



A clear solution for farmers

CATCHMENT SENSITIVE FARMING

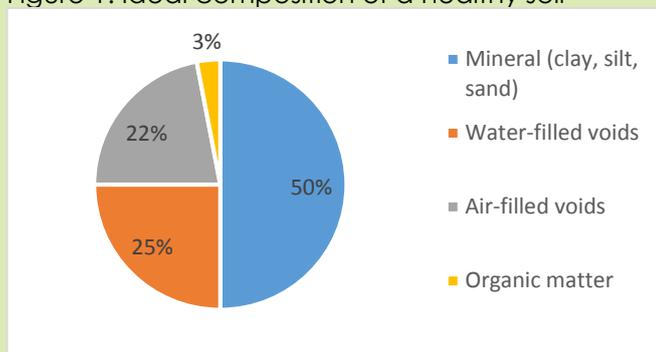
Tyres and Compaction

Soil compaction occurs where the soil is compressed. It can be caused by machinery and/or livestock and can be present in both arable and grassland fields. Compacted soils have a reduced infiltration rate, increased risk of generating surface run-off and therefore present a greater risk of causing water pollution. Tyre types and pressures can affect the level of compaction within soil. Incorrect tyre choices and inflation rates can result in excess wheel slip and higher levels of compaction.

What is the issue?

A healthy soil allows optimum plant growth and productivity, figure one shows the composition of a healthy soil.

Figure 1: Ideal composition of a healthy soil



Compaction can occur at a range of depths throughout the soil profile, ranging from surface compaction to over 300mm deep. Compaction is more likely to occur in wet conditions because the wet soil can bear less weight than dry soils.

Machinery damage on livestock farms is caused by slurry spreading, manure spreading and silage making. Compaction from these operations occurs at the soil surface as surface ruts or deeper compaction down to around 300mm depending on soil conditions.

In arable situations, compaction commonly occurs during cultivations, harvest, spraying and other spreading operations in the tramlines. Widespread compaction can occur in heavily trafficked fields where machinery can commonly run over 80% of the field area.

The compaction reduces the volume of the water and air filled gaps within the soil structure. It reduces movement of water, nutrients and gases, which limits crop production.

How soil compaction contributes to Water Pollution:

Compaction reduces rainfall infiltration and the vertical movement of water and gases through the soil profile. This results in water pollution via surface runoff and poor growing conditions for both arable and grassland crops.

The reduced infiltration causes water to accumulate on the surface that can lead to runoff, which becomes an increasing risk as slope increases. Runoff can be a serious issue even on modest slopes of over 3° and particularly on long slopes which can generate high water volumes

resulting in sheet erosion and creating rills and gullies.

Picture 1: surface run off due to poor soil structure



Surface run-off results in the loss of soil, nutrients, pesticides and other pollutants which can amount to a significant financial cost. The lost soil components end up in watercourses, ponds and lakes and reduce water quality, causing serious problems for the aquatic wildlife as well as increasing the costs and difficulty of water treatment for human consumption.

How tyres and axle load create compaction:

Inflation pressure, contact area and axle load influence the level and depth of compaction. It is important when planning field operations to choose the right tyre and pressure to do the work and carry the weight without producing compaction.

The impact of incorrect tyre choice and inflation pressures on soil compaction:

Picture 2 demonstrates the impact of conventional tyres on the right and low pressure tyres on the left.

Picture 2: Impact of conventional and low pressure tyres on soil



How to avoid soil compaction caused by tyres and machinery:

Factors to consider before starting fieldwork:

- What is the power requirement?
- Tractor weight requirement
- The load on each tyre?
- Field and road speed
- Axle weights

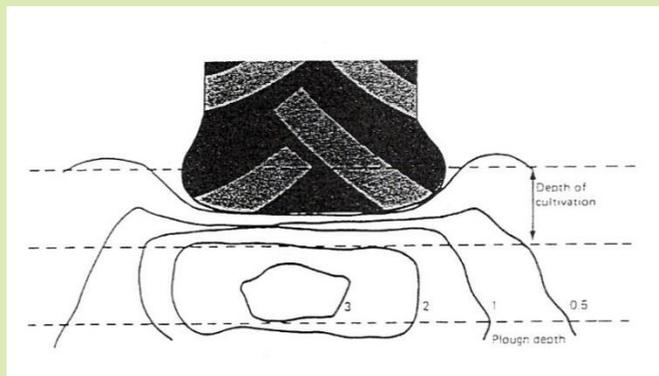
In order to reduce the risk of compaction:

1. the weight of the vehicle should be spread over as large a footprint as possible;
2. using the lowest inflation pressure possible;
3. keep within axle weight limits;
4. Fit the largest section/diameter tyre at the lowest safe working pressure.

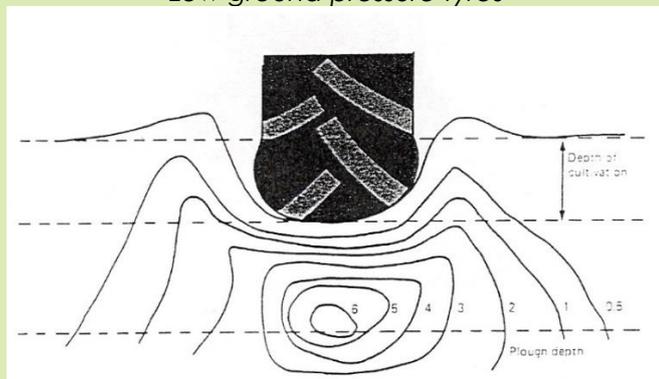
Reducing working tyre pressures can be achieved by using wider tyres of greater diameter with flexible walls. These tyres have a larger footprint to spread the load

over a greater area, see figure 2 below. It is important to consult tyre charts through manufacturers or suppliers or by the tyre company apps.

Tyre pressures for field work are lower than those required for travelling to the field by road. This is because as speed increases, so does the pressure required to carry the load. Therefore, a compromise on pressure results in high in-field pressures and an increased risk of compaction as well as a lower than optimum road pressure that reduces tyre life.



Low ground pressure tyres



Conventional tyres

Figure 2: Impact of contact area

Inflation pressure of over 1bar (15psi) should be avoided in field work to reduce the risk of compaction when soils are moist. However, greater pressures may not result in compaction when soils are dry and hard to depth.

It is important to reduce the risk of soil compaction by using the correct tyre pressure. This will reduce surface runoff from the field and tramlines and therefore prevent water pollution.

Latest Research:

Recent tyre manufacturing developments include Improved Flexion (IF) and Very High Flexion (VF) tyres. These tyres have thinner walls than conventional radial tyres and are designed to flex far more for the same size tyre carrying the same weight.

These tyres are designed to:

1. work at lower pressures;
2. save fuel by reducing compaction and rolling resistance; and
3. be more flexible and last longer

In addition, the reduced compaction risk reduces the likely area of sub-soiling required each year, providing a longer working window for crop establishment and saving time and fuel.

Further information available:

- Defra (2010) The Fertiliser Manual (RB209), section 2, 8th Edition.

- The Catchment Sensitive Farming Website: www.naturalengland.org.uk/csf