ACTIVITY REPORT OF SHORT VISIT OF DR. DR. TSONKO TSONEV UNDER THE SPONSORSHIP OF CNR-STM 2011

Dates of Visit: 3 - 12 May 2011.

The aim of the short-term mobility program was to contribute to evaluation of the impact of elevated temperatures associated with fires, on the emission of volatile organic compounds by two Mediterranean plant species and to clarification of the relationships between volatile organic compounds (VOC) emissions and plant flammability.

Biogenic volatile organic compounds (VOC) emissions and plant flammability were studied in 3-4-years-old *Quercus Ilex* and *Eucalyptus Citriodora* plants. Detached leaves with preliminarily determined area and fresh mass were placed in a Pyrex gas-washing bottle (capacity of 200 mL) immersed in the water bath at 30°C. Synthetic air containing about with controlled CO_2 concentration and humidity was supplied to the washing bottle with flow rate 1 L min^{-1}. The water bath temperature was progressively increased. Isoprenoid emissions were measured at the following temperature: 30, 40, 50, 60, 70, 80, and 90°C. At each target temperature, isoprenoids were sampled by connecting the outgoing flow from the washing bottle to a silcosteel cartridge packed with 200 mg of Tenax. After reaching 90°C, leaves were exposed at this temperature for 55 min, and traps were collected and leaves were weighed after 5, 9, 13, 17, 21, 25, 30, 35, 45 and 55 min following the same procedure just described.

The cartridges were analyzed by using an Agilent GC MS system. Methanol, acetaldehyde, hexenol and isoprenoids were on-line detected by using a proton transfer reaction mass spectrometer (PTR-MS). Flammability of leaf samples was tested by using a glass reactor (5 L capacity) specifically designed. Three-four fully expanded leaves per plant (four plants per species) were detached and after measuring leaf area, and fresh weight they were placed in the fireproof glass reactor. This was placed on a circular plate heater that can reach 500 °C. A Pt100 platinum probe, connected to a digital thermometer, was placed at direct contact with the plant material to measure the temperature reached during heating. A manual timer was used to record the time required to reach the three different phases of flammability, i.e., appearance of visible smoke, incandescence, and flame as described by De Lillis et al. (2009). At each of these phases of flammability, BVOCs were sampled by connecting the outgoing flow from the glass reactor to a dust filter and then to a silcosteel cartridge. The cartridges were analyzed by GC MS as described above.

The results showed that a range of VOCs are emitted from *Eucalyptus Citriodora* (Fig. 1) and *Quercus Ilex* (Fig. 2) leaves and the rate of their emission is highly dependent on temperature. The emited compounds from *Eucalyptus* included cytronellal, isopregol, isoprene, α- and β-pinene, sylvestrene, β-mircene, (E)-β-carbophyllene, β-terpinene, and camphene. There were different patterns of the emissions of these compounds depending on temperature and time. The compounds that were detected during temperature treatment of *Quercus Ilex* leaves (Fig. 3) included sabinene, α- and β-pinene, t-elemene, (E)-β-caryophyllene, β-phellandrene, β-mircene, γ-terpinene, α-tujene and trans-β-ocimene.

In flammability experiment (Fig. 3) we increased temperature up to full burning of the leaves and collected gas samples at 3 characteristic points - pre-smoke (at about 125-150 ºC), smoke (about 250 ºC) and burning (about 320-360 ºC). The data show that eucalypt emits a wide range of VOCs at high temperature. The emission rate of citronellal, isopregol, and α-pinene increased strongly with temperature elevation to the smoke point after that it keeps steady state until the point of burning, while the emission of sabinene, β-pinene and camphene increased continuously from pre-smoke to the burning point. The emission of β-mircene had a maximum at the temperature point of

smoke appearance. Low emissions of tricyclene, linalool and α-thujene were observed without essential changes with temperature. In *Quercus Ilex*, a continuous elevation of the emission rate was observed for camphene, while the emissions of α-pinene, β-mircene and sabinene had a maximum between 0.009 and 0.011 nmol m^{-2} s^{-1} around the smoke point after that they decreased. The emission of β-pinene was relatively low. The rates of VOC emission from *Quercus Ilex* were significantly lower in comparison to these of *Eucalyptus Citriodora*.

It is planned to publish the results of the first study within this year. We are planning joint authorship, with the Ph.D. students also involved in manuscript preparation, and we plan to provide full acknowledgement of the CNR Short-Term Mobility Grant for helping to support the studies.

