Alleviation of soil compaction: requirements, equipment and techniques

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Abstract

The nature of soil disturbance required to alleviate soil compaction in a range of agricultural and land restoration situations is identified. Implement geometry and adjustments required to achieve the desired brittle or tensile deformation of compacted soil arc discussed. Field. operating procedures to achieve the required degrees of soil fissuring, loosening or soil unit rearrangement using the power units and equipment available arc described. A new progressive loosening technique is identified for use within deep, extremely compacted soil profiles. Emphasis is given to the importance of making visual field checks across the loosened soil zone at an early stage, to check the desired disturbance is being achieved. Care must be taken during subsequent trafficking operations, to minimize the risk of recompaction.

Keywords: Soil compaction, soil loosening, recompaction, land restoration

Introduction

Considerable time, money and energy are required to alleviate soil compaction. Such effort can be well justified in situations where, because of dense soil conditions, soil aeration, root development and water percolation are severely impeded (Soane & van Ouwerkerk, 1994). Unfortunately the operations are riot always successful; they may not always be needed and the power requirement as evidenced by the density of tractor exhaust smoke during the operation is not always a good measure of success. Unwanted secondary problems can also arise such as increased cloddiness, diruption of natural root and water pathways, and in the absence of subsurface drainage, increased waterlogging. Soils left in a very loose open condition are also particularly susceptible to recompaction. The need for loosening operations, particularly in the subsoil, therefore, needs to be well established before work commences.

Experience within agriculture indicates that many of the shallower loosening operations to about 300-350 mm depth are successful, whilst the results from deeper operations can be disappointing. Subsequent weather conditions can also have a major influence on crop response following loosening. A three-year subsoiling experiment on 16 sites in the UK on different soils types, failed to produce yield responses except on compacted sandy soils in spring cropping (Soane *et al.*, 1987). The responses, or lack of, were closely related to moisture deficits and hence moisture stress levels during subsequent growing seasons, Where crop moisture stress was small, responses were zero or minimal. In clayey soil situations, natural recovery can occur in dry years through swelling and shrinkage, negating the need for mechanical operations. A North American review of subsoiling experiences also revealed many situations where the yield response was zero and again where responses did occur, most were associated with improved water availability and aeration (Burnett & Hauser, 1967).

In land reclamation following mineral extraction or pipeline installation, it is not uncommon to find that remedial subsoiling has failed to prevent continuing crop loss. This failure has been, in some cases, because of the subsoiling being either too shallow or too deep for the equipment used. In the latter case, the subsoiling tines generated narrow slots through the compact layer without inducing significant reductions in soil bulk density.

'Therefore, the reasons behind such variable responses are many. In a number of cases, particularly for deeper operations, the degree of impedance to roots and water percolation may not have been sufficient to require attention in the first place. In others, the nature of the soil disturbance may have been inappropriate or inadequate, or the equipment

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