Soil Moisture in a Sealing Soil

The soils used for growing irrigated cotton in the Macquarie Valley of N.S.W. are variable and each soil type has its own characteristics and problems. A common problem of the red soils of the area is a tendency to seal at the surface reducing the infiltration of irrigation water. This restricts the ability of an irrigation to replenish soil moisture.

This example from a red sealing soil on Twynam Cotton's Elengerah Station illustrates what happened to the soil moisture levels throughout the 1990-91 cotton season. Moisture content for the top 1.3 metres of the profile, moisture contents for three key depths and root extraction patterns at the start and the end of the season all help to illustrate the infiltration problem and the subsequent loss of subsoil moisture as plants are forced to extract moisture at depth in order to continue to grow.

The soil moisture content of the top 1.3 metres of the profile throughout the season is shown in Figure 1. On the 5/12/90 after an irrigation on 1/12/91 the soil moisture level was 498 mm and this was the highest moisture level the profile reached throughout the season. The next two irrigations on the 16/12 and 26/12 also filled the profile but after this irrigations failed to bring the soil profile back to the full point. The irrigation on 10/1/91 left the profile 45 mm below full point the day after the irrigation. The field was irrigated 7 days later on 17/1 and was 80 mm below full point the next day. An irrigation 5 days later followed by 98 mm of rainfall still didn't wet the profile back to the full point with the profile being 40 mm below full point. The irrigation plus rainfall added 85 mm of water to the profile compared to the amounts of 20-50 mm being added by each irrigation.

