

The traditional irrigation technique of Lake Garda lemon-houses (Northern Italy)

Stefano Barontini (1), Nicola Vitale (2), Federico Fausti (1), Barbara Bettoni (3), Sara Bonati (3,4), Marco Peli (1), Antonella Pietta (3), Marco Tononi (3,5), and Roberto Ranzi (1)

(1) Università degli Studi di Brescia, DICATAM, Brescia, Italy (stefano.barontini@unibs.it), (2) Independent professional, Brescia, Italy, (3) Università degli Studi di Brescia, DEM, Brescia, Italy, (4) Universidade de Madeira, CIERL, Funchal, Portugal, (5) Università degli Studi di Padova, DISSGeA, Padova, Italy

Between 16th and 19th centuries the North-Western side of Lake Garda was seat of an important district which, at the time of its maximum splendour between 18th and 19th centuries, produced and exported lemons and citrus even toward the Northern Europe and the Russia. The *limonaie del Garda* (Lake-Garda lemon-houses), the local name of the citrus orchards, were settled on terraces built on steep slopes, with landfill taken from the Eastern side of the lake, and closed by greenhouses during late autumn and winter in order to protect the cultivations. The terraces were built nearby streams, they were South-Eastern exposed and protected by walls from the cold winds. Thanks in fact to the Lake Garda microclimate, lemon trees were not cultivated in pots, as in the typical orangeries of mid-latitudes Europe, but directly in the soil.

Here the citrus cultivation technique reached a remarkably high degree of standardisation, with local *cultivar* as the *Madernino* or *lemon from Maderno*, and it involved, as in modern industrial districts, all the surrounding land in order to satisfy the needing of required materials to build the terraces, the walls, the greenhouses and the wooden frames to hold the branches laden with fruits. Due to the great water requirement of lemon trees during summer, which is estimated to range from 150 to 300 ℓ every ten days, the water management played a key role in the cultivation technique.

The traditional irrigation technique was standardized as well. During our surveys, we observed that most of the lemon-houses still conserve little stone flumes along the walls upslope to the terraces, with spillways every adult tree, i.e. about every 4 m. The flumes were filled with water taken from an upstream reservoir, built nearby a stream. The spillways were activated with a backwater obtained by means of a sand bag placed within the flume, just downstream to the spillway itself. In order to avoid any excavation, spilled water was driven to the base of each tree by means of a wooden squaring.

According to our field experiments performed in two ancient lemon-houses (*La Malora* at Gargnano and *Il Pra' de la Fam* at Tignale, spring and summer 2015), most of the spillways were able to discharge between 7 and 15 ℓ/min . As only one spillway could be activated at a time, only one tree at a time was irrigated, and it could require from 10 to 30 minutes. Accounting for the great number of adult and young trees at any terrace, it is reasonable to admit that during the summer a continuous irrigation should take place in most of the lemon-houses.