RIVM, August 4, 2020

(10)(2e), (10)(2e), (10)(2e)

The novel coronavirus and irrigation of crops

Irrigation of crops generates droplets and mist, to which employees and passers-by may be exposed leading to possible exposure to potential pathogens in this irrigation water, such as bacteria and viruses. The following question arose: is there risk of infection with the novel coronavirus (SARS-CoV-2) through irrigation of crops? The answer to this question is given below; it is based on the currently available information about SARS-CoV-2.

Irrigation with surface water

Surface water in the Netherlands is to a greater or lesser extent contaminated through discharge of treated wastewater, sewer overflow, run-off of manure from livestock, and input of animal fecal matter. In relation to COVID-19, domestic wastewater seems the most relevant contamination source of the surface water. Surface water may be contaminated with the novel coronavirus through sewage overflow of untreated domestic wastewater, or through discharge of treated domestic wastewater. When the wastewater is discharged onto the surface water, it is diluted. Subsequently, the concentration of the novel coronavirus decreases, but this strongly depends on the relative volume of the wastewater and whether it is treated or not. So the dilution rate will vary for each location. Still, it is unknown if and for how long the novel coronavirus remains infectious in surface water.

The novel coronavirus has been detected in untreated sewage water in the Netherlands[1,2]. Studies in France and Spain have detected genetic material of the novel coronavirus in treated sewage water as well[3,4]. It is unknown how many infectious virus particles are present in the (un)treated wastewater. Due to dilution of the (un)treated wastewater, the concentration of SARS-CoV-2 in surface water will be (much) lower than in the (un)treated wastewater. In an Italian study, genetic material of the novel coronavirus was detected in a few river waters[19]. There are no data on whether SARS-CoV-2 remains infectious in surface water. However the duration of infectivity in surface water seems shorter than that of other viruses, such as hepatitis A virus and norovirus[5]. Based on these data, an infection with SARS-CoV-2 contracted through irrigation with surface water seems unlikely.

The extraction of water for irrigation at discharge points of domestic wastewater is discouraged, not only because of the possible presence of SARS-CoV-2, but also because of the potential presence of other pathogens. It is recommended to position the irrigation installation in such a way that workers or passers-by do not come into contact with water droplets or mist. A previous study on the health risks of fountains has shown that there is a risk of infection with pathogens in the fountain water when the mist of the fountain is tangible[6].

Irrigation with groundwater

The presence of SARS-CoV-2 in groundwater in the Netherlands has not yet been investigated. The quality of groundwater in the Netherlands is good, because soil passage naturally removes micro-organisms, including viruses[7,8]. Groundwater protection is, amongst others, determined by the depth of the groundwater and the composition of the soil layers on top of it. Also, there are various protection zones, areas in which soil threatening activities are restricted or banned to protect the

groundwater quality. This is particularly the case in areas where the groundwater is used for the production of drinking water. In the Netherlands, the possibility of groundwater becoming contaminated with domestic wastewater or human feces is minimal. Consequently, exposure to SARS-CoV-2 when using groundwater for irrigation of crops is neglectable.

Background information about the novel coronavirus in feces and wastewater

The major transmission route for SARS-CoV-2 is through droplets that come into the air when an infected person coughs or sneezes[4]. SARS-CoV-2 is present in the feces of about half of the confirmed coronavirus patients. This has been shown in several, for instance in China[9,10], Singapore[11], Germany[12], France[13] and the United States[14]. The novel coronavirus excreted with the feces enters wastewater and subsequently wastewater treatment plants. In the Netherlands, the genetic material of the new coronavirus has been detected in untreated wastewater[1,2]. In France, the genetic material has also been detected in treated wastewater[3]. Based on the amount of genetic material, a hundred times less was detected in the treated wastewater than in the corresponding untreated wastewater. To what extent the novel coronavirus is inactivated by wastewater treatment processes is unknown.

It is yet unsure whether the novel coronavirus in wastewater is infectious for humans. Human infections through wastewater have not yet been demonstrated. In two studies[17,18], infectious virus has been isolated from feces, however, others studies have not been able to isolate infectious virus from feces[12]. It is unclear how many infectious particles of the novel coronavirus are excreted by infected persons and enter the wastewater. A study could not culture infectious virus from wastewater[4]. It is also unknown how long the virus remains infectious in wastewater. Whether the novel coronavirus in Dutch wastewater is infectious or not, is currently investigated by RIVM. The RIVM also investigates the possible spread of SARS-CoV-2 via aerosolization.

References

1. Lodder, W.J., and De Roda Husman, A.M. 2020; SARS-CoV-2 in wastewater: potential health risk, but also data source. Lancet Gastroenterology and Hepatology 2020. DOI: https://doi.org/10.1016/S2468-1253(20)30087-X
2. Medema, G.J., Heijen, L., Elsinga, G., Italiaander, R., Brouwer, A. Presence of SARS-Coronavirus-2 in sewage (2020). doi: https://doi.org/10.1101/2020.03.29.20045880
3. Wurtzer, S., Marechal, V., Mouchel, J.M., and Moulin, L. Time course quantitative detection of SARS-CoV-2 in Parisian wastewaters correlates with COVID-19 confirmed cases. (2020). MedRixv. DOI: https://doi.org/10.1101/2020.04.12.20062679.
4. Randozza, W., Truchado, P., Cuevas Ferrando, E., Simon, P., Allende, A., Sanchez, G. SARS-CoV-2 RNA titers in wastewater anticipated COVID-19 occurrence in a low prevalence area (2020). Water Research. doi: https://doi.org/10.1016/j.watres.2020.115942
5. World Health Organization. Water, sanitation, hygiene, and waste management for the COVID19 virus: interim guidance (23 April 2020). https://apps.who.int/iris/bitstream/handle/10665/331846/WHO-2019-nCoV-IPC_WASH-2020.3eng.pdf
6. De Man, H., Heederik, D.D., Leenen, E.J., De Roda Husman, A.M., Spithoven, J.J., Knapen, F. Human exposure to endotoxins and fecal indicators originating from water features (2014). Water Research. Doi: 10.1016/j.watres.2013.10.057.
7. Schijven, J. F., Hassanizadeh, S. M., de Roda Husman, A. M. (2010). Vulnerability of unconfined aquifers to virus contamination. Water Research, 44(4), 1170-1181.

