

The influence of management and environmental factors on insect attack on cork oak canopy



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ABSTRACT

The decline of oak (*Quercus* spp.) forests is a current trend in Northern Hemisphere and is characterized by a loss in tree vigour and increased mortality. The canopy insects are suspected to have role in this decline, but there is poor knowledge about their incidence in evergreen-oak stands. The main aim of this study is to characterize the incidence of main insect groups affecting branches and leaves of an evergreen-oak species (the cork oak *Quercus suber*) and evaluate which management practices and environmental traits of agroforestry systems affect it. In the spring/summer of 2018, we measured the incidence of attacks on branches and leaves by gall-makers (Diptera, Cecidomyiidae), blade-miners (Lepidoptera and Coleoptera), midrib-miners (Lepidoptera, Heliozelidae), chewer caterpillars (Lepidoptera), chewer sawflies (Hymenoptera, Tenthredinidae), weevils (Coleoptera, Curculionidae) and branch-borers (Coleoptera, Buprestidae). We analysed the frequency of pest signs according to different indicators: management practices, tree maturity, forest diversity, forest fragmentation, and latitude and longitude. The most frequent signs of insect pests on tree leaves corresponded to blade-miners, midrib-miners, chewer caterpillars and chewer sawflies. With exception of midrib-miners and branch-borers, all insect pests were found on cork oak stands experiencing decline and benefited from management intensification. Our study suggests that a diverse-aged stand may reduce the frequency of midrib-miners and chewer caterpillars, as well the attack of branch-borers. Moreover, a high plant diversity in forests can contribute to reduce the impact of defoliators on cork oaks (e.g., chewer sawflies) and understory reduction decreased the exposure of trees to gall-makers. Moreover, we found that forest fragmentation may increase the frequency of blade-miners and chewer caterpillars. We conclude that insect pests have a high incidence in cork oak stands and thus, may have an important role in its decline. Considering that a high frequency of pests is often associated with increased management intensity, a change to a more sustainable use of these systems is urgently needed.

1. Introduction

Arthropods are key elements of forest ecosystems as they play an essential role in several ecological processes, such as plant pollination, seed dispersal or nutrient recycling (Losey and Vaughan, 2006; Stewart et al., 2007). Consequently, arthropods contribute to ecosystem integrity and are acknowledged bioindicators of natural and anthropogenic disturbance in forests (Rainio and Niemelä, 2003; Maleque

et al., 2006). However, some arthropod species can markedly increase their numbers and reach high population levels, which in turn, induce stress in trees (e.g., defoliation or phloem-feeding) affecting their vitality and compromising the provision of ecosystem services (Boyd et al., 2013). Some characteristics of the canopy, including the extent of the growing season, nutrient concentration and the incidence of insect pests or fungal diseases are important signals of stress in trees (Dobbertin and Brang, 2001; Saxe et al., 2001; Rizzo et al., 2002).

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