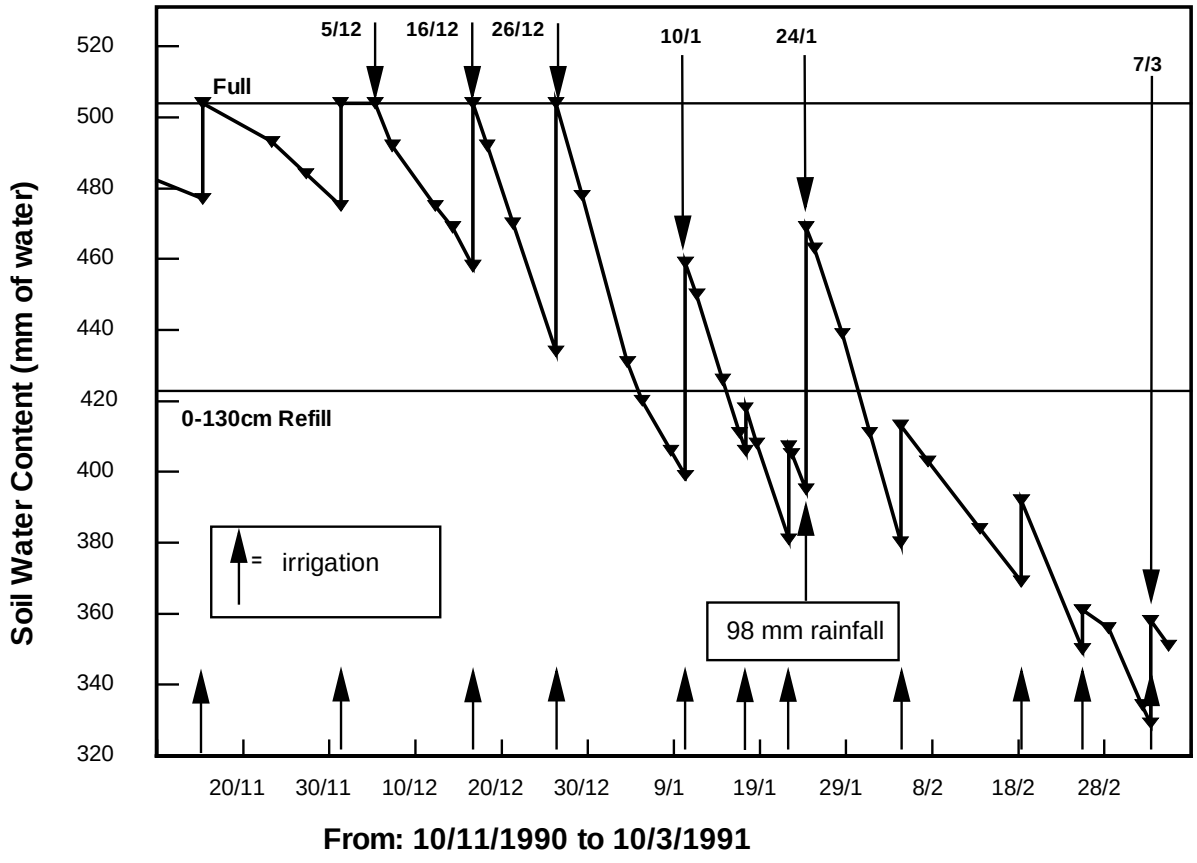


Figure 1. Soil Water Content in the 0-130 cm layer.

The soil moisture at 30 cm (Figure 2) is affected by each irrigation and up to the end of January each irrigation had reasonable success in rewetting this depth. The Volumetric Soil Water % (VSW %) dropped in February and March and soil moisture levels were 5-10 % below full point.

