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Aridity or low temperatures: What affects the diversity of plant-parasitic nematode communities in the Moroccan argan relic forest?

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ABSTRACT

Farming activities that are likely to induce the development of emerging pests increasingly disturbs the Argan Biosphere in Morocco. Considering that plant-parasitic nematodes strongly contribute to the decrease in plant growth production, a survey was conducted in the Argan Biosphere in order to assess nematode diversity and distribution. It was established that the parasitic nematofauna was rich, with 70 species belonging to 34 genera and 12 families. Species with high plant decay potential belonging to Longidoridae, Heteroderidae, Hoplolaimidae, Meloidogynidae, Paratylenchidae and Pratylenchidae are present in the argan forest. *Telotylenchus* sp., *Paratylenchus microdorus* and *Paratylenchus veruculatus*, *Xiphinema italiae* and *Xiphinema pachtaicum* (virus-transmitting nematodes), and *Helicotylenchus crassatus* are the most dominant species. Populations of root-knot (*Meloidogyne* spp.) and lesion (*Pratylenchus* spp.) nematodes are also present. Climate forces have driven the structuration of the argan forest to topoclimatic landscapes that led the diversity of the plant-parasitic nematodes communities. The north–south typology of the arid climate affects the richness and the taxonomic and functional diversity of nematodes, while the west–east temperature typology mainly affects the abundance of nematodes, especially of colonizing species. The emergence of plant-parasitic nematode problems as a consequence of intensive agroforestry or argan orchard development is considered.

1. Introduction

The argan tree (*Argania spinosa* (L.) Skeels) is an endemic species that covers a large patchy relic forest consisting of approximately 8.5×10^5 ha in western Morocco. This forest extends along the Atlantic Ocean from the mouth of the Tensift River (northern latitude) to the mouth of the Noun River (southern latitude), and extends in an eastward direction to the foothills of the High and Anti-Atlas mountains, encompassing the Souss and the Massa Valleys. In 1998, the "UNESCO's Man and the Biosphere Program" designated it as a Biosphere Reserve (Msanda et al., 2005). However, this region is one of the most densely populated in Morocco, and the argan forest is greatly disturbed by grazing and crop cultivation. Most of the preserved argan forests remain in the High and Anti-Atlas mountains. In the foothills, grain and legume crops are introduced in the forest. The most degraded situations are found in high added-value production areas such as in the eastern part of the Souss Valley (citrus production) and in the western part of both the Souss and the Massa Valleys (vegetable production) where argan trees largely disappear.

The argan tree is a thermophilic and xerophytic plant (Diaz-Barradas et al., 2010) adapted to arid climates (from 400 mm annual rainfall in the north of the Reserve to less than 100 mm in the south). Mean annual temperatures vary between 17 and 24 °C, with higher values in the pre-Saharan zone, but the minimal average temperatures of the coldest month (MACM) of the year recorded in some argan places in mountains can reach below 5 °C. These climate regimes define three main types of topoclimatic vegetation (Médail and Quézel, 1999; Msanda et al., 2005, 2007): (i) the infra-Mediterranean bioclimate with high atmospheric

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humidity and values of MACM above 6 °C; (ii) the thermo-Mediterranean bioclimate with a MACM ranging from 3 to 6 °C and with low relative humidity; (iii) the meso-Mediterranean bioclimate occurring in the High and Anti-Atlas mountains, with a MACM below 3 °C.

Argan trees are particularly valued for food and cosmetic oil extracted from their olive-like fruits (Charrouf and Guillaume, 2002). Whereas soil is a key compartment for plant growth and production, a survey was conducted for the first time in the Argan Biosphere Reserve to assess the diversity of plant-parasitic nematodes associated with argan trees. In agriculture, overall yield losses due to these parasites are estimated at 20% depending on the crop (Ferraz and Brown, 2002). Moreover, plant-parasitic nematodes are also able to reduce plant growth in less disturbed ecosystems, such as forests (Sutherland and Webster, 1993), fallows (Cadet et al., 2003) or shore dunes (Brinkman et al., 2005).

