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Decomposition process in the Mediterranean region. Chemical compounds and essential oil degradation from *Myrtus communis*

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ABSTRACT

All aromatic plants emit volatile substances into the environment either during life cycle or during decomposition. These volatile constituents affect the top soil microflora, the nutrients recycle process and the vegetation establishment. *Myrtus communis* is a perennial aromatic shrub, rich in aromatic substances which can be found abundant in the Mediterranean. Fresh mature leaves of myrtle were used for this study using the litterbag technique. The essential oil content of the initial plant was 0.62% dry weight (dw) and after eighteen months burring dropped to 0.05%. The major oil compounds were 1,8-cineole (29.6%), α-pinene (24.7%) and myrtenyl acetate (10.6%). The essential oil degradation rates were similar under the relative small area of the investigation. Terpenes, esters and alcohols were released fast from buried material. The bacterial activity was induced by the presence of myrtle volatile oil. The only compounds that remained after eighteen months were 1,8-cineole and camphene.

1. Introduction

Aromatic plants which contain essential oils are one of the major plant categories in the Mediterranean region. These plants have the capacity to synthesize, accumulate and emit volatiles that may act as aroma and flavor molecules due to interactions with living organisms. These low-molecular-weight substances derived from the fatty acid, amino acid and carbohydrate pools constitute a heterogenous group of molecules and cyclic structures bearing various functional groups (e.g. alcohols, aldehydes, ketones, esters and ethers) and also nitrogen and sulfur (Schwab et al., 2008). Almost all plants, and mainly the aromatic ones, emit volatile substances (Yang et al., 2009). The essential oil into aromatic plants represents 0.1–3% of the dry weight, and there are several ways that these secondary metabolites escape into the environment.

Essential oils do not survive forever in plant material and the fade of the oil following leaf fall is a topic that requires more research. According to Margaris and Vokou (1986) the terpenoid emissions participate in photochemical reactions leading to aerosol production. Essential oil decomposition can occur even when the plant is placed in the dark. As Sombrero (1992) stated, the longer the plant remained in the dark the higher the drop in oil content, reaching approximately 40% in a period of twenty-four days. Plant essential oils are incorporated in plant material and follow the litter fall. Litter deposit depends primarily on the productivity of plant communities, which in turn are affected by climate, soil fertility, soil water retention and species composition (Pausas, 1997). The decomposition of the essential oil is achieved by the presence of microorganisms which need to have the enzymatic capacity to break down the organic compounds of the litter. The litter and its components constitute source of carbon and nutrients (Melillo and Aber, 1984). Plant essential oils constituents are insoluble or almost insoluble in water. The terpenoids which are characterized by their liability (Knobloch et al., 1989) have been found to interfere with enzymatic reactions of energy metabolism. The presence of essential oils or individual compounds derived from essential oils in the top soil layer has been found to enhance biodegradation (Tandlich et al., 2001; Isidorov and Jdanova, 2002; Rhodes et al., 2007; McLoughlin et al., 2009; Suttinun et al., 2009).

The most prominent among the organisms known to attack hydrophobic residues are members of the genus *Pseudomonas* and *Nocardia* (Gunsalus and Marshall, 1974; Zorn et al., 2004; Solyanikova et al., 2008; Marostica and Pastore, 2009). It was also found (Stevenson, 1967) that Arthrobacter spp. are able to utilize a great number of aromatic hydrocarbons as their sole carbon source. There are a number of reports dealing with the ability of *Arthrobacter* in degrading aromatic structures (Shimoni et al., 2003). Gibbon and Pirt (1971) found that the volatile oil is decomposable by bacteria and that at least six species of *Pseudomonas* were able to degrade

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