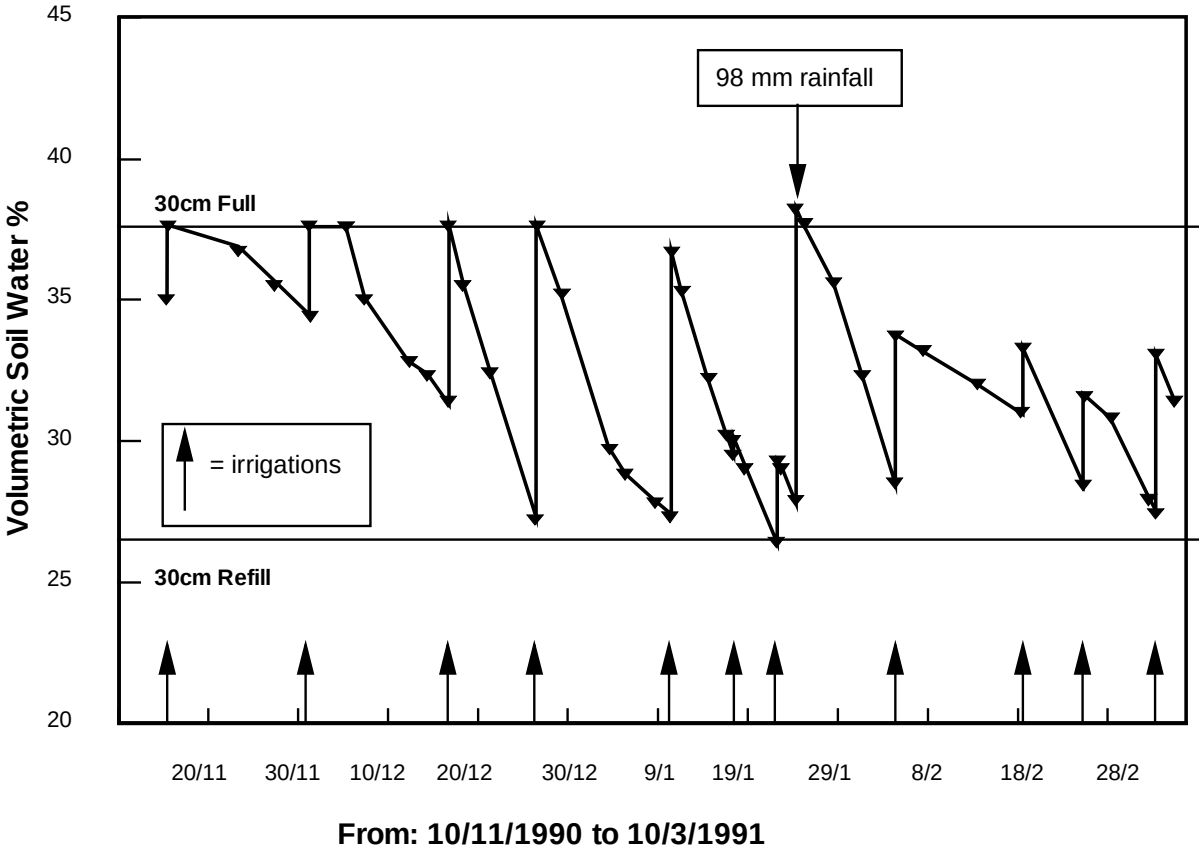
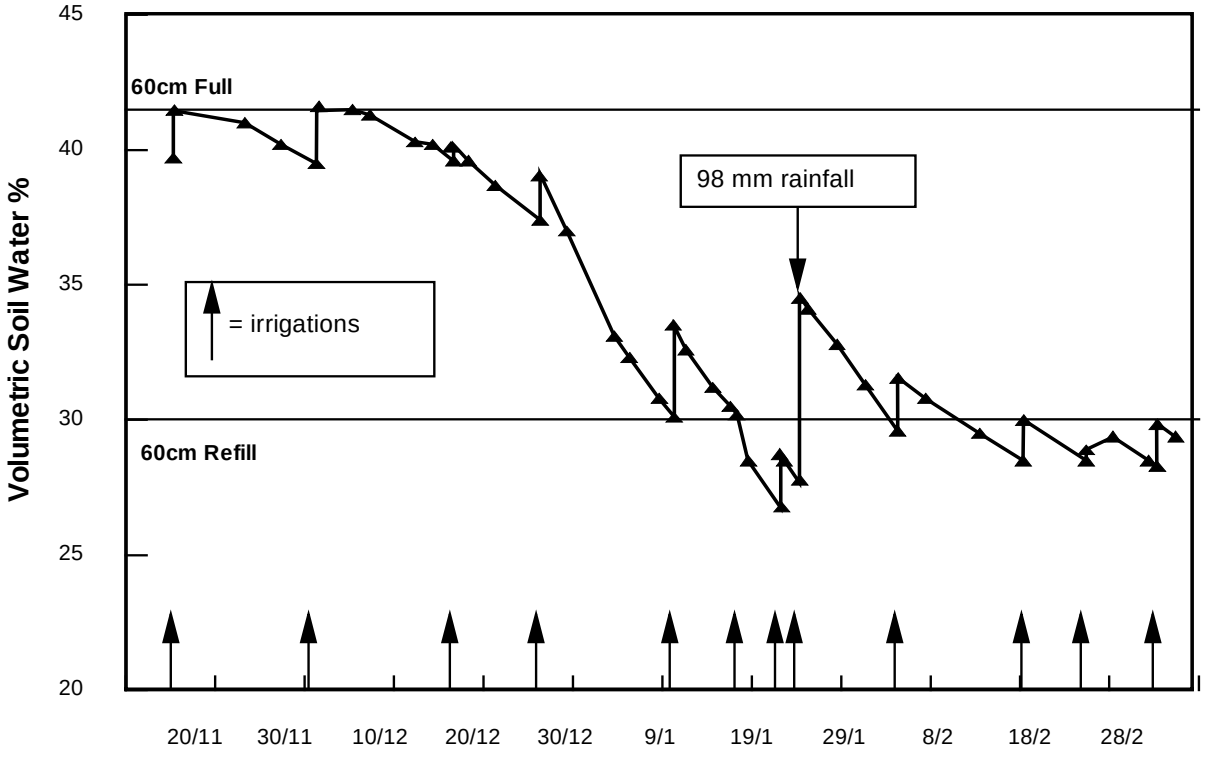


Figure 2. Soil Water Content at 30 cm.

At 60 cm (Figure 3) trouble was experienced from early December onwards in restoring soil moisture levels. During December and January the VSW % declined from 40 % to 30 %. During February and March VSW % fell below 30 % and remained there and irrigations had only a small effect on moisture levels.

