

Shrinkage Cracks and Salt Leaching in Swelling Soils - Coleambally Irrigation Area, NSW

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Cracking soils present a variety of challenges to sustainable agriculture including rapid bypass flow and water ponding. To better manage these challenges a better understanding of the dynamics of crack systems and their influence on flow and transport behaviour is required. This Masters research study focused on swelling and cracking behaviour as well as on water flow and salt leaching in a clay lysimeter.

An artificial cylindrical soil profile (diameter 1.33 m, depth 0.45 m) was constructed on a weight scale. 798 g of granular NaCl was mixed into the top 5 cm of the profile before irrigation commenced. A first set of rain simulations was carried out in March 2002 and after 33 months of drying a second series of simulations was completed in June 2005. A water and salt balance was established for the soil column while monitoring the dynamics of the surface crack network with time lapse images. The collected images were processed to determine the average crack spacing; the total crack area and the reappearance rate of cracks for each time sequence.

After the drying period of 33 months, cracks reached through the entire soil profile segregated the soil into 5 major soil peds. The cracks developing in the 2-4 weeks between irrigation events in 2005/06 reached depths of 3.5 cm or less. Cracks did not reappear at crack locations of previous desiccation periods. The swelling response of the soil surface declined with an increase in the initial moisture content of the soil matrix. During desiccation the crack spacing decreased in the first days after each rain simulation before it reached a constant value (Fig. 1).

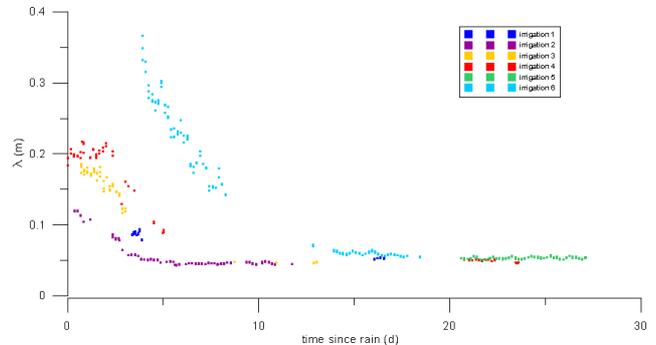


Figure 1: Crack spacing (λ) during desiccation after irrigation 1- 6

The final surface crack spacing was directly influenced by the amount of infiltrating water and varied from 4.2 cm to 5.9 cm. Figure 2 shows the final crack network after irrigation 1.

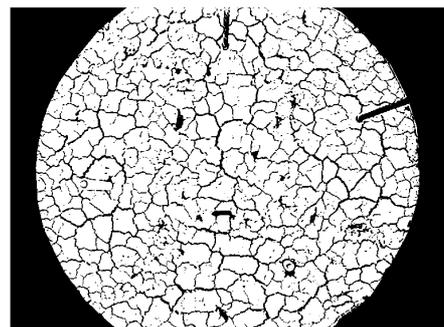


Figure 2: Separate soil aggregates at end of desiccation period

Despite cracks through the entire profile no drainage out of the lysimeter occurred during the first four irrigation events after the 33 month drying period (Fig. 3).

Once drainage occurred it showed a higher ion concentration than the drainage water collected before the 33 month drying period. This indicates increased preferential flow and transport from the saline top soil layer.