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Vegetables can absorb heavy metals from contaminated irrigation water

Certain vegetables take up heavy metals from contaminated water used for irrigation, a new study finds. The researchers grew vegetables in greenhouses similar to field conditions in Greece and found that concentrations of nickel and chromium increased in potatoes and onions, but not in carrots, when irrigated with water containing contaminant levels similar to those found in industrial wastewater.

In many countries, sewage and wastewater from industry are used for irrigating farmland. This practice has two purposes: it disposes of wastewater and adds nutrients and organic matter to soils. However, there is concern about harmful pollutants in wastewater entering the food chain. If consumed in high concentrations, heavy metals can deplete important nutrients and lead to serious health problems.

According to the researchers, their study highlights a problem that has affected Greek agriculture for many years. Farmers here have been irrigating their crops with polluted underground water for decades.

Previous studies in the Asopos river region of central Greece have revealed that chromium levels in food were twice as high in areas where the water bed was polluted by heavy metals, compared to non-polluted areas. In the same polluted areas, nickel levels were nine times higher than in non-polluted areas.

In the new study, the researchers conducted experiments in a greenhouse, simulating growing conditions in the Asopos and Messapia regions, which are both important crop-growing areas of Greece. They wanted to understand more about how vegetables absorb heavy metals from irrigation water. Carrying out their experiments in a greenhouse meant they could precisely control the levels of contaminants in the irrigation water, and that they could separate the effects of contamination caused by irrigation water and the effects of heavy metals already present in soils.

The researchers grew six tubs of potatoes, six tubs of carrots and six tubs of onions, and watered them every three to ten days. For each vegetable, they watered one tub with uncontaminated water and the other five with water containing varying concentrations of nickel and chromium – between 10 and 250 micrograms per litre.

These heavy metal concentrations were selected to resemble concentrations found in waterbeds in Asopos and Messapia as closely as possible. After harvesting, the researchers took samples of vegetables from each tub, and measured nickel and chromium concentrations.

Potatoes and onion shoots and leaves contained nickel and chromium when they were collected from tubs that were irrigated with contaminated water. Uptake of the heavy metals varied depending on the vegetable and contamination level of the water used. For example, onion leaves from plants irrigated with the mostly highly-contaminated water contained 61% more chromium and 90% more nickel than onion leaves from plants irrigated with clean water. Carrots, on the other hand, did not contain higher levels of heavy metals when the plants were watered with contaminated water. This may have been because the metals accumulated in parts of the plant other than the vegetable itself.

The researchers suggest that food control authorities should assess levels of heavy metals in crops and that farmers should use clean water for irrigation in order to reduce the levels of heavy metals entering the food chain.

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