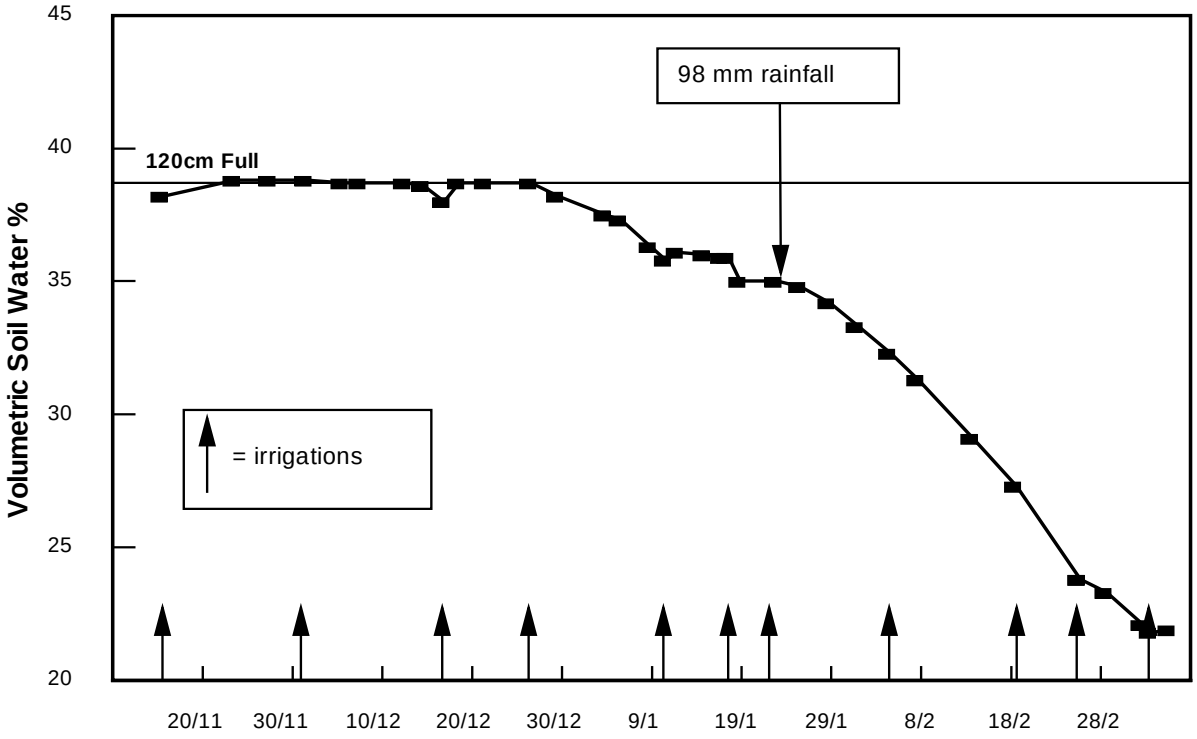
At the 120 cm level (Figure 4) the VSW % started to decline on the 28/1/91 indicating that plants were not getting enough moisture from the higher depths to satisfy demand. From this time on VSW % continued to fall as the crop continued to use moisture at 120 cm and irrigations failed to replace moisture at this depth. Water use at 120 cm was high in February as indicated by the steepness of the line in figure 4 and the 0-130 cm profile falls well below the refill point (Figure 1).

On the 7/3/91, two days after an irrigation the top 1.3 metres of the profile was 147 mm below the original full point, soil moisture at the 30 cm depth was on the refill point and at deeper depths soil moisture was well below the refill point.



From: 10/11/1990 to 10/3/1991

Figure 3. Soil Water Content at 60 cm.



From: 10/11/1990 to 10/3/1991

Figure 4. Soil Water Content at 120 cm.

The root extraction patterns (figure 5) show the large deficit in subsoil moisture that was evident at the end of the season. On the 5/3/91 large amounts of moisture had been extracted at all depths quite evenly down the profile compared to the original full point moisture levels from 16/12/90.

