Anatomical structure of some spontaneous plant species under the influence of air polluting agents in southern Tunisia

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ABSTRACT: Anatomical changes induced by air pollutants (cement and chemical factories of Gabes, Tunisia) in *Lygeum spartum* Loelf., *Erodium glaucophyllum* L. and *Reaumuria vermiculata* L. were evaluated. Significant increase in root cortex thickness of *L. spartum* and *E. glaucophyllum* was recorded under pollution. Also, a proliferation of cortical parenchyma cells area and thickening of cortical cell walls from polluted sites was noticed. The stem cortex and pith thickness was reduced in *E. glaucophyllum* and *R. vermiculata* under pollution. Furthermore, the size of xylem elements increased in the roots of *L. spartum* and *E. glaucophyllum* growing near cement factory while decreased significantly in *E. glaucophyllum* and *R. vermiculata* stems. Leaf lamina and mesophyll thickness increased in *E. glaucophyllum* and decreased in *L. spartum* and *R. vermiculata* in polluted areas. Leaf vascular tissue area increased in *E. glaucophyllum* submitted to pollution and reduced in *R. vermiculata* leaves exposed to cement dust. The effects of pollutants could also be observed in the stomata size (decrease) and density (increase). Dark deposits were observed in root cortical cells, stem cambium area and in mesophyll cell wall of *R. vermiculata*. The dark deposits are present in cortical cells and stem vascular system of *E. glaucophyllum* and only in root cortex of *L. spartum*. These anatomical changes resulted from cumulative environmental conditions especially under the effects of cement dust. The tolerance degree is indirectly correlated with the intensity of injuries which occur in plant structure. Our experiments identified *L. spartum* and *E. glaucophyllum* as more tolerant to pollutants.

Keywords: *Lygeum spartum*, *Erodium glaucophyllum, Reaumuria vermiculata*, gases pollution, cement dust, anatomical changes.

1. Introduction

Air pollution is a major problem in many populated and industrialized areas around the world [1]. Intensive industrialization is usually accompanied with the emission of various toxic substances and gases that harm human health and natural ecosystems [2]. Industrial polluting agents, gas or solid, are considered permanent aggression factors for air, soil and water quality. Spontaneous plants often respond to atmospheric contamination in the same way as they respond to other abiotic stresses which, most often materialize through an ecological misbalance [3]. Theses created environmental conditions in combination with resource availability appear as key factor of the distribution and functional characteristics of plant species in polluted region. Gaseous air pollutants and heavy metal caused injury and damage to plants and their organs in different ways [4-5]. The extent of injury depends on gases concentration, fumigation frequency, duration of exposure and the local environmental conditions [6]. The cement industry plays a major role to imbalances the environment by producing air pollutants [7]. The impact of cement dust on plants has never received the same level of attention as phytotoxic pollutants.

Plant species usually possesses morphological and anatomical adaptations face to unfavourable environmental conditions [8]. Industrial pollutants affected the plant function, structure and anatomy [9-10]. According to Gomes et al. [11], anatomical changes of an adaptive nature are detected: an increase in the thickness of the epidermis and endoderm and increased cell walls of the xylem and cortical parenchyma as contamination by heavy metals increased. When penetrating the roots, heavy metals are predominantly accumulated and translocated in the cell wall system [12]. In addition, the vessel walls were thickened and their width was reduced in both the stems and roots of *Amaranthus hybridus* subjected to pharmaceutical effluents [10]. Studying changes in leaf tissues also helps to understand the process of plant adaptation and tolerance to pollutants. Leaves become thin, contain less palisade parenchyma, abridged upper and lower epidermises in plants occupying polluted habitats [13]. Under adverse environments, leaf palisade and spongy parenchyma decrease significantly [14]. However, recent work showed that leaf structure was stable under the effect of