Crop Response to Amelioration of Agricultural Soils are Mediated by Constraint Combinations and Soil Type

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Over the past decade alternative strategic deep tillage approaches have been developed to complement more established soil amelioration methods. Strategic tillage takes the form of a one-off or occasional intervention, implemented to overcome a number of soil and biotic constraints. Deep ripping can effectively remove subsoil hardpans and potentially delve up some subsoil to the surface depending on tine design. Deep soil mixing, using rotary spaders or large disc ploughs, can mix and incorporate topsoil and amendments deeper into the soil profile and reduce topsoil repellence. Soil inversion, using mouldboard, square or one-way disc ploughs, can bury surface-applied amendments, as well as repellent topsoil and weed seeds. While these techniques principally address soil constraints, some also improve weed control and reduce frost damage. A review of published and unpublished crop response data collated from replicated research trials and on-farm large scale strip trials over the past 12-years was undertaken to assess the impact of tillage and soil type on crop yield response. Subsoil compaction is a key constraint on deep sandy-textured soils and deep ripping gives first-season average wheat yield increases of 0.7 t/ha (36%), provided it is deep enough to effectively remove the hardpan. Shallower ripping is less effective with first year average wheat yield increases of 0.25 t/ha (12%). Rotary spading has similar cereal grain responses to inversion ploughing in the first two seasons post treatment. Size of the average yield gain reflected yield potential of soils and environments. Average gains in cereal yields from soil inversion were 0.5 t/ha (61%) on pale deep sand, 0.7 t/ha (42%) on a higher yielding deep sand over clay or gravel duplex soil and 0.9 t/ha (29%) on forest gravels in the higher rainfall zone. In cases where the inversion did not significantly increase yield, seasons were very dry or crop establishment was poor due to herbicide and/or wind damage or surface crusting. Higher yield potential, more fertile soils, maintained the cereal yield benefits for a longer time after amelioration than the pale deep sands. For the pale sands, the average increase in yield benefit for soil inversion or deep mixing after three or more years was 0.2 to 0.3 t/ha and for about half the sites the response was not significant. For the other soil types average yield benefits in excess of 0.5 t/ha were maintained for three or more years after amelioration