World Journal of Agricultural Sciences 2 (2): 00-00, 2006
ISSN 1817-3047


# Monitoring of Changing Chlorophyll Content of *Buxus sempervirens L.* and *Euonymus japonica L. fill* Leaves Affected with Air Pollutants in Ankara

*Mehmet Sayım Karacan*

Department of Chemistry, Gazi University, 06500, Teknikokullar, Ankara, Turkey

**Abstract:** Chlorophyll concentration of a leaf is strongly affected by numerous external factors, for example; light and pollutants etc. Therefore, their quantitative determination, in different objects, is specially recommended. Chlorophyll content of *Buxus sempervirens* and *Euonymus japonica* leaves in different localities which exposed air pollutions of vehicle traffic and rural have compared throughout eight month between October/2002 and May/2003. Chlorophyll contents of *Buxus sempervirens* and *Euonymus japonica* were observerd lowest level between November and January, these results were compared CO NOx and $SO_2$ concentrations in the same time. Chlorophyll content is seemed inverse proportion with air pollution.

**Key words:** Chlorophyll content · seasonal changing · air pollution indicators · *Buxus sempervirens* · *Euonymus japonica*

## INTRODUCTION

Photosynthesis is the main process that transforms light energy coming from the Sun to the forms of energy that can be utilized directly by living organisms, thus making life on the Earth possible. Photosynthesis is the most important mechanism for earth and its vital product is oxygen.

Higher plants contain chlorophyll a (the major, yellow-green pigment), chlorophyll b (blue-green), accessory pigments and several additional forms of chlorophyll.

Both chlorophyll a and b pigments are associated with light harvesting processes at the antenna. Mining, smelting, metal-working and some other industries, as well as intense urbanization, cause environmental pollution with heavy metals and, eventually, environment degradation.

Numerous authors demonstrate a rapid chlorophyll content response to internal as well as external factors [1].

Photosynthetic activity is inhibited by winter condition and the recovery of photosynthesis from winter inhibition is influenced by the nutrient status of green plants [2]. It may take several months of growing season before photosynthesis is fully recovered [3].

Environmental conditions affect photosynthetic activity like topographic position, temperature, sunshine, air pollution, soil moisture etc., [4]. Photosynthesis yield of green plants is especially changed by light in the same way by season. It is known that photosynthetic yield of green plants decreased in winter depending on lower light and temperature. Photosynthesis slows at low temperatures. Since photosynthesis is slowed, growth is slowed and this results in lower yields. Moreover air pollution is also affected as decreasing factor. Chlorophyll content is an important indicator for photosynthesis yield.

Knudson *et al.* [5] suggest that chlorophyll content could be a useful indicator for the evaluation of injury induced by pollutants. Therefore, the variation in chlorophyll content has been used in many studies in order to investigate the effects of pollutants on plants [5-9].

Decrease in the chlorophyll content of leaves, following exposure of plants to ozone, has been reported in many species such as *Nicotiana tabacum L.* [10], *Avena sativa L.* [8] and *Hedera helix* [9]. Price *et al.* [11] found no differences in the relative reduction of chlorophylls *a* and *b*, although both chlorophyll forms decreased by 20-40% in barley exposed to 200 ppb of $O_3$.

The aim of this study was to compare chlorophyll content of *Buxus sempervirens* and *Euonymus japonica* leaves in different localities which exposed air pollutions sourced by the vehicle traffic and rural between October /2002 and May/2003.

**Corresponding Author:** Dr. Mehmet Sayım Karacan, Department of Chemistry, Gazi University, 06500, Teknikokullar, Ankara, Turkey E-mail: mkaracan@gazi.edu.tr

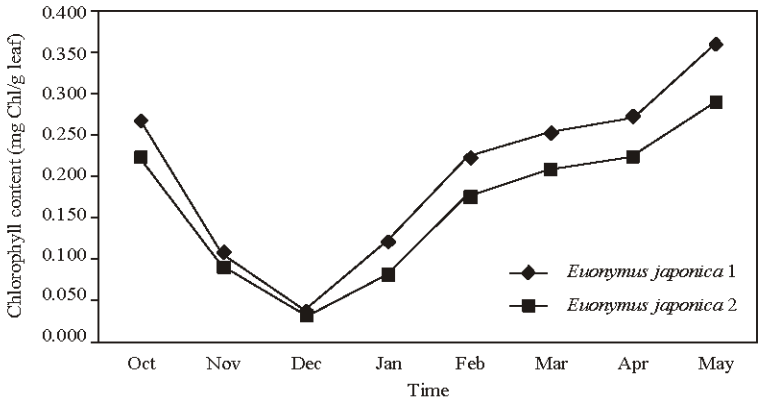


Fig. 1: Chlorophyll content changes of *Euonymus japonica* sample from October to May

