Crop microclimate: can alleycropping alleviate climate change effects on durum wheat?

F. Reyes, Marie Gosme, Kévin Wolz, Isabelle Lecomte, Christian Dupraz

L02.2_O.04

Crop microclimate: can alleycropping alleviate climate change effects on durum wheat?

Reyes F.[1] (freyes@unitus.it), Gosme M.[2], Wolz K.[2], Lecomte I.[2], Dupraz C.[2]

[1]*DAFNE, University of Tuscia, Viterbo, Italy*; [2]*UMR System, INRA, University of Montpellier, Montpellier, France*

Climate Change (CC) is expected to lead to both improvements and worsening of the crop growing conditions, depending on site-specific conditions. Agroforestry (AF) systems have significant effects on the climate experienced by the understory crop. The complex crop-tree-soil-microclimate dynamics make it challenging to predict crop yields in AF systems with too simple/empirical models. We explore the use of a process-based bio-physical AF model (Hi-sAFe) for the prediction of the drivers of crop growth and yields in AF under CC.
Hi-sAFe is a 3D model representing tree-crop interactions for the capture of light, water and nitrogen, as well as the effect of tree shading on crop temperature and crop water use efficiency. The model was used to compare a monocrop of winter wheat and an alley cropping plot combining wheat and hybrid walnut tree lines. Each plot was simulated over cycles of forty years, in a location in southern France, as driven by climatic projections from IPCC, representing Past, Present, and Future climates.
Trends in intercepted PAR radiation by the crop and thermal comfort indices were interpreted for the different agricultural systems and climate scenarios, taking into account the effect of the tree size in agroforestry. By this approach the positive and negative impacts of trees on crop growth temperatures for the different climate scenarios were discriminated.
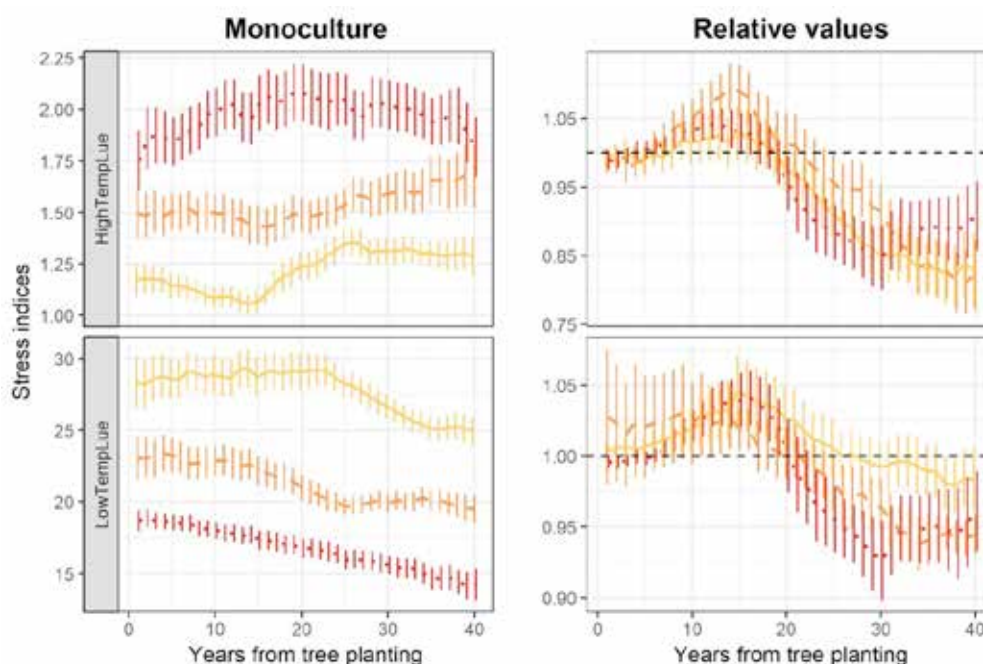
Thermal stresses on photosynthesis due to sub-optimal high (above) and low (below) temperatures across climatic scenarios (solid yellow line: Past; dashed orange line: Present; red dotted line: Future). Stress values are calculated as the product of the number of days of stress annually experienced, multiplied by one minus the mean annual value of the stress index. Stresses are represented after the application of a moving average with a window of eleven years. Vertical lines represent confidence intervals. The horizontal dashed lines correspond to relative stresses equal to one.

Keywords: Stress, Modeling, Growth, Optimal temperature, Agroforestry.