The onset of infiltration problems in these red soils coincides with row closure and the end of cultivation. Surface sealing appears at this time and greatly reduces infiltration rates. Rather than setting refill points these fields need to be monitored carefully after cultivation ceases and once infiltration problems are evident visual monitoring assumes greater importance. The fields have to be irrigated frequently and plants wilt quickly when stressed. Final irrigations have to continue late into the season to allow plants to finish off top bolls, and to have some moisture in the profile at defoliation.

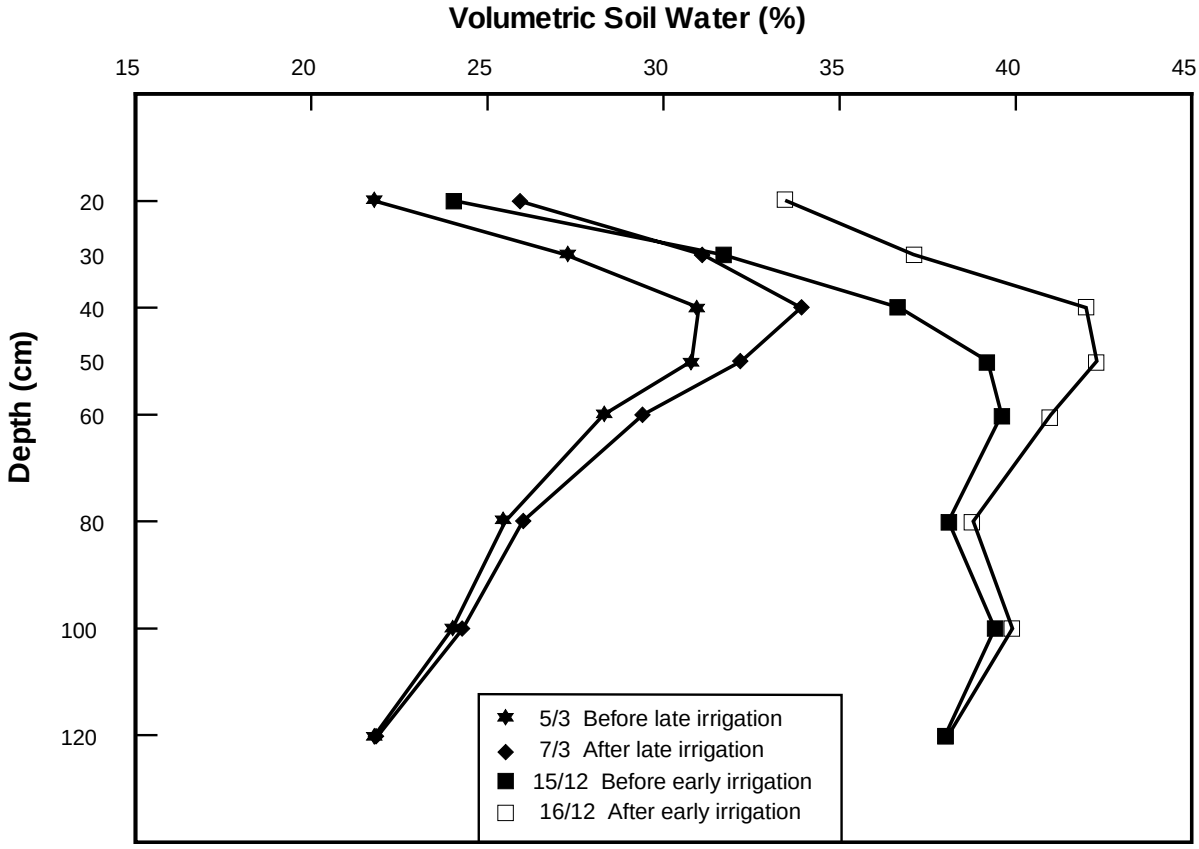


Figure 5. Water extraction patterns at the start and end of the season.

ICT International Pty Ltd
PO Box 503, Armidale NSW 2350, Australia
Ph: [61] 2-6772-6770 Fax: [61] 2-6772-7616
sales@ictinternational.com.au
www.ictinternational.com.au