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A WATER BALANCE MODEL ON AN OAK MIXED FOREST IN THE ITALIAN ALPS: EFFECTS OF DROUGHT IN SUMMER 2003

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THE AREA

The permanent plot of Savignano (Adige Valley, 680 m) is in a mixed, mainly deciduous forest, with a relative majority of downy oak (*Quercus pubescens*). It can be set in a climatic frame of the middle latitudes - humid, temperate type - with no dry season and moderate oceanicity features. Rainfall shows two climatological maxima in late spring and autumn. Winter is a relatively dry season. In summer, local thunderstorm activity accounts for the major part of water supply.

WATER BALANCE MODEL

The estimate of water stress has been assumed as a base for an evaluation of the effects of meteorological agents on the wood health.
Due to the numerical preponderance and to the ecological interest, the balance models has focused on downy oak (*Q. pubescens*). The general methodology has been inferred by the "Wageningen Protocol" (Klap *et al*., 1997). The main features are:
- works with daily values;
- Penman – Monteith equation for evapotranspiration;
- water stress expressed as "relative transpiration index" (RTI), i.e. the ratio between *actual* and *potential* transpiration: $RE_T = Tr_{act.} / Tr_{pot}$; transpiration is given by $Tr = ET – E_i - E_s$ (ET=evapotransp., E_i = evaporation of intercepted water, E_s = evaporation from soil);
- a stress-induced reduction of transpiration is accounted for;
- canopy and aerodynamical resistance coefficients (r_c and r_a) have been adapted from literature (Kelliher et al., 1995); a correction for daily values has been applied, based on linear regression with the daily estimated value for sky cover (see graph, left) and assuming that hourly values of r_c and r_a represent the true ones;
- field measures for sub-models: LAI (see graph, right), weekly throughfall and stemflow, soil hydrologic properties, soil water content at 4 depths (capacitive probes) + average in the 50 cm layer (TDR).

The period from 22nd August to 31st October 2003 was available for a comparison between modelled and measured soil water content. Results (see graph, right) point out a very good matching between measured and simulated water trends, excepts for the last days of the period. Yet, differences are evident among measuring sites, even close one another (probes A and B, about 10 m), and stress the natural unhomogeneity in soil moisture within the forest environment of the sides of Adige Valley.

TREE DAMAGES ASSESSMENT

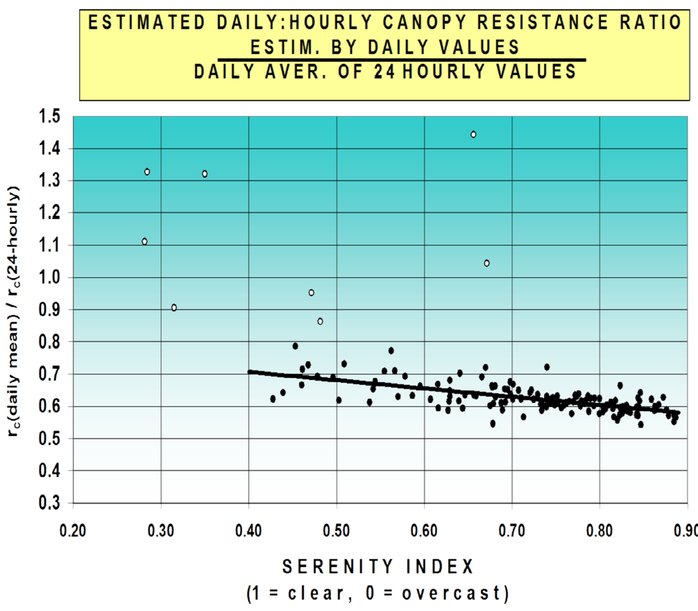
Defoliation and discoloration are the main parameters evaluated in crown condition assessment under the UNECE ICP-IM programme (Pylvänäinen, 1993). The mean discoloration ranged between about 2% and 7% (sample of 30 trees, mixed species) along the years. Due to the low figures and the negligible effects, this parameter was not deemed useful for damage quantification. The defoliation estimated on the same sample ranged between 8% and 16%. Noteworthy, it can be seen that correlation is good between broad-leaves species and the whole sample, but not between *Quercus* spp. and broad-leaves (see graphs, left). This difference might be related to a general trend of oak decline in Europe and particularly in Italy (Ragazzi and Della Valle, 2000), but the low number of oaks in the sample (9 out of 30) makes this feature questionable.