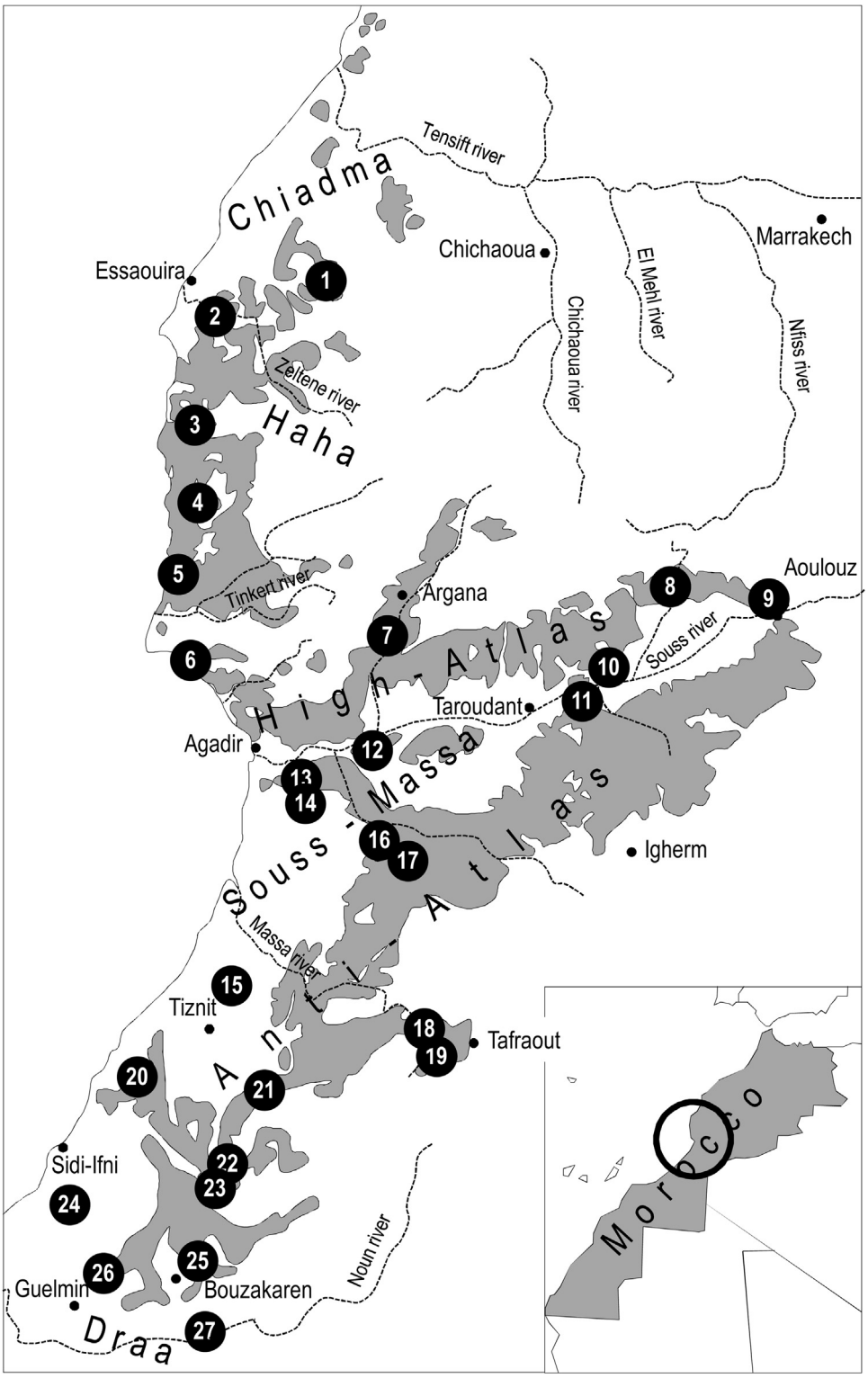

Fig. 1. Distribution of *Argania spinosa* (L.) in western Morocco (from Msanda et al., 2005) and localization of the sites surveyed. Encoding for sites is listed in Appendix A.