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Micro-irrigation and contaminant uptake into almond trees in a semi-arid environment

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In the early to mid-1900s, waste of all descriptions, including automobile parts, appliances, and batteries, was disposed in unlined trenches throughout California. Such waste deposits were often incinerated and later simply covered with a layer of soil. Almond trees were planted in 1996 over one such site in the Central Valley of California. Concentrations of more than 20 elements were measured during the 2003 and 2004 growing seasons in leaves, wood, hulls, and nuts of the almond trees, including metallic and nonmetallic elements that function as plant nutrients as well as elements that do not. Annual mean rainfall in the region is 165 mm with annual crop water requirement of about 1300 mm. Trees were irrigated with micro-sprinklers attached to plastic surface tubing, and the wetted volume of the tree rootzone was about 50% of the total orchard floor. Soil moisture was measured weekly at selected locations using a Campbell Pacific Nuclear Hydroprobe 503DR. We found that applied irrigation was barely adequate to provide for crop needs, virtually eliminating deep percolation. The concentrations of elements and soil salinity found in 1–2 m depth in soil over waste trenches were high compared to concentrations found at the same depth in soil away from the waste trenches. In most almond orchards, the measured levels of total salinity and/or sodium and chloride concentration in the 1-2 m depth would cause severe leaf burn and defoliation during harvest. However, only slight defoliation and a small amount of marginal leaf burn was seen in the trees planted over waste trenches. Excessive measured soil levels, such as Zn at 134.6 ppm, can cause toxicity in plant tissues. However, they can also act to prune roots, stopping root development and protecting the plant from excessive uptake. Comparing plant water use to rainfall plus applied irrigation, we posit the influence of semi-arid conditions, alkaline soils, and the use of efficient micro-irrigation diminished contaminant movement into almond trees.