SUMMARY

The Decentralised Waste Water Treatment System (DEWATS) is used in countries such as India and Indonesia for the treatment of human waste. The waste is passed through a series of baffles where it is anaerobically degraded, resulting in the production of the Anaerobic Baffled Reactor (ABR) effluent. Disposal of the effluent can still pose a challenge if not done properly and lead to environmental pollution. The effluent has been shown to contain high concentrations of mineral elements such as nitrogen and phosphorus, which are important for plant growth. There is little information on the use of effluent for agriculture particularly under the South African climatic and edaphic conditions. This study investigated the effect of using ABR effluent on the nutrient uptake, growth and yield of Swiss chard (*Beta vulgaris* subsp. *cicla*) on selected soil types. Field and tunnel experiments were carried out at Newlands Mashu Permaculture Centre in Durban (longitude of 30°57'E and latitude of 29°58'S). The initial experiment planted in the summer season of 2012 was designed to collect baseline data on growth and yield of Swiss chard and other selected crops under rain-fed vs. irrigated conditions using tap water. The treatments were laid out using a randomised complete block design (RCBD) with three replications. The treatments included: tap water irrigation without fertiliser application (TW); tap water irrigation with fertiliser application (TWF) and rain-fed with fertiliser application (RFF). The second experiment was conducted in winter 2012 with the aim of investigating growth and yield of Swiss chard irrigated with ABR effluent during the dry season. In the second study, the treatment "tap water irrigation without fertiliser application" was substituted with irrigation with ABR effluent while the other treatments were maintained. The third experiment was conducted in the summer season of 2013. The treatments remained similar to those of the winter 2012. Soil samples were collected from the top 30 cm before planting and after harvesting for chemical analyses. A neutron probe access tube was also installed in the middle of each plot in order to monitor soil water status and irrigate plots according to the root zone soil water deficit. Wetting Front Detectors (WFDs) were installed at 30 cm and 50 cm depths to monitor nutrient leaching. The leachates collected by WFDs were analysed for nitrates and phosphates using Merck Reflectoquant test kit. Similarly, the ABR was analysed for its chemical composition before each irrigation event. Treatment effect on Swiss chard and soil was tested by analysing fresh crop biomass, dry biomass, chlorophyll content, crop nutrient uptake and soil chemical properties. Parallel studies were conducted in a tunnel to investigate growth and yield response of Swiss chard grown on different soils (acidic, clayey loam and sandy loam soil) treated with varying fertiliser rates. The experiment was laid out as a factorial treatment structure with the following factors: Irrigation source (2 levels); soil type (acidic, clayey loam and sandy loam soil) and fertiliser application rate (No fertiliser, half-optimum recommended rate and optimum recommended rate based on soil analyses) replicated four times. The Swiss chard was grown in the tunnel in pots for 11 weeks. Crop growth and chlorophyll data, similar to that collected from the field was also collected from the pot trials. Data analysis was done using GenStat® 14th Edition (VSN International, Hemel Hempstead, UK). The results from the baseline study (experiment 1) did not reveal significant differences between treatments (TW, TWF and RFF) thus suggesting that the inherent soil fertility was high and could support Swiss chard growth. There were significant differences ($P<0.05$) between the treatments (ABR, TWF and RFF) during the winter season (experiment 2) with respect to Swiss chard biomass. Swiss chard plants produced under rain-fed conditions had lower dry mass compared with those that were irrigated using ABR effluent and tap water with fertiliser. However, the effect of using ABR effluent on Swiss chard biomass was comparable to tap water with fertiliser because these did not differ significantly. The results from the third experiment showed a lack of significant differences with respect to N and P leaching between the irrigation sources (ABR, TWF and RFF). Controlled experiments in the tunnel revealed a significant interaction between soil type and irrigation source. Swiss chard pots containing acidic soil and irrigated using the effluent showed significantly higher dry mass ($P < 0.01$), fresh mass ($P< 0.05$) and leaf area index ($P < 0.001$) compared to those irrigated with tap water. In conclusion the ABR effluent may have a liming effect which could have possibly increased Swiss chard growth in acidic soil. ABR effluent was more useful as an irrigation source in winter than in summer; however in summer the effluent could be more useful as a fertiliser source in areas where water is not limiting for crop production. N and P leaching and uptake could not be associated with irrigation using ABR effluent.