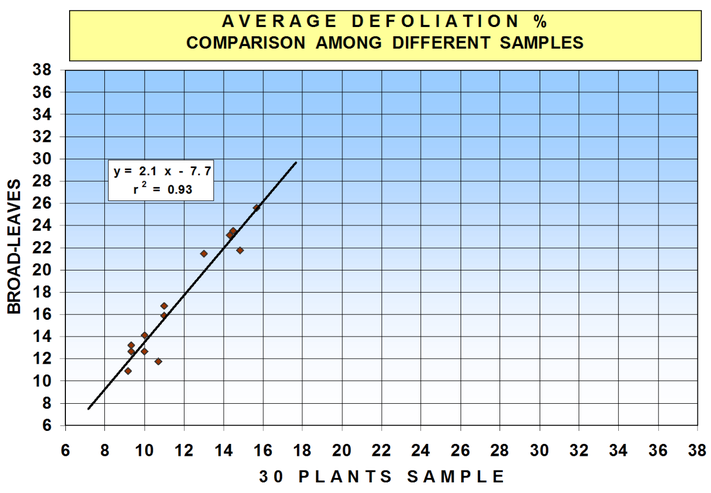
RESULTS

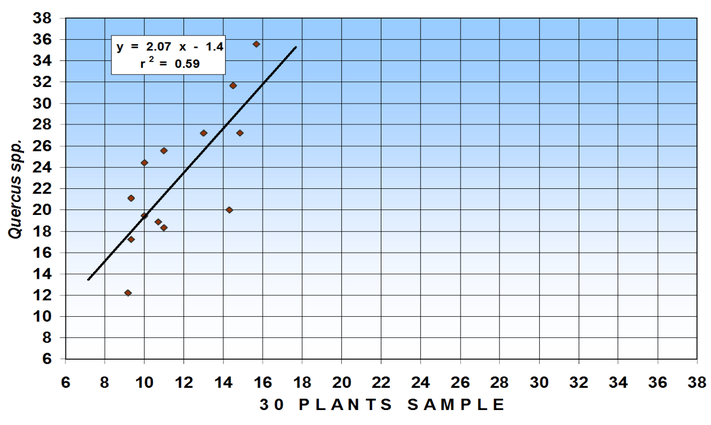
Summer – early autumn 2003 hit an absolute record in RTI, both for its length and magnitude; extremely low levels of soil water content were modelled (see graphs, right). Unexpectedly, the yearly trend of defoliation seems little correlated with drought indices (here the nr. of days from 1st Nov. to 31st Oct. with RTI < 0.6 or 0.5 - see graph, right), even though the highest value of discoloration (7%) was attained in 2003. This is evident for peculiar years 2003, 1995, 2000, 2001. Similar results (not shown) have been obtained when using only the more sensitive broad-leaves (17 out of 30) and oaks (9 out of 30).

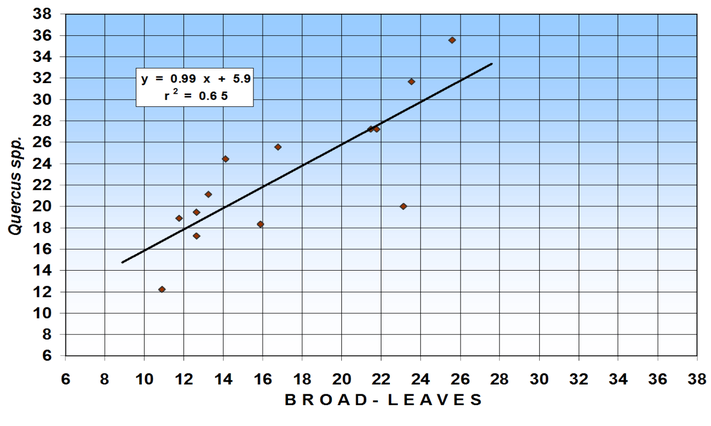
CONCLUSIONS

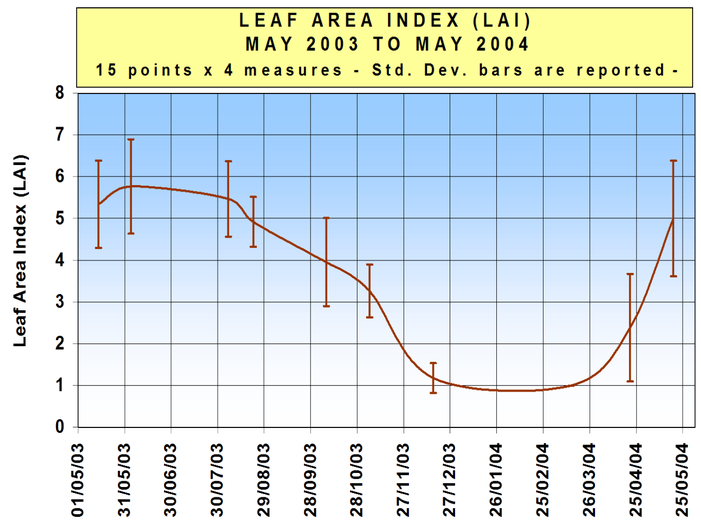
Results show that, despite evident differences in the outcomes of water balance along the years, the trees have a good homeostasis in the area, and/or that defoliation and discoloration - either because of the protocol and/or of the numerousness of samples - may be unsatisfying parameters for assessment of damages induced by water stress.

