

## ABSTRACT

*Vertosols are the main soil type on which cotton is grown in Australia. Eighty percent of irrigated cotton is grown in retained hill. However, from time to time the hills may need realignment which requires knocking down the old hills and forming new furrows and hills. As a result, new hills can be relocated over old wheel tracks, causing a compacted zone beneath the hill in the root zone, thus impeding root growth. The very nature of the Vertosols lends themselves to self-repair under repeated wet/dry cycle. An attempt has been made in this study to investigate the effect of wet/dry cycles in repairing the structure of a compacted Vertosol from a commercial cotton farm in the Darling Downs of Queensland.*

*Wetting/drying experiments were carried out in a controlled environment glasshouse on intact soil cores collected from the compacted wheel furrows and adjoining hills. The effect of a number of wet/dry cycles on the infiltration rate, surface shear strength, % total crack, crack width and block size distribution, and soil porosity using image analysis was measured. Wetting was done by flooding and by simulated rainfall. Drying was achieved by surface evaporation. It was observed that five flood-wet/dry cycles resulted in a two-fold and 1.7 fold increase in water infiltration rate for the wheel and hill cores respectively. This increase was associated with a marked decrease in surface shear strength of the cores after only one wet/dry cycle for both types of wetting. Quantification of the surface soil structure parameters using a digitizer indicated that % total crack increased and shrinkage block size decreased for wheel cores with the increasing number of wet/dry cycles. Cracks became narrower and size of shrinkage blocks smaller as the number of flood wet/dry cycle increased, while rain wetting produced both bigger cracks and blocks but fewer in number compared to flood wetting. Comparison of the slope in the normal shrinkage zone for the wheel cores showed that the slope was greatest after five flood-wet/dry cycles in the 5 cm depth. The slope of residual shrinkage was 1.8 times greater after five flood-wet/dry cycles relative to pre-wet/dry cycle at 30 cm depth. This showed that five flood-wet/dry cycles had improved the structure of the soil. For hill cores, higher values of clod specific volume and the specific volume of air-filled pores (at zero water content) after one flood wetting relative to pre wet/dry cycle, in the 10-20 cm depths, suggested that bulk density had decreased and porosity increased. Rain-wetting only slightly improved the soil structure compared to flood-wetting with most improvement in the surface layer. Image analysis results showed that by far, the greatest porosity was obtained after*

nine flood-wet/dry cycles in the 0-50 mm zone depth. Combination of high porosity, increased surface area, greater pore star length and reduced solid star length suggested the development of pore spaces near the surface as a result of nine flood-wet/dry cycles. For hill cores, binary images of pores and solid showed that after five flood-wet/dry cycles considerable fragmentation occurred in the 10-100 mm zone. Five flood-wet/dry cycles increased porosity by 1.5 times more than one flood-wet/dry cycle in the 60-90 mm zone. Flood wetting caused more fragmentation of the soil than rain wetting.

Based on the results and techniques used to assess the structure changes associated with the number of wet/dry cycles, it was concluded that the soil in this study had fairly poor potential for self-repair with repeated wet/dry cycles. The techniques found useful in assessing the structure repair were the SARAN resin technique and image analysis. The usefulness of other measures can not be conclusiveness as the data obtained from these measurements were limited.