"Soil compaction problems may occur at different depths, taking different forms and require different treatments for their successful alleviation."

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SUBSOILING

Improved minimal tillage tools offer great advantages in reducing the time, energy and cost of soil tillage. However their benefits may be thwarted if the soil at depth is compacted, and crops cannot achieve their yield potential.

Soil compaction problems may occur at different depths, taking different forms and requiring different treatments for their successful alleviation. Surface layer problems (<250mm) usually arise through surface trafficking and animal trampling. In other situations compaction may be in the form of a pan. In such cases, remediation may be complete pan disruption or the creation of fissures through the compacted zone to allow root, air and water penetration. Deeper (>350mm) problems usually take the form of more massive soil conditions containing minimal cracks. They may be caused by very high surface loadings, during poorly executed restoration or through natural consolidation.

One of the best ways of detecting compaction is to observe the growing crop in the late spring. Often the zones suffering most will be tramlines, headlands and gateways. It is recommended that farmers should dig a profile pit to detect the depth of compaction/depth of rooting, and if the roots are deeper than the subsoiler tines there is little benefit in remedial action.

Soil moisture conditions

Generally the drier the soil conditions then the better the ability of the subsoiler to shatter the soil, especially for conventional tines without wings and leading shallow tines. Should the soil be plastic at depth the tine foot could create a "square mole channel" rather than shatter the soil. This may not be a complete loss as the leg, acting like a mole plough, can produce cracks to assist in water movement from the soil surface to any deeper drainage (natural or man-made).

Depth of work

The subsoiler tines should be set to work approximately 25mm below any discreet layer (pan) or as deep as the tractor can sensibly pull when the subsoil is massive. Do not operate the tines any deeper than required as the draught force increases dramatically with tine depth. Operating conventional tines too deep can cause them to operate below their "critical depth" (about 5 to 6 times the width of the tine point, e.g. 0.40 to 0.45m deep for a 75mm wide point) and that can restrict the overall zone of loosening, as shown in Figure 1a, and cause the "square mole channel" effect referred to earlier, as shown in Figures 1b and 3 (right). The attachment of wings to the foot of the subsoiler prevents this, as shown in Figures 2b and 3 (left). While the addition of wings increases the draught force this is far outweighed by increases in the amount of soil disturbance and the potential to increase the tine spacing.

Figure 1. Subsoiler tines working above (a) and below (b) their critical depth.

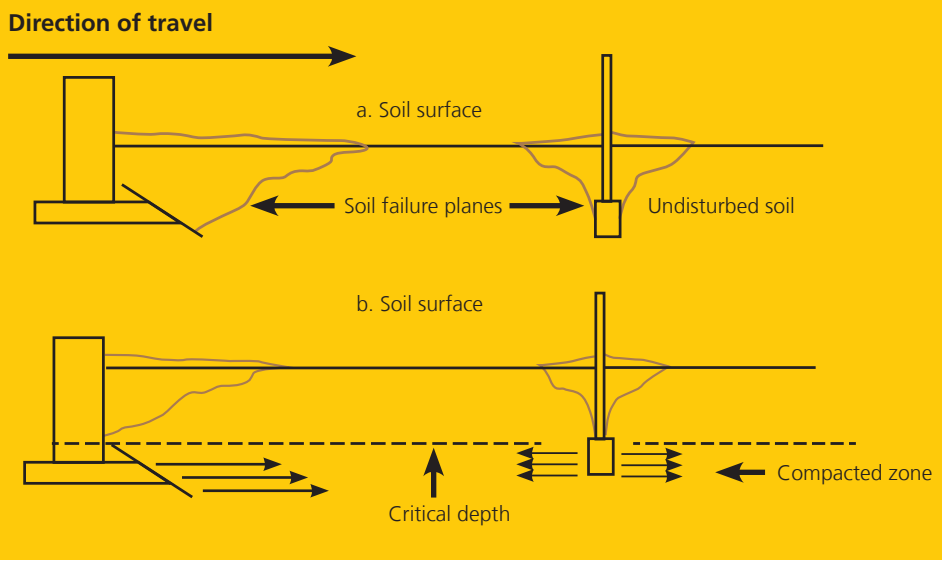

Figure 2. a. and b. Soil disturbance without and with wing attachments, c. Soil flow over wing.

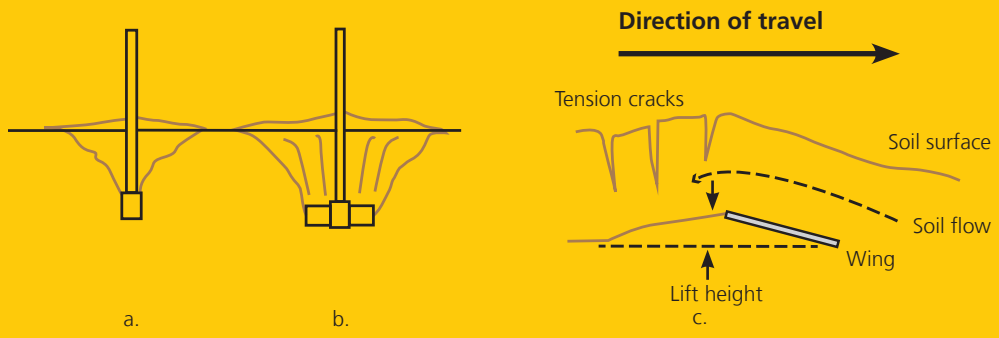

Figure 3. The soil disturbance produced by a tine working below its critical depth (left) and that produced by a winged subsoiler (right)

Tine spacing

The optimum spacing for conventional and winged subsoiler tines in friable soil conditions is 1.5 and 2.0 times the depth of work respectively. Please check that you are obtaining the correct sub-soil disturbance and adjust the spacing accordingly.

Wing lift height

Commercially available wing attachments are available with different lift heights. Those approaching 50 to 75mm are designed to work at depths greater than 0.40m and leave a more broken/cloddy surface whereas shallower lift height wings (25mm) are designed to leave relatively even surface with tension cracks (see Figure 2c) at shallower depths. These can cause minimal surface disturbance and mixing, which together with disc attachments can be used to ease the compaction in grassland.

Direction of travel

This is most likely to be in the general direction of cultivation/harvesting in the main body of the field, but should focus on compacted tramlines/combine/trailer wheeling marks rather than the entire field depending upon previous traffic management/soil conditions. Compaction at the headlands should be conducted along the field boundary, this will probably require overall loosening, whereas that along the tramlines could concentrate on the wheel marks only.

Post cultivation management of land

Loosened soil is prone to re-compaction and in certain instances one sequence of field operations could re-compact the soil to the same if not greater density than it was prior to loosening. To overcome these problems the following alternatives are suggested for following operations: -

1. Adopt a 1 pass system incorporating deep loosening, surface cultivation and drilling,
2. Reduce the weight and inflation pressure using a low ground pressure system, or
3. Control field traffic to predetermined track lanes, namely controlled traffic farming.

When not to subsoil

Generally avoid disturbing the soil when either in “plastic” or “extremely hard/dry” conditions. Clay soils that have naturally cracked below subsoiling depth, may not benefit from soil loosening, however, these cracks may close as a result of swelling following autumn/winter rainfall. In this instance carefully study the deeper rooting habits to see if there are signs of roots between the soil peds, and if so decide not to disturb the subsoil.

In any crop establishment system good soil structure to depth is critical to enable crops to achieve their full yield potential by enabling the rooting system to exploit the available moisture and nutrients, and to enable excess water to drain naturally to the deeper soil horizons or to a subsurface drainage system.