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Abstract

India has the largest paddy output in the world and is one of the largest exporter of rice. This cultivation has an important impact on the water quantity and quality. Return flow from irrigation in some regions as Andhra Pradesh may lead to water salinization as it enhances concentration of elements as fluoride. Infiltration and solute transport in paddy fields are driven by a strong soil heterogeneity including cracks. Although these processes have been observed further investigations are needed on the hydrodynamics of paddy fields to fully understand solute transport. We assess infiltration using a water balance methodology by indirect measurements and we compare it with direct measurements from a tracer test experiment using bromide as a non-reactive tracer to observe infiltration velocity on the upper 2m of the soil.

Tracer is recovered using porous cups during one month. The tracer is driven by more the 20 irrigation cycles. This experiment is coupled with regular tensiometer monitoring and irrigation water level. Soil structure is composed by black clay to dark brown sandy clayed sand in the first 50 cm and by sandy soil from 0.5m to 2m depth. Coupling of tensiometric measurements, water level, irrigation time shows a daily five steps behavior of the entire system. The hydrodynamics are mainly controlled by the plow pan. Results from the tracer test show an important heterogeneity on the flow velocity up to 2 m/day with various responses depending on the depth. While fast velocities are observed and concentrations are within the same range at each investigated depth, spreading is different depending on the soil structure. Results show that hydrodynamics is controlled by cracks and retention zones. Tracer test indicates that part of the solutes are retained in the first centimeter of the soil and then slowly diffuse to the underneath layers. Although porous cups have limitation to assess fastest velocities, the methodology is reliable to have an integrated information on the infiltration dynamics in paddy soil. Comparative study shows that although mass balance and mean tracer test velocities are in the same range, the solute transport through tracer test exhibit a larger complexity.

These observations are of importance to understand the behavior of geogenic contaminants such as fluoride and anthropic contaminants such as nitrates.