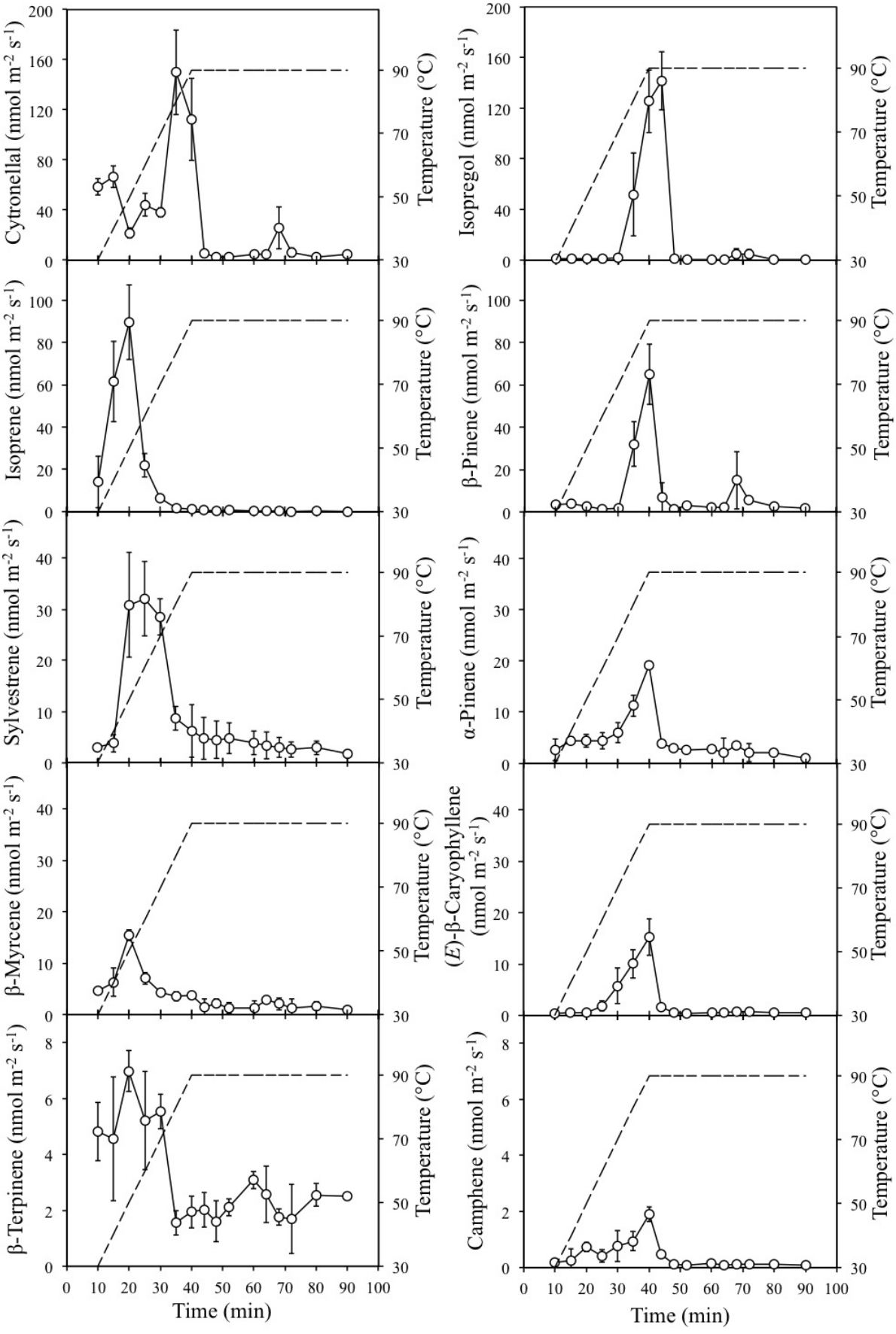
Cytronellal (nmol m-2 s-1)
Isopregol (nmol m-2 s-1)
Isoprene (nmol m-2 s-1)
β-Pinene (nmol m-2 s-1)
Sylvestrene (nmol m-2 s-1)
α-Pinene (nmol m-2 s-1)
β-Myrcene (nmol m-2 s-1)
(E)-β-Caryophyllene (nmol m-2 s-1)
β-Terpinene (nmol m-2 s-1)
Camphene (nmol m-2 s-1)
Temperature (°C)
Time (min)

Fig.1. Temperature and time response of VOC emissions from detached *Eucalyptus Citriodora* leaves.