8. Wuijts, S., Rutjes, S.A., Van der Aa, N.G.F.M., Mendizabal, I., en De Roda Husman, A.M. (2008) Invloed humane en animale verontreinigingen op grondwaterwinningen. Rapport 734301031/2008. https://www.rivm.nl/bibliotheek/rapporten/734301031.pdf
9. Wang, W., Xu, Y., Gao, R., Lu, R., Han, K., Wu, G. and Tan, W. (2020) Detection of SARS-CoV-2 in different types of clinical specimens. Journal of the American Medical Association. DOI: 10.1001/jama.2020.3786
10. Xiao, F., Tang, M., Zheng, X., Li, C., He, J., Hong, Z., Huang, S., Zhang, Z., Lin, X. and Fang, Z. (2020) Evidence for gastrointestinal infection of SARS-CoV-2. Gastroenterology. DOI: https://doi.org/10.1053/j.gastro.2020.02.055
11. Young, B.E., Ong, S.W.X., Kalimuddin, S., Low, J.G., Tan, S.Y., Loh, J., Ng, O.T., Marimuthu, K., Ang, L.W., Mak, T.M., Lau, S.K., Anderson, D.E., Chan, K.S., Tan, T.Y., Ng, T.Y., Cui, L., Said, Z., Kurupatham, L., Chen, M.I., Chan, M., Vasoo, S., Wang, L.F., Tan, B.H., Lin, R.T.P., Lee, V.J.M., Leo, Y.S., Lye, D.C. and Singapore Novel Coronavirus Outbreak Research, T. (2020) Epidemiologic Features and Clinical Course of Patients Infected With SARS-CoV-2 in Singapore. Journal of the American Medical Association. DOI: 10.1001/jama.2020.3204
12. Wölfel, R., Corman, V.M., Guggemos, W., Seilmaier, M., Zange, S., Mueller, M.A., Niemeyer, D., Vollmar, P., Rothe, C. and Hoelscher, M. (2020) Clinical presentation and virological assessment of hospitalized cases of coronavirus disease 2019 in a travel-associated transmission cluster. Nature. DOI: https://doi.org/10.1038/s41586-020-2196-x
13. Lescure, F.-X., Bouadma, L., Nguyen, D., Parisey, M., Wicky, P.-H., Behillil, S., Gaymard, A., Bouscambert-Duchamp, M., Donati, F. and Le Hingrat, Q. (2020) Clinical and virological data of the first cases of COVID-19 in Europe: a case series. The Lancet Infectious Diseases. DOI: 10.1016/S1473-3099(20)30200-0
14. Holshue, M.L., DeBolt, C., Lindquist, S., Lofy, K.H., Wiesman, J., Bruce, H., Spitters, C., Ericson, K., Wilkerson, S. and Tural, A. (2020) First case of 2019 novel coronavirus in the United States. New England Journal of Medicine. DOI: 10.1056/NEJMoa2001191
15. Wu, F.Q., Xiao, A., Zhang, J.B., Gu, X.Q., Lee, W.L., Kauffman, K., Hanage, W.P., Matus, M., Ghaeli, N., Endo, N., Duvallet, C., Moniz, K., Erickson, T.B., Chai, P.R., Thompson, J., Alm, E.J. SARS-CoV-2 titers in wastewater are higher than expected from clinically confirmed cases. medRxiv. DOI: https://doi.org/10.1101/2020.04.05.20051540
16. Ahmed, W., Angel, N., Edson, J., Bibby, K., Bivins, A., O'Brien, J.W., Choi, P.M., Kitajimam, M., Simpson, S.L., Li, J., Tscharke, B., Verhagen, R., Smith, W.J.M., Zaugg, J., Dierens, L., Hugenholtz, P., Thomas, K.V., Mueller, J.F. First confirmed detection of SARS-CoV-2 in untreated wastewater in Australia: A proof of concept for the wastewater surveillance of COVID-19 in the community. Science of the total Environment (2020).
17. Wang, J., Feng, H., Zhang, S., Ni, Z., Ni, L., Chen, Y., Zhuo, L., Qu, T. SARS-CoV-2 RNA detection of hospital isolation wards hygiene monitoring during the Coronavirus Disease 2019 outbreak in a Chinese hospital. International Journal of Infectious Diseases (2020). DOI: https://doi.org/10.1016/j.ijid.2020.04.024
18. Zhang, Y., Chen, C., Zhu, S., Shu, C., Wang, D., Song, J., Song, Y., Zhen, W., Feng, Z., Wu, G., Xu, J., Xu, W. Isolation of 2019-nCoV from a Stool Specimen of a Laboratory-Confirmed Case of the Coronavirus Disease 2019 (COVID-19), 2020, CCDC Weekly / Vol. 2 / No. 8
19. Rimoldi, S.G., Stefani, F., Gigantiello, A., Polesello, S., Comandatore, F., Mileto, D., Maresca, M., Longobardi, C., Mancon, A., Romeri, F., Pagani, C., Moja, L., Gismondo, M.R., Salerno, F. 2020. Presence and vitality of SARS-CoV-2 virus in wastewaters and rivers. MedRixv doi: https://doi.org/10.1101/2020.05.01.20086009