus sempervirens shows that the variation of the proline is very highly significant in the time (p = 0,000 \*\*\*) when in the space (p = 0,000 \*\*\*), stalled means that the contents it proline vary according to time and of the site.

#### 2.4- MF/MS :



**Figure 8 :** Variations spatiotemporal of the report MF / MS at Cupressus sempervirens.

La figure 8 show that the report MF / MS at present Cupressus sempervirens of the fluctuations from March till June then stabilizes the rest of the months of study. We also notice that there is no big variation between both sites 1 and 3. This is doubtless due to the sustainability of the always green sort.

As regards the comparison of the spatiotemporal variation of the relationship MF / MS at Cupressus sempervirens, we notice that it is not significant in the space ( $P = 0,220$ ) whereas it is very highly significant in the time ( $p = 0.000$  \*\*\*).

## Discussion

Considering its geographical position (in basin), Annaba is a coastal city characterized by a high rate of humidity throughout the year, an important pluviometry with the risks of temperature inversion which create a climate convenient to the development of the pollution.

Concerning the relative results in bio surveillance of the pollution plombique near main highways, we notice that: by comparison of the volume of traffic long-distance truck driver at the level of three axes for the same schedules of counting, we notice at first by the sites 1 and 3 that there is so difference according to the schedules of counting, on the other hand the difference is smelt at the level of the site 2 where the road traffic seems more intense during rush hours. Indeed this site harms the city El Bouni, the urban areas of El Hadjar, Sidi Amar, Chaïba, the University and the steel-making Complex as well as the other destinations towards Guelma and Souk Ahras; this is understandable by the importance of these urban areas and infrastructures harmed by these strongly frequented roads.

Concerning the accumulation of the lead(shot), the results(profits) which we obtained demonstrate well the presence of a strong plombique pollution of automobile origin, revealed to the cypress (Cupressus sempervirens) at the level of the site 2, where the road traffic is the most intense, Cupressus sempervirens accumulates 268,33  $\mu\text{g} / \text{g}$  the September. These results denote a strong accumulation to the sorts in the persistent foliage.

This is approved by (Madany and al., 1990) which demonstrate that the emitted particles are better got by the rough surfaces where embossed and the presence of a pilosity which favors their retention that by the smoother skins where covered with cuticles for the same site and the same exposure in the automobile pollution. So (Little and Martin, 1974), notice that the rough sheets can collect ten times more lead(shot) than the smoother sheets. Par ailleurs, nous enregistrons une accumulation temporelle nette de plomb entre le mois de mai et le mois de septembre, soit pendant la période de sécheresse. Nous considérons en général que les précipitations durant le mois de mars et avril ont tendance à lessiver les polluants particulaires au niveau du feuillage, ce qui va influencer la concentration en plomb accumulé.

Thus dusts, containing heavy metals, accumulate on the air parts, particularly the sheets. This deposit of surface of leaves can be qualified as latent pollution because the cuticle is considered as a waterproof barrier which opposes to the penetration in leaves. (Arvik et Zimdahl, 1974) Showed that very fine lead particles could penetrate into stomate, but it is improbable that big lead quantities penetrate in this way and this process can be responsible only for a low part of the contamination of leaves by the lead.



However, when leaves age, the efficiency of this barrier is distorted, it appears microphone cracks and pollutants which remain normally on-surface can easily penetrate. Therefore, lead particles put deposited on the surface of leaves do not practically penetrate inside and can be easily washed.

This upper vegetable indeed shows of the air quality thanks to its power accumulator. However this last rest always function of the nature of the species (its morphology, its vegetative cycle), of the exposure time, the intensity of the pollution, and to the environmental factors such as the direction of winds, the precipitation, the humidity .etc. The spatiotemporal follow-up of the moderate physiological parameters (content in chlorophyll, it proline and the report MF / MS), indeed testifies of the air quality of every site.

The follow-up of the counting of vehicles on three road main trunk roads harming(serving) the urban area(conglomeration) of Annaba demonstrated well to us the volume of road traffic the most marked on the R.N.16Annaba - El-Hadjar and not insignificant on the other axes. The statistical processing allowed well us to classify its main highways.

## Conclusion

The explanation of all these results integrates all the parameters of the environment, susceptible to influence on one hand the dispersal of pollutants such as the topography of sites, the direction and the wind speed, the situation of the road: the case of the axis 2, where the road is taken by the urban areas of El Bouni and Sidi Amar, the infrastructures of the industrial park thus pollutants tend to stagnate around the road. So the presence of trees near the road is also a factor of retention of pollutants. And on the other hand, the variation of the physiological parameters of the used vegetables of which the lead is a part but is not the only person in charge, so the other pollutants can interferes view the presence of several polluting infrastructures. However, all the species of a perimeter affected by a pollution do not react in the same way to pollutants. They are intrinsic factors in plants, morphological where physiological, which determine the resistance, the tolerance where the sensibility of plants. Other factors bioticks aged-related, at the physiological stage can intervene in the sensibility of vegetables in this plombique pollution.

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