Crop production on duplex soils after landforming

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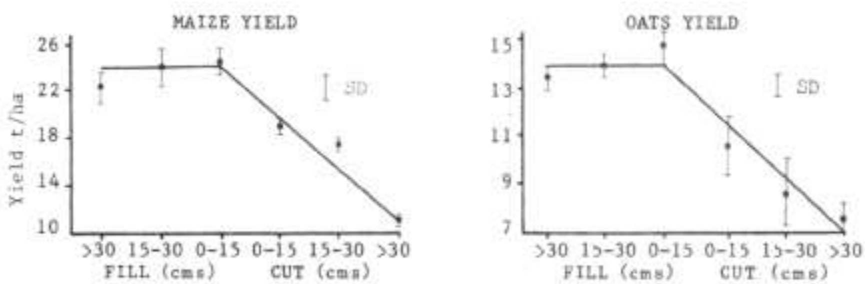
Landforming to achieve increased irrigation efficiency was reported by Pritchard and Mason at the 1982 Agronomy Conference to be causing problems with low productivity of land where the A horizon had been removed. This paper presents data collected since then. The red-brown earths of the Riverine plain have a shallow loam A horizon (10-15 cms) which contains most of the OM, N and P, while the B horizon, if exposed, has these serious limitations:

It is a heavy clay (>60%), very dense (bd 1.6), unstable (Ni+Mg : Ca = 1:1) and has low OM (.6%), low P (<2ppm), low N (<.01%) and low Zn (3ppm). This leads to problems with slaking, dispersion, water penetration, soil aeration, seedling emergence and subsequent crop growth.

Experiment 1. Field survey. DM yields of maize and oats shown on the graph are from a 2.5 ha bay where landforming resulted in a large range of cut (soil removal) and fill (extra soil added) levels.



Yield progressively decreased as depth of cut increased, but yield did not progressively increase where extra soil was added, so that overall productivity was decreased.

Experiment 2. Topsoil replacement. 3 Treatments. 1) Normal soil, 2) Exposed subsoil + ripping + gypsum + compensatory fertilizer (N+P). 3) Exposed subsoil + gypsum with 7.5 cm of topsoil replaced. An additional sub treatment of more frequent irrigation was included viz.(E-R 45 mm cf 75 mm).

Results. Maize grown after topsoil replacement achieved the same yield as on normal soil while on exposed subsoil the yield was reduced by 29%. There was no advantage from more frequent irrigation of the exposed subsoil. Zinc deficiency symptoms appeared in the young crop in treatment 2, and remained until anthesis despite foliar Zn application.

Experiment 3. Topsoil v subsoil in pots. In an experiment designed to remove the physical limitations in the field (ie., drainage, water supply, aeration, density), and test chemical nutrition, maize on subsoil with NPK and Zn yielded as well as topsoil. Without Zn, subsoil yield was reduced by 33%. There was no extra response to a more complete micro-nutrient treatment. Thus Zn deficiency can be an important limitation to maize yields on subsoil. However, when crop nutrition is corrected and physical limitations artificially removed, yield is restored to normal. Data from an oat crop being grown under a similar range of treatments will also be presented.

Conclusions: Under field conditions, production from exposed subsoil is substantially less than from normal soil. Amelioration by deep ripping and adding gypsum plus compensatory fertilizer does not overcome this problem in the field, even if irrigation frequency is increased. Topsoil replacement is an expensive option but as it can immediately restore productivity, its cost can be balanced against the cumulative losses from exposed subsoil.