Germs in wastewater often become airborne

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Using household wastewater to irrigate food crops in drought-stricken or arid regions isn't the perfect solution. The chemicals and disease-causing germs it might contain could contaminate crops. Viruses that have their origin in the human intestines are often released into the air as fine spray during irrigation and then carried further even on moderately windy days. This is according to a new study in Springer's journal *Agronomy for Sustainable Development*, led by researchers Guillaume Girardin and Pierre Renault of the French National Institute for Agricultural Research in France.

This study is the first to look into what happens on windy days when wastewater is used to irrigate soils, and how disease-causing pathogens end up becoming aerosolized when they are trapped in fine airborne spray. To do so, a series of repeatable wind tunnel experiments using various virus contaminated plots were performed. Among others, the influence of wind speed, soil surface moisture, temperature and the chemistry of the irrigation water were tested. Ultrapure water and ultrapure water plus treated wastewater which is reclaimed for agricultural irrigation near Clermont-Ferrand in France were used to water the plots. Murine mengoviruses were used as surrogate for human enteric viruses, so that the impact of environmental conditions could be tested safely. The aerosolized viruses were trapped in special glass tubes designed to collect airborne contaminants, before being analyzed further.

The team also devised a mathematical model to be used for one or more virus groups, depending on their number of viruses and their ability to combine with spray and be blown around in the air. The model was fitted

to the real trial data and was used to generate numerical experiments to study the effect further.

This showed that between one percent and fifteen percent of viruses carried to the soil were converted into a fine spray and became airborne. This happened quite quickly. In up to 89 percent of cases the action happened within half an hour of the soil's being irrigated.

Two groups of viruses were detected: one that gets aerosolized almost immediately, and another in which this process happens more gradually. Up to 90 percent of the viruses in the latter group were released into the air after about ten days. The size of this group increased at higher wind speeds or if there was more organic matter in the spray water, but it decreased when the soil was warmer.

"Aerosolization when using wastewater cannot be neglected both in terms of quantities and speeds, because it can have an effect even on moderately windy days," says Girardin.

"Combined with knowledge on virus exchange from respiratory to gastroenteric tracts and virus inactivation in air, we anticipate that our model will help policymakers to refine regulations and standards governing wastewater reuse in irrigation," adds Renault.

More information: Guillaume Girardin et al, Viruses carried to soil by irrigation can be aerosolized later during windy spells, *Agronomy for Sustainable Development* (2016). DOI: 10.1007/s13593-016-0393-7

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