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Water balances and perennial-annual interactions of small plots in a dryland planted forest

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In autumn the soil surface of pasture-only catchments in the eastern Mediterranean is quasi-bare due to grazing in the preceding spring and summer. Rainfall distribution in these areas is unimodal and the high intensity rainfall events, typical of autumn and spring, lead to the generation of runoff and the concomitant erosive soil losses. Forests decrease the production of runoff, but large scale afforestation in drylands may however affect the catchment hydrological balance. The presence of tree canopies decreases runoff generation by reducing the energy of the drops that hit the surface, thereby reducing crusting and runoff, and could therefore potentially lead to an increase of the input of water into the soil. On the other hand, trees intercept rainfall and the intercepted drops may evaporate before reaching the soil. In addition trees could use a larger fraction of the water stored in the soil than annual herbs do and the latter two processes could offset the previously mentioned gain and thus negatively affect the water balance.

The present study, whose aim was to determine the effect different types of vegetative cover have on the water balance of small plots, was carried out in a forty-year old forest planted in the Yatir area (average annual precipitation 270 mm and annual evaporation from class A pan 2000 mm).

The effect four different cover types (bare soil, annual herbs, trees and trees with an annual herb understory) have on water balance of small plots within the Yatir forest was studied during four consecutive seasons.

At the lowest point of each plot, the generated runoff was collected and measured using specially built tipping buckets with a sensitivity of 0.133 mm (runoff)

s^{-1}connected to a single event data logger. Soil moisture was monitored using a neutron probe. At least one access tube to a depth of 4 m was installed in each plot.

Rainfall and runoff were monitored during rainfall events and soil water content and above ground dry biomass were routinely monitored during four years.

The results indicate that the highest runoff was produced by the bare plots. During dry years different vegetative covers reduce runoff with similar efficiency. During wetter years on the other hand, the annual herbaceous vegetation was more efficient than the other vegetative covers. Maximum influx of water into the soil was registered for those treatments for which the lowest runoff was recorded. The depth of penetration of the wetting front was affected by total seasonal rainfall and treatment. During drier years treatment effect was minor and was 0.5 m for the vegetated treatments. During wet years maximum penetration was recorded for the plots with annual herbaceous cover (0.9 m) and minimum penetration for bare plots (0.5 m).

No changes in the soil water content were registered at depths greater than 1.5 m. No significant differences could be found in the total soil water content for the various treatments towards the end of the dry season irrespective of the amount of rainfall received during the preceding wet season.

The results obtained indicate that in the area we carried out our study water did not percolate below the root zone and that afforestation does not meaningfully alter the water balance on the scale studied.