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Quantifying Preferential Flow during Rainfall and Irrigation in the North China Plain

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Water resource shortage has been a serious problem since the 1980s, especially in arid and semi-arid areas in the North China Plain (NCP), resulting in plenty of environmental problems. Estimating the groundwater recharge exactly is vital for managing groundwater effectively. However, the phenomenon of preferential flow is common in the filed, especial for structured soils, which play a vital role on groundwater recharge. In the filed, the preferential flow would appear mainly during the heavy rainfall and flooding. Therefore, five years soil water contents were investigated to estimate the percentage of preferential flow in the soil profile of 3.4m in the Luancheng County, North China Plain. The results showed that the pattern of rainfall or irrigation water infiltrate into soil of 0-20cm depth was piston flow, while preferential flow for over 20cm depth. The percentages of preferential flow and piston flow were 54.5% and 45.5, respectively. The preferential flow was affected by initial soil water content and intensity of rainfall and irrigation. When the intensity of rainfall was lower 10mmd⁻¹, the soil water just infiltrated into depth of 0-10cm, and no preferential flow happened. When the intensity of rainfall was 30-80mm, the level of preferential flow raised, whereas the level wasn't affected when the intensity of rainfall was lower than 30mmd⁻¹ or higher than 80mmd⁻¹. During the flooding, the preferential flow increased when the initial soil water contents increased. On the other hand, the percentages of preferential flow increased when the intensity of rainfall or irrigation was higher. The results implicated that deep plowing could destrov the preferential paths in the soil, restrain the preferential flow, improving the utilization efficiency of rainfall and irrigation.

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Key words: preferential flow, groundwater recharge, soil water, quantifying

References

Beven K, Germann P., 1982. Macropores and water flow in soils. Water Resources Research, 18(5): 1311-1325.

- Fei, Y.H, Zhang, Z.J., Zhang, F.E., and Z, W., 2007. An analysis of influence of human activity and climate change on water resources of the North China Plain. Acta Geoscientica Sinica, 28(6): 567-571.
- Jin, M., Zhang, R., Sun, L., Gao, Y., 1999. Temporal and spatial soil water management: a case study in the Heilonggang region, PR China. Agricultural Water Management, 42: 173– 187.
- Hardie, M A., Cotching, W.E., Doyle, R.B., Holz, G., Lisson, S., and Mattern K., 2011. Effect of antecedent soil moisture on preferential flow in a texture-contrast soil. Journal of Hydrology, Elsevier B.V., 398(3-4): 191–201.
- Larsson, M.H., Jarvis N.J., Torstensson, G.,and Kasteel, R., 1999. Quantifying the impact of preferential flow on solute transport to tile drains in a sandy field soil. Journal of Hydrology, 215(1-4): 116–134.
- Lu, X.H., Jin, M.G., van Genuchten, M.T., and Wang, B.G., 2011. Groundwater recharge at five representative sites in the Hebei Plain, China. Ground Water, 49(2): 286-94. doi:10.1111/j.1745-6584.2009.00667.x.
- Scanlon, B.R., Healy, R.W., and Cook, P.G., 2002. Choosing appropriate techniques for quantifying groundwater recharge. Hydrogeology Journal, 10(1): 18-39. doi:10.1007/s10040-0010176-2.
- Wang, B.G., 2008. Research on Estimating Methods of Groundwater Recharge [Ph.D. thesis]: Chinese University of Geosciences (Wuhan), 121 p.
- Wang, B.G., Jin, M.G., Wang, W., Nimmo, J. R., and Yang, L., 2008. Estimating groundwater recharge in Hebei Plain, China under varying land use practices using tritium and bromide tracers. Journal of Hydrology, 356(1-2): 209-222. doi:10.1016/j.jhydrol.2008.04.011.
- Wang, S.F., Zhang, X.Y., and P, D., 2006. Impacts of different water supplied conditions on root distribution, yield and water utilization efficiency of winter wheat. Transactions of the CSAE, 22(2): 27-32.

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