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A comparison of two UK sites to monitor the role of climatic parameters on tree growth and the development of *Tuber aestivum* mycorrhiza

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Abstract: Climatic and soil parameters have a marked impact on tree growth. Soil parameters also have a significant impact on the development of various mycorrhizal species. The response of *Tuber aestivum* mycorrhiza to a range of soil conditions has been previously studied, but data relating to specific climatic details are lacking. In this study we compare two sites, with strong similarities but differences in climatic conditions. We find that increased wind speed slows tree growth and increased rainfall speeds tree growth. The associated *T. aestivum* mycorrhizae are unaffected. The reasons for the observed results are discussed.

Zusammenfassung: Klima- und Bodenparameter haben bedeutenden Einfluss auf das Baumwachstum. Bodenparameter haben zudem großen Einfluss auf die Entwicklung verschiedener Mykorrhizapilze. Die Reaktion von *Tuber aestivum* Mykorrhiza auf unterschiedliche Bodenbedingungen wurde schon früher untersucht, aber Daten bezüglich spezifischer klimatischer Details fehlen. In vorliegender Untersuchung vergleichen wir zwei Standorte, die sehr ähnlich sind, aber große klimatische Unterschiede aufweisen. Es zeigt sich, dass erhöhte Windgeschwindigkeit das Baumwachstum verlangsamt und erhöhter Niederschlag es beschleunigt. Die assoziierten *T. aestivum* Mykorrhizen bleiben unbeeinflusst. Die Gründe für die beobachteten Ergebnisse werden diskutiert.

The influences of abiotic factors on tree growth are well documented and include, but are not limited to, precipitation, wind speed and temperature. Reduced rainfall has been shown to reduce relative height growth rate in *Quercus* spp., COTILLAS & al. (2009). Wind speeds impact on tree growth by causing not only a reduction in tree height, JAFFE & FORBES (1993) but also a greater allocation of biomass to their root systems, NICHOLL & RAY (1996). In the UK temperature is generally positively correlated with tree growth in *Quercus* spp. (PILCHER & GREY1982).

Mycorrhiza development in relation to specific edaphic factors has also been studied with many taxa having discrete distributions in relation to soil chemistry (TOLJANDER & al. 2006).

Data of the response of *Tuber aestivum* mycorrhiza development in relation to abiotic factors is primarily confined to soil characteristics, where some excellent work has outlined its ecological preferences, WEDEN & al. (2004) and CHEVALIER & FROCHOT (1997). In contrast, climatological studies for *Tuber aestivum* are primarily confined to

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broad climatic data for an entire region and precise climatic parameters that the study site is exposed to is therefore of great interest.

In order to address such questions, we have designed a study of paired-experimental design. The design incorporates two separate sites (LE and LI), both one hectare in size, located in Central England (UK). Both have been planted with 1-year old saplings of *Quercus robur* and *Corylus avellana* inoculated with *Tuber aestivum* in the winter of 2008.

Weather station data for the two sites reveal that LE has significantly greater rainfall, but significantly lower wind speed and there is no difference in mean temperature between the two sites.

The trees were visited in the autumn of 2009 and tree height as well as colonization of the root-tips by *Tuber aestivum* was recorded. The results show that overall LE had significantly taller trees than LI, but when looked at on a species level there was no significant difference in the height of *Corylus avellana* trees between sites.

Root samples of 4-5 cm were taken from each tree and the presence or absence of *Tuber aestivum* mycorrhiza was analysed. 100% of samples from both sites had some level of *Tuber aestivum* mycorrhiza colonization.

From the results, it may be concluded that both wind speed and precipitation impact on tree growth, with wind speed impacting negatively and precipitation impacting positively. However, although there is a clear difference in tree height between the two sites, there was no difference on the development of the *Tuber aestivum* mycorrhiza. It can also be concluded that *Quercus robur* is more susceptible to these climatic variables than *Corylus avellana.*

The fact that we observed no impact on the mycorrhiza development could be a consequence of three factors. Firstly, the trees may need longer exposure to these differences to result in an observable difference in mycorrhiza development. Secondly, the method of recording the mycorrhiza development needs to be refined to allow greater resolution. Thirdly, although wind speed reduces the tree height (perhaps resulting in a reduced total-photosynthetic capability) the increase in allocation to root biomass (as reported by NICHOLL & RAY 1996) may compensate for this reduction in terms of mycorrhiza supporting capacity.

Sites LE and LI will continue to be monitored to track progress.

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