## MATERIALS AND METHODS

Evergreen *Buxus sempervirens L.* [Buxaceae] and *Euonymus japonica L.* [Celastraceae] leaves were chosen as material which never shed leaves. Leaves sample were picked up from October /2002 and May/2003. *Euonymus japonica L.* and *Buxus sempervirens L.* leaves were picked up from two different localities, first[1] has no traffic in the rural fields (30 km outside of Ankara) and second[2] has heavy traffic of vehicles (Tandogan in Ankara).

Each leaf sample was weighed 20 g and chloroplast was extracted to according to a procedure described by Whatley [12]. The chlorophyll content of the samples was determined spectrophotometrically according to Arnon [13] and results were given as mg Chl/g leaf.

The chlorophyll content was assayed with a UV-Visible spectrophotometer (Unicam UV2-100). Each sample was measured three times in the same conditions and results were given as average of three value.

## RESULTS AND DISCUSSION

**Chlorophyll content changing of *Euonymus japonica* sample from October to May:** Chlorophyll content of *Euonymus japonica* has been decreased dramatically from October to December as depend on sunshine and temperature in winter. There was a dramatic increase after December towards May depend on get sunshine (Fig. 1 curve 1).

Chlorophyll content of sample[1] and sample[2] has been declined significantly between October and December (Fig. 1, curve 1 & 2). It has reasonable results because of Sun light decreases gradually during in this period. A leaf chlorophyll concentration is strongly affected by numerous external factors and they have also included light. They reached a minimum on the December, after December both of them have been increased sharply until February and then there was a steady increase from February to May. Lower chlorophyll concentrations were found in sample[2] which exposed air pollutions of vehicle traffic more than rural sample[1]. It has shown that air pollution has decreased photosynthetic yield of plants almost 20% (Fig. 1) for all months investigated.

**Chlorophyll content changing of *Buxus sempervirens* sample from october to may:** Chlorophyll concentrations of rural sample[1] and urban sample[2] have been declined considerably between October and January. It has reasonable results because of Sun light decreases steadily. Chlorophyll concentrations reached a minimum on the January. They remained almost constant stable from January to February. After February both of them have been increased sharply until April and then there was a steady increase from April to May.

In the *Buxus sempervirens* leaves sample[2] which exposed air pollutions of vehicle traffic, has shown less concentrations than sample[1]. Air pollution has decreased chlorophyll contents of *Buxus sempervirens* between 24 and 9%.

All of results have shown that Chlorophyll content of *Euonymus japonica* and *Buxus sempervirens* dropped in winter considerably because of low sunlight intensity and low temperature. In Ankara, sometimes temperature drops about -20°C in winter season. Moreover air pollution was also decreased chlorophyll content of leaf in winter (Fig. 1, & 2; curve 2). Most of CO and NOx are a component of motor vehicle exhaust. Highest level of CO, NOx ($NO+NO_2$) and $SO_2$ concentrations are especially on November, December

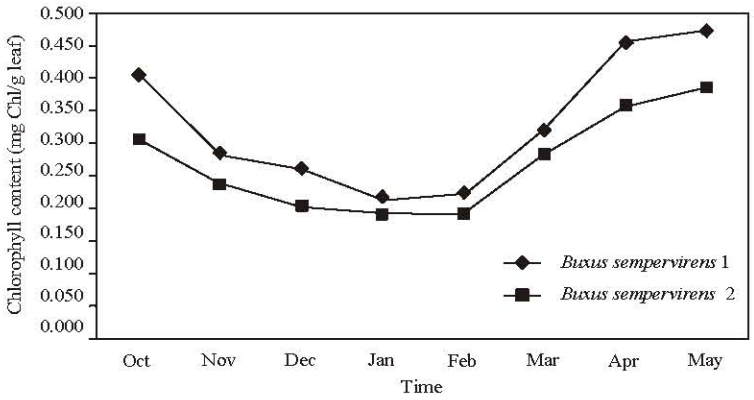


Fig. 2: Chlorophyll content changes of *Buxus sempervirens* samples from October to May

