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Plant mycorrhizal traits in Europe in relation to climatic and edaphic gradients

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Around 90% of plant species associate with mycorrhizal fungi. The symbiosis is known to provide plants with soil N, P and water, and fungi with plant photosynthesized carbohydrates. However, not all mycorrhizal symbioses are identical. The identity of associated plant and fungal species differs, as does the effect of the symbiosis on nutrient cycling and ecosystems more generally. In this study, we analysed the European distribution of two plant mycorrhizal traits in relation to climatic and edaphic drivers. We used the European distribution of the frequency of mycorrhizal colonization (plant mycorrhizal status); whether mycorrhizal fungi either always (obligately mycorrhizal, OM), or sometimes (facultatively mycorrhizal, FM) colonize plant roots, and the four main plant mycorrhizal types; arbuscular (AM), ecto-(ECM), ericoid (ERM), and non-mycorrhizal (NM) plants. We expected AM species to predominate in ecosystems where most soil nutrients occur in inorganic forms (lower latitudes) and those with higher soil pH. By contrast, due to the saprophytic abilities of ECM and ERM fungi, we expected ECM and ERM plants to predominate in ecosystems where nutrients are bound to organic compounds (higher latitudes) and those with lower soil pH. NM plant species are known to be common in disturbed habitats or in extremely phosphorus poor ecosystems, such as the Arctic tundra. Our results showed that the distribution of mycorrhizal types was driven by temperature and soil pH, with increases of NM, ECM and ERM, and decreases of AM, with latitude. FM predominated over OM species and this difference increased with latitude and was dependent on temperature drivers only. These results represent the first evidence at a European scale of plant mycorrhizal distribution patterns linked with climatic and edaphic gradients, supporting the idea of a tight relationship between the mycorrhizal symbiosis and nutrient cycling.