

LIFE VineAdapt LIFE19CCADE001224

C1 Climate change induced drought, effects of irrigation and solutions for resource-efficient irrigation techniques

C4 Deliverable

Environmental risk assessment of irrigation systems

The actions and studies on vineyard irrigation were only set up and run in France.

Measurements to assess ecological risks and benefits of irrigation were estimated in 18 vineyards of the Luberon mountains in South-Eastern France. The climate is Mediterranean to subcontinental with mild and humid autumns/winters and dry and hot summers. Average annual rainfall is about 700 mm but only 80 mm in the three summer months. Rainfall is very rare and irregular from mid-June to mid-August. Since summer drought has increased due to climate change, winegrowers have to cope with reduced grape yield and high sugar content degrading wine quality. Irrigation allows stabilizing yields and lowering sugar content. Consequently, the area of irrigated vineyards has exponentially increased in the last 25 years from nearly 0 % in 2000 to about 35 % nowadays.

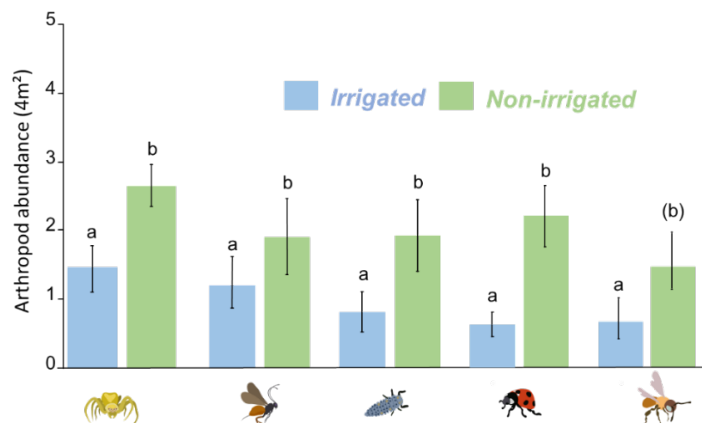


Fig. 1: Effect of irrigation on beneficial arthropod abundance in 2021, Melloul et al. 2024, Basic and Applied Ecology 77

We analysed vegetation, beneficial arthropod abundance (predators, parasitoids, pollinators, yield, grapevine performance, grape quality) in the inter-rows of nine irrigated and nine non-irrigated vineyards of same grape variety, similar soil, topography and age. In the study year 2021, drip irrigation was applied twice or thrice involving an additional water supply of about 50 mm (63 % of summer rainfall, 143 % of July/August rainfall). Although vegetation and arthropod surveys were conducted in May 2021, before irrigation started, we found a negative effect of irrigation on beneficial arthropod



abundance, in particular on ladybirds, crab spiders, parasitoids and wild bees (Fig. 1). We did not find any significant influence on plant species composition but the flower cover was lower in irrigated vineyards. This may be due to a delayed phenology, and/or irrigation induced changes in the mowing regime. Neither vineyard performance nor yield nor quality parameters were affected by irrigation in the study year.

In a second study, we compared the effect of irrigation on vegetation and soil organisms in spring and summer 2022. In contrast to the first study, all measurements were taken within the grapevine rows showing higher disturbance than inter-rows (glyphosate treatment and/or mechanical weed control). In April, before irrigation started, vegetation cover was lower in irrigated vineyards whereas soil mesofauna abundance was not significantly different. During the irrigation period mite and springtail abundance were clearly higher in irrigated vineyards whereas neither plant cover nor plant species richness were affected. In contrast to the 2021 study, irrigation increased grapevine yield and reduced sugar content. The results suggest that the strong positive effects of irrigation on soil mesofauna rapidly vanish after the irrigation period and are not significant any more in the following spring.

The last study is an experiment manipulating irrigation in 12 blocks within same vineyards. Again, measurements focused on soil organisms within grapevine rows but included soil microorganisms and soil functioning (respiration, organic matter decomposition). The experiment was established in irrigated vineyards, and in each block, half of the irrigation tubes were covered with a plastic coat (second tube) to exclude irrigation. All parameters except for organic matter decomposition were measured four times: (1) one week before irrigation, (2) during irrigation, (3) one week after irrigation, (4) in September several weeks after irrigation (and with beginning autumn rainfall). Mesofauna abundance, microbial biomass, soil respiration and organic matter decomposition were higher in irrigated than in unirrigated plots, but only at (2) and (3) whereas at period (4) all differences disappeared with an increase of abundance and activity in non-irrigated plots. Thus, the results confirmed the short-term character of irrigation effects on soil organisms already observed in the second study.

In conclusion, irrigation may reduce the abundance of key arthropods and thus biodiversity in vineyard ecosystems. The reduction can be explained by shifts in plant species composition and floral resource provisioning in the Mediterranean flora adapted to strong summer drought. However, we did not find strong irrigation effects on plant community composition and structure. Irrigation has clearly positive effects on soil organisms and soil functioning during summer drought although rapidly vanishing after the irrigation period in autumn. Irrigation may further limit water competition between inter-row vegetation and grapevine plants and thus increase the acceptance of inter-row greening beneficial for arthropods and related ecosystem services (action C1). The currently applied moderate irrigation limited to a short period between June and August and the very local application using drippers, are thus well-adapted methods to combine biodiversity conservation and soil functioning with appropriate grapevine yield and grape quality.