

SOIL AERATION BASICS

INTRODUCTION

Along with correct soil nutrition and soil biology, proper physical structure of the soil is essential for a healthy soil. Only a healthy soil will provide the best plant growth and response – especially when the plant is exposed to adverse environmental conditions such as drought, hot and cold extremes (including frost) and floods. An ideal soil consists of about 25% air, 25% water, 45% minerals, 5% organic matter and less than 0.5% soil biota, with soil structure housing all these components.

The physical condition of soil can be described in several ways; soil type (sand, silt, clay), texture, organic matter (OM), slaking, aggregation and compaction are some. A number of these can be changed by human intervention or management, while others can not. An open free draining soil has better plant-available chemistry, including pH, and is more biologically active due to air and water presence. There is a close relationship between the three soil parameters of **Nutrient**, **Physical structure** and **Key biology**, which means by changing soil physical structure the plant available nutrients change and so too will the activity and numbers of soil biology.

Compaction is one soil limiting factor that can be managed with aeration. Aeration can be naturally occurring, or mechanically improvised with the right equipment. It is important to have an open uncompacted soil so it can hold the necessary air and water, is structured so roots can easily penetrate without being impeded and provides the right environment for soil biology to build habitat, diversity and numbers. The best example of this is a soil with many active earthworms burrowing to make air and water pathways and in the process creating worm (vermi) caste to feed the roots as they follow. *Earthworms will only do this if they have enough soil bacteria to feed on – and soil bacteria live in and around organic matter in the presence of air and water. Aim for 20-30 earthworms in a spade square and deep for optimum natural aeration making mechanical aeration redundant.*

WHY IS SOIL COMPACTED?

Soil compaction can come about by a number of different causes, with some being clearly manageable and others externally imposed due to certain conditions, but still within the control of the land manager. Managing for soil health and reduced compaction means that over stocking/over grazing must be avoided, machinery access minimised or restricted to designated tracks, only necessary cultivation performed with suitable equipment, perennials and not annual plants encouraged and stock kept off paddocks that are excessively wet. Cumulative effects of seasonal extremes such as drought or flood and pre-existing soil compaction due to certain soil chemistry and physical conditions are typical causes of naturally occurring compaction which can be largely addressed.

HOW TO ASSESS COMPACTION

Soil compaction is measured by using a calibrated penetrometer or can be estimated with experience by using an improvised device such as a metal rod or wire. It is important to be able to measure soil compaction because research has shown that soils that resist greater than 300psi will restrict most plant roots' downward movement, will often slow or prevent soil rehydration and will also have a detrimental chemical and biological effect. *Note that a compacted soil forms formaldehydes and alcohols which are extremely toxic to plant roots, with aerobic beneficial soil biology also reluctant to build their homes in this toxic environment. Root or acid mat and peat soils are associated with this condition.*

As with normal soil sampling techniques, many points across a paddock should be tested and measured with a calibrated penetrometer to ensure a paddock profile is reasonably accurately mapped. This is needed so that the correct management action can be selected from the options available. Be sure to particularly check around tracks, stock camps, fence lines (existing and old), manure pads, in places of changed vegetation and high spots versus low spots. Note the variations in relation to the different surface indicators (such as weeds or plants with more vigour) by taking as many probes as reasonably able and dissecting the paddock if levels and depths vary considerably.

SOME MANAGEMENT CONSIDERATIONS

The choices to deal with compaction are predicated on several considerations. The severity of the compaction, the urgency in recovering the soil, the need to rehydrate the soil/subsoil, the risk to creating (or even positively arresting!) soil erosion, the risk of losing existing pastures/plants, timing of mechanical aeration (not too wet for fear of damaging soil structure), soil topography and access with machinery, equipment availability and cost (contract versus capital purchase)

and the number of repeat treatments are some of the up-front deliberations. Indirectly, grazing or plant management, comparing high cost vs low cost production system attributes, recognising and managing the soil building qualities of soil biology (macro and micro-biology can perform aeration and soil structure formation), and last but not least the unpredictable seasonal outcomes based on weather events must also be factored into the decision making process.

Ultimately, the bottom line is that either mechanical aeration is undertaken for immediate results, or the natural processes supported so that recovery can take place over a longer time period by allowing soil plants and soil life to perform its task of rejuvenating the soil. The final decision is usually balanced against the financial cost of purchasing or hiring/contracting equipment and the benefit that can be reasonably expected versus low cost but time and season constrained natural processes.

If mechanical aeration is required, select the correct equipment once the paddock survey has been made by matching the depth of the compaction layer to that of the equipment's capacity. There is no point in deep ripping/aerating soil when the compaction layer is on or just beneath the surface, nor is there any value in using a surface aerator when compaction is deeper than the equipment can reach.

If the natural biological option is taken for either recovery or maintenance, always ensure the soil organisms are protected, watered and fed by keeping some plant material on the soil surface at all times – and preferably maintain a continuously growing perennial plant base mix by using a Holistic Grazing or plant management system wherever and whenever possible.

DO'S AND DON'TS SURROUNDING SOIL COMPACTION

DO check your soil regularly with a penetrometer - especially during seasonal changes in autumn and spring.

DO measure compaction before any new crop is sown to be sure roots can go deep for moisture and nutrients.

DO dig into the soil with a spade to assess soil moisture, smell, plant root direction, vigour and active growth.

DO check for soil adhesion to plant roots – a measure of active soil biological activity and good structure.

DO encourage earthworm activity by leaving a litter layer of food and shelter.

DO allow adequate rest and recovery time for soils and plants after grazing.

DO manage towards year round perennial growth of plants so active roots continue to explore the soil.

DO select the most appropriate equipment for the job when the decision to aerate or cultivate is made.

DO use aeration as a means of directing early autumn rainfall into the root zone to encourage root depth.

DO check the results of any actions by monitoring the soil before and after the action was taken. *(This means a site assessment that could extend to soil nutrient and biological testing by a laboratory.)*

DON'T expect soil aeration to fix all soil problems –it is just one tool to help support soil health and production.

DON'T drive all over paddocks with heavy machinery or equipment and not expect compaction.

DON'T use aeration/cultivation equipment that leaves a smeared surface of compaction, eg, rotary hoe, discs, etc

DON'T mechanically work wet soils because this will destroy its structure.

DON'T overwork soils (includes over stocking, over grazing and over cultivation.)

DON'T keep stock on wet soils where pugging takes place unless deliberately done as a sacrifice paddock.

DON'T expect a shallow cultivation or aeration to remedy a deep soil compaction problem.

DON'T remove all vegetative cover from soil – especially during the hot dry months and at flood times. *(Severe surface compaction can take place from raindrops alone if bare soil is exposed to these rapidly falling water droplets.)*

This information sheet is provided by AgriSolutions for the benefit of its client soil managers.



P O Box 81
DARNUM VIC 3822
P/F 03 5627 8663

E info@agriculturalsolutions.com.au
W www.agriculturalsolutions.com.au