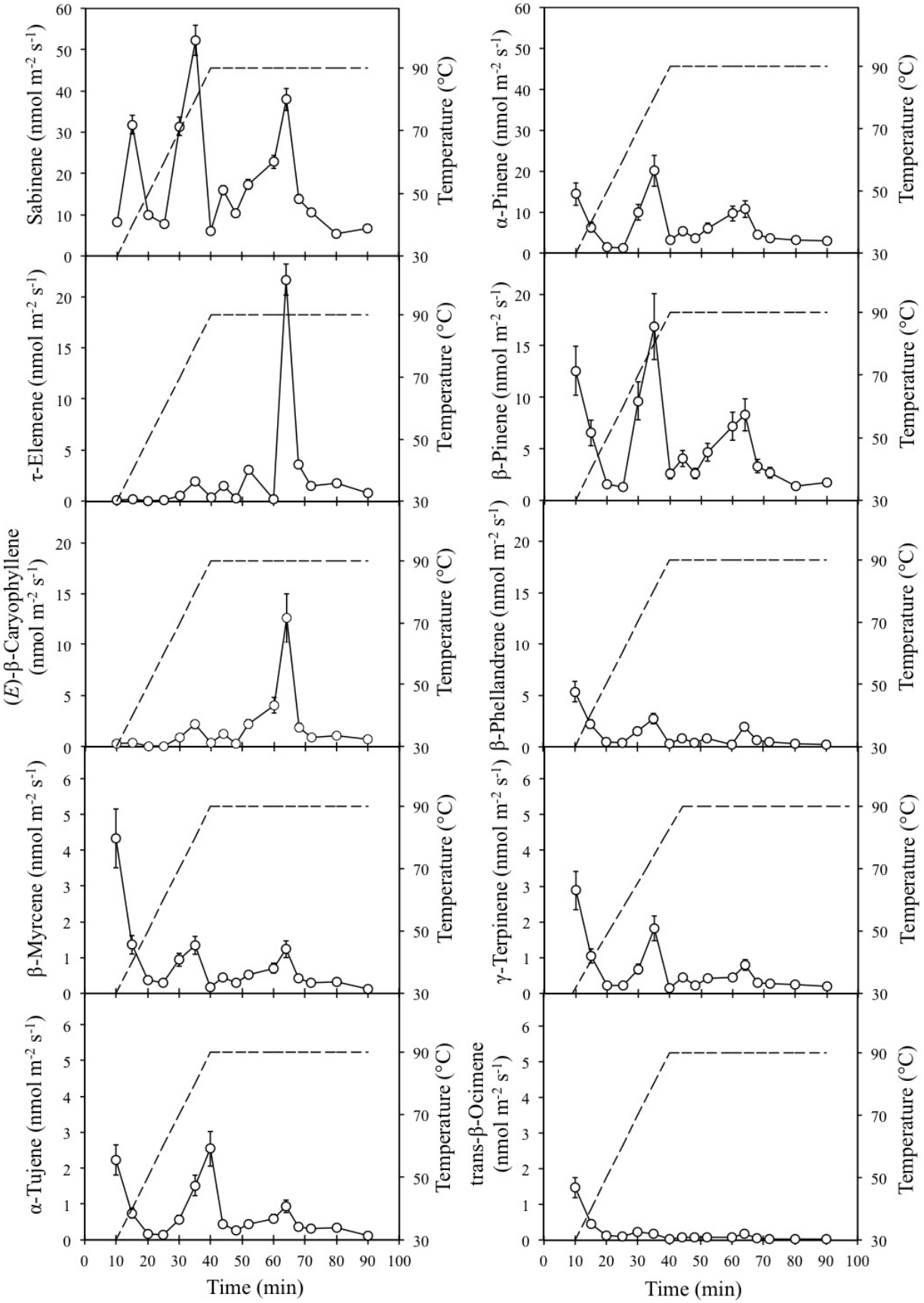

Fig.2. Temperature and time response of VOC emissions from detached *Quercus Ilex* leaves.

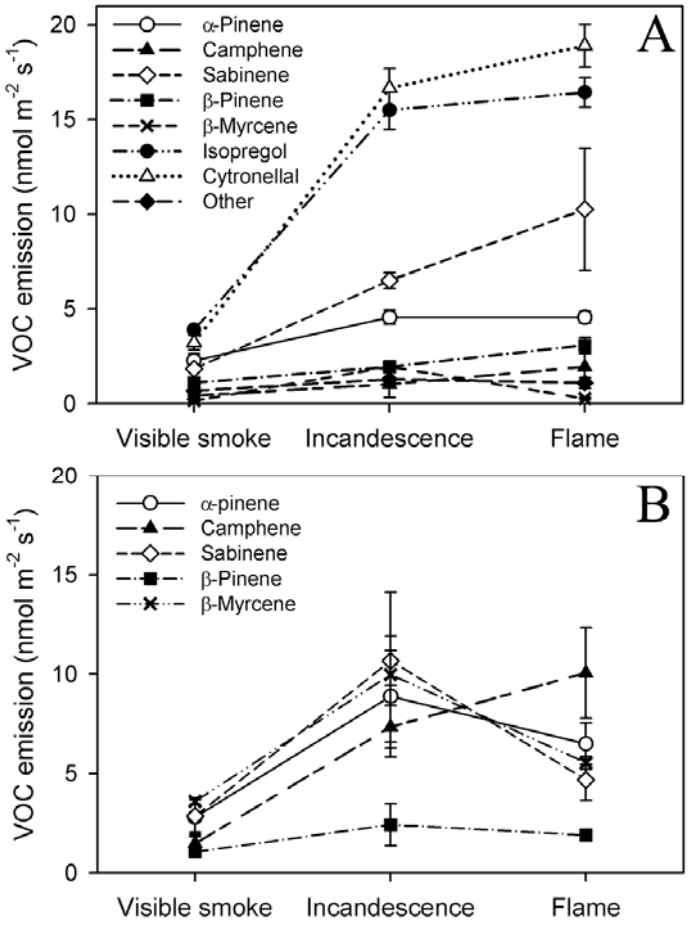

Figure 3. Volatile organic compounds emission from *E. citriodora* (A) and *Q. ilex* (B) leaves during the three phases of burning.