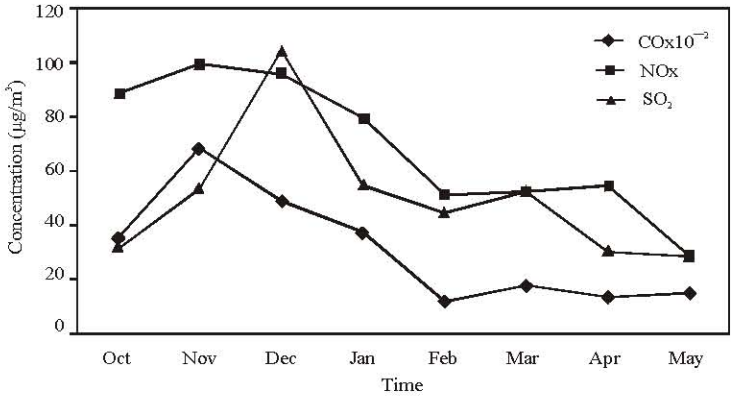


Fig. 3: CO, NOx and $SO_2$ Concentration in Ankara Between Oct/2002 and May/2003
Figure 3 was obtained from www.rshm.saglik.gov.tr data which is monitored air pollution in Ankara

and October in Ankara (Fig. 3). Thus, air pollution has a dropping effect on the photosynthetic activity of plants. *Euonymus japonica* would use more suitable as biomonitor than *Buxus sempervirens* because of more stable chlorophyll content dropping with air pollutant. Consequently, If we measure and monitor chlorophyll content of evergreen plants throughout year we will monitor the air pollution changes in the city. This methods could be supported more simple mobile instruments.

## REFERENCES

1. Ferus, P. and M. Arkosiová, 2001. Acta fytotechnica et zootechnica, Special Number "Variability of chlorophyll content under fluctuating environment". pp: 123-125.
2. Strand, M. and T. Lundmark, 1995, Recovery of photosynthesis in 1-tear old needles of unfertilized Norway spruce (*Picca abies* (L) Karst during spring. Tree Physiol., 15:151-158.
3. Linder, S. and E. Troeng, 1980. Photosynthesis and respiration of 20-year-old Scots pine. In: Persson T. (Ed., Structure and Function of Northern Coniferous Forests - An Ecosystem Study Ecol. Bull., 32: 165-181.
4. Tange, T., 1996. Seasonal changes in photosynthesis of young Cryptomeria japonica growing on ridges and foot slopes, Forest Ecology and Management. 89: 93-99.
5. Knudson, L.L., T.W. Tibbitts and G.E. Edwards, 1977. Measurement of ozone injury by determination of leaf chlorophyll concentration. Plant Physiol., 60: 606-608.
6. Kobriger, J.M. and T.W. Tibbitts, 1985. Effects of relative humidity prior to and during exposure on response of peas to ozone and sulfur dioxide. J. Am. Soc. Hortic. Sci., 110: 21-24.
7. Robinson, D.C. and A.R. Wellburn, 1991. Seasonal changes in the pigments of *Norway spruce* and *Picea abies*. Karst and the influence of summer ozone exposures. Trans L. New Phytol., 119: 251-259.

8. Pleijel, H., L. Skärby, K. Ojanperä and G. Selldén, 1994. Exposure of oats, *Avena sativa L.* to filtered and unfiltered air in open-top chambers: effects on grain yield and quality. Environ. Pollut., 86: 129-134.
9. Della Torre G., F. Ferranti, M. Lupattelli, N. Pocceschi, A. Figoli, C. Nali and G. Lorenzini, 1998. Effects of ozone on morpho-anatomy and physiology of Hedera helix. Chemosphere, 36: 651-656.
10. Adedipe, N.O., R.A. Fletcher and D.P. Ormrod, 1973. Ozone lesions in relation to Senescence of attached and detached leaves of tobacco. Atmos. Environ., 7: 357-361.
11. Price, A., A. Young, P. Beckett, G. Britton and P. Lea, 1990. The effects of ozone on plant pigments. In: Balscheffsky, M. (Ed.), Current Research in Photosynthesis, vol. 4. Kluwer Academic Publishers, Dordrecht, pp: 595-598.
12. Whatley, F.R. and D.I. Arnon, 1963. Methods in Enzymology, Academic Press, New York, l: 308.
13. Arnon, D.I., 1949. Plant Physiology, 24: 1-15,
Air Pollution data of Ankara, http://www.rshm.saglik.gov.tr/hki/hki.htm