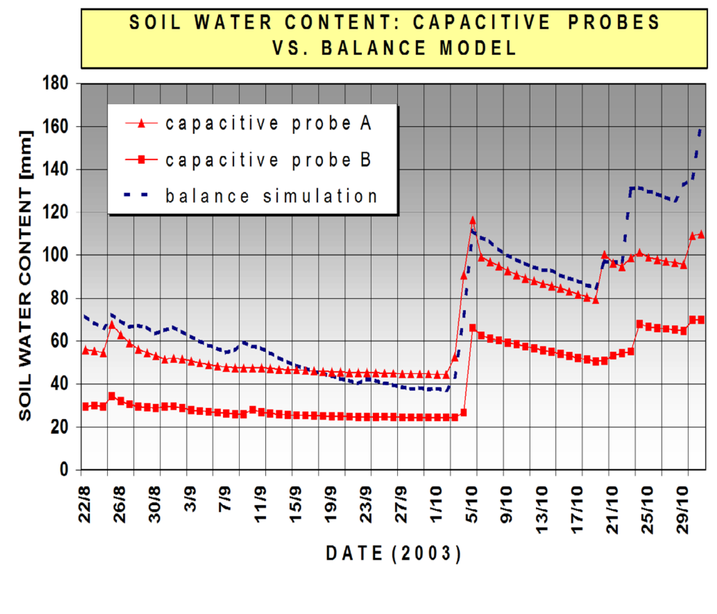


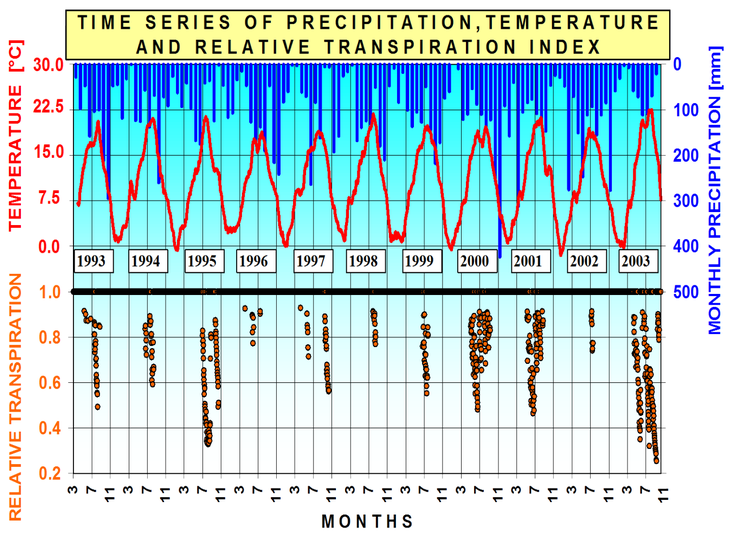


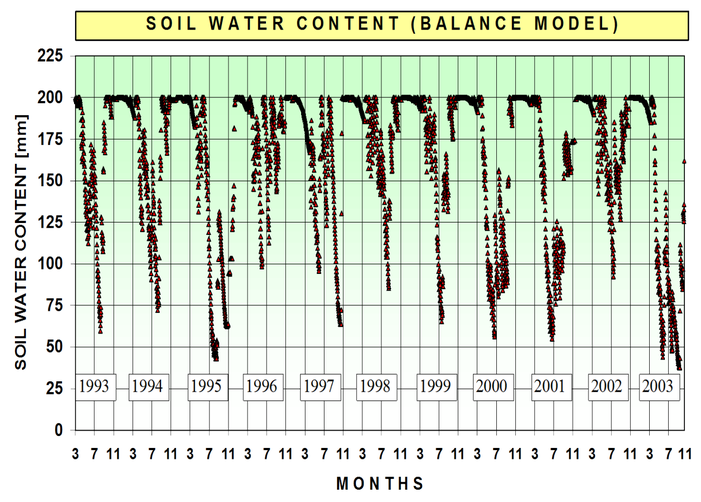


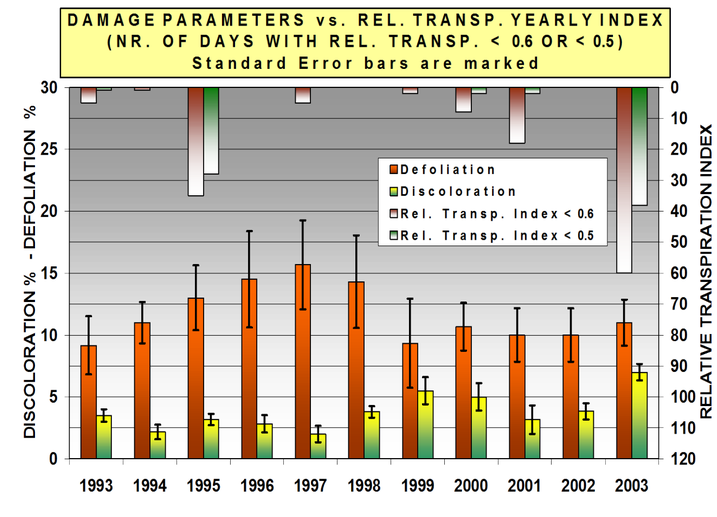












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