Behavior of pathogenic micro-organisms and micro-contaminants in vegetable plots irrigated with municipal waste water in Senegal

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In Senegal, as in many other semi-arid countries of West-Africa, municipal waste waters are often used for irrigation in suburban areas, either directly or mixed with the often saline local ground water. This practice has the advantage of coping the scarcity of water and resulting in an accelerated growth of crops, but bears considerable risks for microbial and chemical contamination for farmers, consumers, soils, ground waters. In this paper we present preliminary biogeochemical results on water and soils from vegetable cultures of the coastal area east of Dakar (Pikine, Fig. 1). It is dominated by flat dunes with highly permeable sand-dominated ferruginous soils with maximum 4% organic matter in its top layer. The ground water, slightly saline (6 permil), shows shallow levels between 1 and 5 m and crops out in natural and digged ponds. During the dry period between November and June the wastewater, deviated from channels leading to abandoned waste water treatment plants, is applied twice a day by traditional hand-sprinkling, either pure or mixed with local groundwater. The wastewaters are typically slightly reducing and contain high amounts of solid suspended matter (1600 mg/l), carbon (1500 mg/l DOC), nitrogen (200 mg/lNH4) and phosphorus (50 mg/l PO4). Their heavy metal content is astonishingly low (most elements are below 10 microg/l, except Zn and Cu (max. 100 resp. 70 microg/l). Other micro-pollutants, such as hormones or pesticides have not yet been analyzed. Their microbiology is dominated by enterobacteria (E.coli, Shigella, Salmonella). In order to quantify them as a function of soil depth, two methods have been used: (a) Classical plate cultivation on agar medium (PCA) to determine the total aerobic mesophilous microfauna and (b) DNA-extraction and identification by fluorescence in-situ hybridization (FISH). First results on Zn and microfauna are shown in Fig. 2 and Fig. 3. First FISH-results also indicate the presence of enterobacteria-DNA at up to 60 cm soil depth. The decreasing Zn values point to the same average depth to which components of the waste water apparently typically migrate, before they are either consumed by the plants or are evaporated. Recently installed free flow lysimeters and piezometers will hopefully give a definitive answer on the frequency with which these waste irrigation-waters reach and contaminate the local ground waters and to which extent a heavy metal accumulation in the soils will take place in the future.

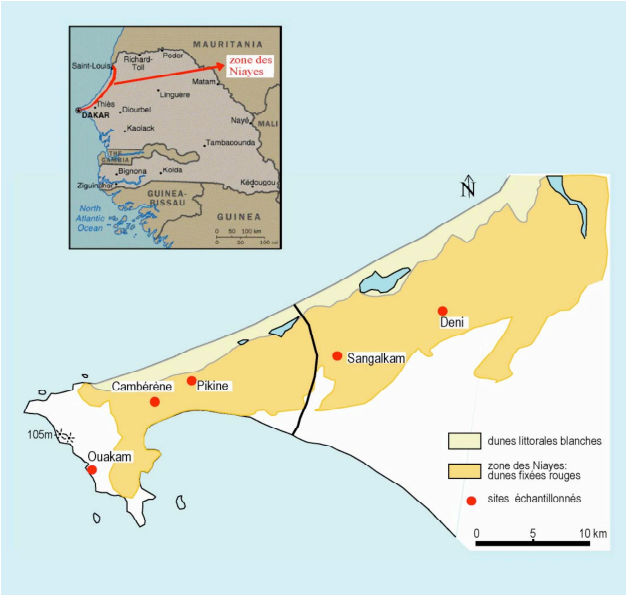

Figure 1: Location of the study site

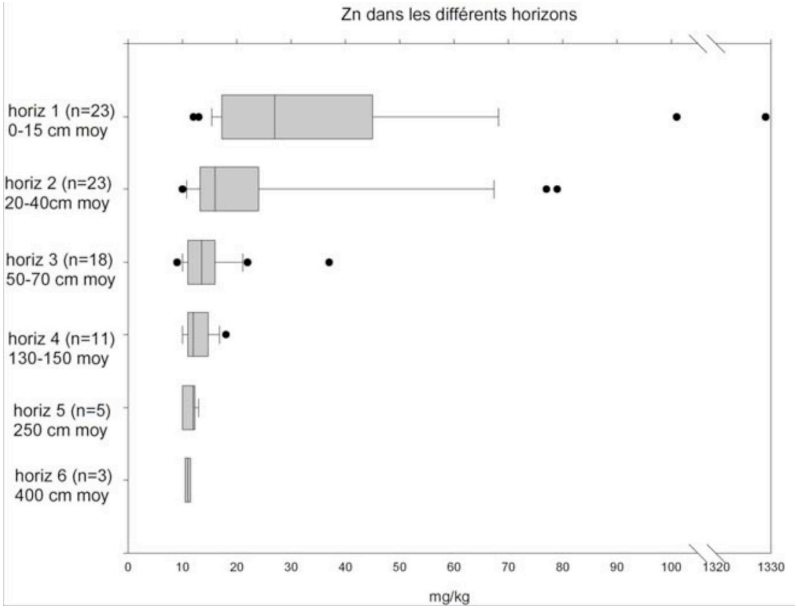

Figure 2: Zinc as a function of soil depth in a vegetable plot, regularly irrigated by waste water during several years

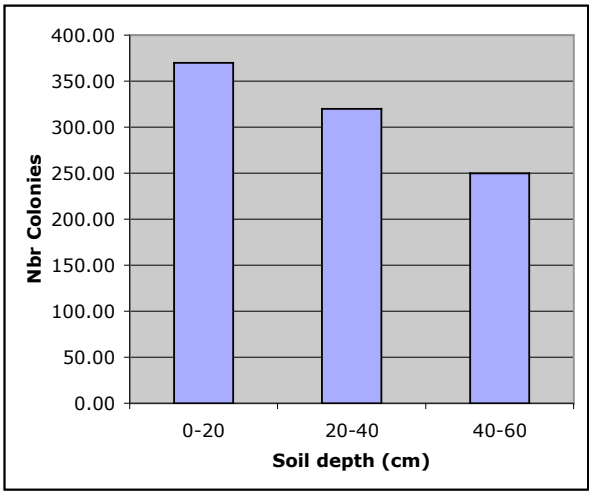

Figure 3: Total number of mesophilous microfauna in the same plot