

The bigger the better has downsides

Tractors torment the soil

Agricultural vehicles are far too large, says soil researcher Guido Bakema. They compact the soil, which inevitably has negative consequences.

It has to be admitted they look very impressive, those giant tractors deploying equally massive machines to harvest the crops quickly and efficiently. And agricultural machinery seems to be getting bigger and bigger. But is that actually good for the soil?

The answer is a resounding 'no', says researcher Guido Bakema. He is an expert on soil compaction. Farmland is suffering from the increasing pressure put on the soil from the ever heavier machines. 'The weight increases by 20 per cent every 15 years,' says Bakema, who is worried about the consequences of this trend for the soil. He argues that 'soil compaction is a secret killer'.

The reason for the trend is obvious: efficiency. 'Bigger machinery makes it possible to work faster, with fewer labourers.' But a fascination with size also plays a role. 'As with cars, people love the huge machines. I have a neighbour who thinks it's amazing to drive his tractor, perched high above the road, racing along at 50 kilometres an hour.' But there is a downside to that fascination. The soil is gradually becoming compacted, which has an effect on how it functions. Yields fall because it becomes harder for water and air to penetrate the soil. In dry periods, plants can't reach the water further beneath the surface. During heavy downpours, fertilizer and chemicals are more likely to be washed off into the ditches.

So far, many farmers can keep the

problems at bay by using irrigation and fertilizers. 'The negative effect on yields also depends a lot on the soil type and the weather. Plants are affected more in dry years than in wet years, because in wet years the plants don't need to reach the water that is deeper under the ground.' But not all farmers have the option of irrigation, says Bakema. 'In many areas, you are likely to face bans on the use of surface water. So you would need to use groundwater, but that isn't always available, or it's brackish.'

Ploughing and turning

If soil gets compacted, ploughing or turning it over can loosen it. But that only affects the top layer, whereas the problem is mainly in the deeper layer 25 to 50 centimetres below ground level. 'The deeper a particular plant's roots go, the more it is affected by compaction; for instance in the case of maize with roots going down 80 to 90 centimetres. However, the problem also affects plants

'Farmers don't have complete control over their land anymore'



Text Roelof Kleis

that don't normally have deep roots but need to access deeper water when there is a drought: they can't get to the water because of the compact soil.' Plants adapt if at all possible, according to research (the project 'Delving into Soil Compaction') that Bakema and colleagues carried out for the Ministry of Agriculture. If a maize plant senses compaction, it produces thicker roots. Bakema: 'The roots are twice as thick and therefore strong enough to penetrate the compacted layer. Once the roots have passed through that layer, they become thin again. What is more, research by colleagues at Utrecht shows the roots of some plants secrete a kind of lubricant that makes it easier to penetrate a compacted layer.' Problem solved? Unfortunately not. 'The thicker roots cost the plant energy,' continues Bakema. 'That is energy it can't invest in growth above ground, which is a big disadvantage.'

Even so, the study shows that plants with deep roots can be one solution. 'The soil

has a porous structure,' explains Bakema. 'When you put weight on the soil, the pores are compressed. Our research shows larger pores compress more easily than smaller pores. That means the porous structure survives to some extent. Plants with deep roots can penetrate those smaller openings. They don't churn up the soil completely, but that isn't necessary because they do prepare the soil for the next crop. If you use a combination of plants with deep roots and a variety of root systems, you will create a diverse soil structure.'

That finding has consequences for the definition of compacted soil. A simple indicator was used for a long time: the dry weight of a cubic metre of soil. If that exceeds 1,600 kilograms, the soil is compacted. 'This norm was set – for sandy soil – by a German professor in the 1970s, and it has been used as the yardstick ever since. But our research

shows soil compaction is a sliding scale because soil can be compacted at values below that norm. Or a particular soil can be naturally above that norm. It depends on the type of deposits that created the soil. Anyway, you never know what a soil was like originally. There isn't a single square metre in the Netherlands that hasn't been stamped on by humans. We therefore advocate putting less emphasis on the bulk density and more on the distribution of the soil's porosity. That is far more important.'

Setting limits

Even so, prevention is better than cure. In a policy advisory report for the ministry, Bakema therefore recommends setting limits for the weight (10 tons per axle) and tyre pressure (1 bar) of agricultural machinery. The greater the tyre pressure, the greater the weight the tyres can take. 'There is a similar weight limit for trucks

on the roads because otherwise they would damage the bridges and asphalt. So why not have a limit for agricultural machinery on farmland? If you don't set a limit, the trend of ever larger machines will simply continue. Of course, it also depends on what weights you are carrying onto the land. If you are spreading manure, you could take half a tank instead.'

According to Bakema, a lot of farmers know deep down that the heavy machinery isn't good for the soil. 'But they are trapped in the agricultural system. Farmers don't have complete control over their land anymore. They need to be competitive and deliver their products on time, and they often depend on agricultural contractors for this. They in turn inevitably use large machines to get the job done efficiently. What is more, a lot of land is leased, so the farmer is only farming it temporarily. That complicates the efforts to prevent soil compaction.' ■

'Soil compaction is a secret killer'



Agricultural machinery is becoming heavier and heavier, which is causing soil compaction and affecting how the soil functions: it is harder for water and air to get into the soil. • Photo Shutterstock