Geophysical Research Abstracts, Vol. 8, 09296, 2006
SRef-ID: 1607-7962/gra/EGU06-A-09296

Water Availability and Tree Growth in Semi-arid Rainfed Orchards at Various Scales

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The cultivation of rainfed tree crops in the northern Mediterranean is associated with processes of soil degradation. One method to control erosion processes is the application of cover crops. However, there is a lack of information about the conditions under which the growth of cover crops is physically feasible. Therefore the aim of this study was to investigate the magnitude and nature of the spatial variation in water availability at different scales to establish physical thresholds for the growth of cover crops. At the Mediterranean scale, the relation between the tree spacing of olive orchards and climate was studied. The humidity index (HI) was used as an climate indicator, defined as the mean annual precipitation divided by the mean potential evapotranspiration. A non linear threshold envelope could be distinguished between tree spacing and the HI. For HI $<$ 0.5, this envelope describes the minimum tree spacing under specific climatic conditions. This minimum tree spacing could directly be related to the canopy cover and the NDVI index. Hence, this relationship can be used to assess the potential crop cover at the regional scale. For HI $>$ 0.5, the minimum tree spacing remains constant, indicating that under these conditions water availability is not the limiting factor. At the regional scale, the role of parent material was studied by comparing the spatial variation in trunk diameter of young almond groves on stony soils and soils on marls in south east Spain. On marl soil, the amount of spatial variation was considerably higher (40% of total variance) than on stony soil (20% of total variance), indicating a more pronounced later redistribution of soil moisture. At the field scale, several terrain indices were derived from digital elevation models and related to the observed variation in trunk diameter. Under dry conditions (HI = 0.3) neither the wetness index, nor slope, aspect, or curvature did explain the observed variation in tree growth. Runoff concentrating in small areas was reflected in larger diameters of 5% of the trees. The homogeneous cropping pattern does not reflect these local runoff

patterns.