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

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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 pollution 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 observed lowest level between November and January, these results were compared CO NOx and SO2 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 O3.

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.

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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 has no traffic in the rural fields (30 km outside of Ankara) and second has heavy traffic of vehicles (Tandogan in Ankara).

Each leaf sample was weighed 20 g and chloroplast was extracted 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 sample1 and sample2 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 sample1 which exposed air pollutions of vehicle traffic more than rural sample2. 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 sample1 and urban sample2 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 sample1 which exposed air pollutions of vehicle traffic, has shown less concentrations than sample2. Air pollution has decreased chlorophyll contents of *Buxus sempervirens* between 24 and 99%

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+NO₂) and SO₂ concentrations are especially on November, December
Fig. 2: Chlorophyll content changes of *Buxus sempervirens* samples from October to May

Fig. 3: CO, NOx and SO₂ Concentration in Ankara Between Oct/2002 and May/2003

Figure 3 was obtained from www.nshm.saglik.gov.tr data which 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 a year, we will monitor the air pollution changes in the city. This method could be supported by mobile instruments.

REFERENCES


