The effect of sodicity severity and depth on irrigated cotton production at Hillston, New South Wales

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Abstract

Sodic soils have been highlighted as a major land degradation issue within the last decade, and currently affect a large proportion of Australia's arable land. Sodicity is known to produce yield declines, yet the failure to adequately identify the mechanisms responsible for reduced productivity, has limited the ability of landholders to target and improve the effectiveness of available amelioration strategies. In this study the direct (plant) and indirect (soil) effects of sodicity on irrigated cotton yield were examined. Twenty sites were selected in two individual fields of two farms in the Hillston district (32°28'S 145°32'E) of southwestern New South Wales, in which cotton yield varied. At each "high" and "low" yielding site, soil samples to a depth of 1.0 m and leaves from the youngest mature leaf stage were collected, with soil cores taken from topsoils and subsoils in a subset of the sampling locations.

Sodicity was not uniformly associated with yield declines across different sampling locations. Direct effects of sodicity on cotton plant nutrition did not appear to play a significant effect in yield reduction, with no significant difference in macro and micronutrient concentrations between high and low yield zones in both fields A and B. Sodicity-related soil parameters, such as ESP and aggregate instability were more severe at shallower profile depths in low yielding zones of field B, due to the influence of landforming processes. The proximity of these structurally altered layers to the root zone was therefore thought responsible for yield declines, as dispersed layers presumably reduced the water availability to the plant. In contrast, the upper 0.45 m of soil profiles at field A displayed similarly large ESP values across low and high yielding zones, yet exhibited a limited propensity for soil dispersion. In this case, yield differences are attributed to other factors such as variable irrigation rates. Where indirect effects of sodicity occurred the dataset was used to quantify 'critical' values or the point at which sodicity-induced changes impact on soil structural behaviour and crop production. Based on data compiled at field B, an ESP and ASWAT score greater than 6 in the top 0.45 m of the soil profile was strongly correlated with significant reductions in irrigated cotton yield. The ability to determine these benchmark figures could benefit landholders, allowing growers to assess the economic viability, via soil analysis, of crop production prior to sowing.

Keywords: Sodicity; sodic soils, irrigated cotton; cotton yield; Lachlan Valley