# Got Compaction?

## You can't manage what you can't measure.

This is an old business management adage that can be applied to soil management as well. Unless you measure or make good recorded observations it's difficult to know if something is improving or getting worse. While soil changes due to management practices can take months or even years to become apparent, there are measurements that can be used to monitor and measure changes in soil health.

## Penetrometer

One such measurement is field penetration resistance which is used to assess soil compaction. Field penetration resistance can be measured using a simple tool called a penetrometer. A penetrometer consists of a cone tip, a metal shaft, and a gauge that measures resistance in pounds per square inch (psi).

The gauge *(shown in the first picture on the right)*
The penetrometer comes with two different sized tips which correspond to two different scales. The outer scale and inner scales correspond to the larger 3/4 inch tip (for soft soils) and the smaller 1/2 inch tip (for hard soils). Readings in the green zone are ideal. The yellow zone indicates soil conditions that are not ideal. The red zone indicates the inability of plant roots to penetrate the soil and thus likely having a negative effect on crop yield.

The shaft *(shown in the second picture on the right)*
The shaft of the penetrometer is graduated in three inch increments so that both surface and subsurface compaction can be detected. The increments will also allow you to determine the depth at which the compaction occurs.

Use *(shown in the third picture on the left)*
Slow even pressure should be applied to the penetrometers when taking readings. The penetrometers should advance into the soil at a rate of approximately 4 seconds per 6 inches or less.

The theory is logical. The greater the psi reading as you slowly push the penetrometer through the soil, the greater the difficultly plant root penetration through the soil will be. Roots cannot penetrate the soil with readings above 300 psi. The shaft of the penetrometers is graduated (usually in 3 inch increments) so you can also detect the depth at which the compaction is occurring.

## When to Test

The best time to test for compaction is when soil moisture is at field capacity. Usually this is reached several days after a good rain. The soil should not be


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saturated but it should be moist and never test for compaction if the soil is dry. If the moisture conditions are not ideal, the readings might be harder to interpret. For example, if the soil is quite dry, the readings will indicate that the level of compaction is far greater than what the readings would indicate if they were taken at field capacity moisture.

## Putting the Information to Use

Having a good handle on your levels of compaction will give you important information to take into consideration when planning for the growing season. If your soils are showing slight compaction you may choose to incorporate plants with more aggressive and deeper roots into your crop rotation, or as a cover crop. Cornell University recommends fall mustards, forage radish, medium red clover and sweet clover to break up deep compaction. Hairy vetch, forage turnip and white clover are recommended to break up surface hardness. In more extreme cases it may be necessary to consider subsoiling, which will help for a while but eventually the soils will resettle and subsoiling may be necessary again. However, the best way to tackle soil compaction is a little preventative medicine. Reducing the traffic in a field both in terms of number of passes and axel load will help prevent compaction as well as trying to stay off the fields when they are wet. As well, maintain good organic matter levels. Surface applied organic matter will increase the resiliency of surface soil and incorporated organic matter will aid in soil aggregation thereby reducing compaction and increase water infiltration.

Whatever strategy you choose to employ to prevent or alleviate soil compaction, by taking some simple measurements, you'll have the satisfaction of knowing whether your plan has been a success or whether it's time to try plan B.

This photo shows induced compaction in a high traffic zone in the field. Both surface and subsurface compaction was substantial in the area around the specialist. The penetrometer readings were greater than 300 psi. The edge of the field, near the penetrometer (red circle), had been left in perennial cover and there was no indication of compaction. This illustrates how land management can greatly influence soil physical structure. In one case, annual cropping (corn) and high traffic have led to significant compaction. In the other case, no traffic and the presence of roots year round resulted in no detection of compaction.

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