

Treading & Pugging – Time to Stomp it out

What is treading

Treading is when the hooves of grazing animals deform the topsoil and affect the growing environment for pasture. Its incidence is related to factors such as rainfall, soil physical properties and grazing intensity.

The effects of treading

Treading by grazing animals can have two main effects on soil physical properties:

Pugging - where soils are very wet (ie close to saturation), the penetration of animal hooves pugs the surface soil. Pugging involves remoulding the surface soil and the destruction of any large soil pores. During this process there can also be extensive tearing and burying of pasture plants

Compaction - at lower soil moisture levels (ie around field capacity), pugging is less of a problem. The soil is still plastic and malleable and can be compacted by treading of grazing animals. Like pugging, compaction will destroy soil pores vital for plant growth. Compaction depth can vary from 2 to 12 cm below the surface.

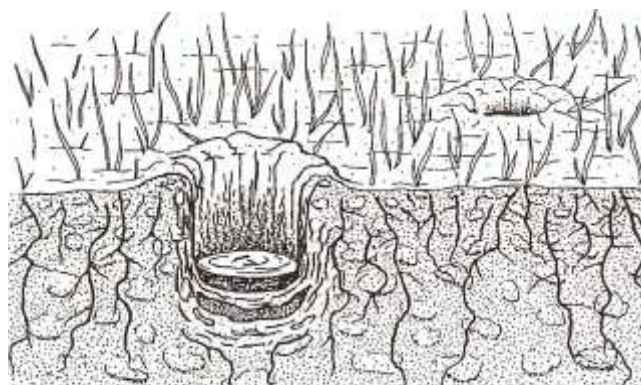


Figure 2. The effects of pugging on soil structure and the pasture growing environment.

Effects of treading on pasture production

The consequences of treading on pasture production occur through direct damage to plants and indirectly through compacted soil conditions limiting subsequent growth:

Crushing and bruising of leaves and stems, damage to roots and burial of plants in mud can cause a direct and significant reduction in subsequent pasture yield.

Compaction reduces the volume of large pores in the soil, thus restricting the movement of water into the subsoil. This increases the soil's susceptibility to waterlogging and anaerobic conditions, which can restrict plant root growth. In addition, compaction increases mechanical resistance to root growth. As a result of these factors, pasture production can be reduced.

Trials were carried out at Agresearch's Ballantrae Hill Country farm near Woodville, using rising two-year-old cattle at three different stocking rates and three threshold moisture levels. Initial results after two years showed:

On wet soils (moisture content above 40%) in the winter and high stocking rates (greater than 300 head/ha/day for 24 hours every 4-6 weeks) the pasture growth rates were reduced by as much as 50%. This reduction persisted throughout the spring and summer but by the autumn the pasture growth rates appeared to have recovered. Over the first twelve months this amounted to a 35% reduction in pasture production, or a drop in effective carrying capacity of over 3.2 stock units per hectare (su/ha). Assuming a net income of \$40/su, this represents a loss of \$128/ha. Other effects included a drop in white clover production of over 50% and consequently a reduction in the ability of the sward to fix nitrogen. The impact on the soil resource was even more pronounced. The ability of the soils to drain water, under saturated conditions, fell from 57 mm/hr to 16 mm/hr at the end of the first year. Earthworm numbers were also reduced more than threefold by the effects of cattle during the first year.

In the second year at the same stocking rate and soil wetness, pasture growth did not exceed 25 kg DM/ha/day at any time in spring or summer. Legume growth was also reduced by 75%. The overall reduction in pasture growth at the end of the second year exceeded 54%. This represents a drop in effective stock carrying capacity of over 4.2 su/ha and a loss in potential farm income of over \$168/ha.



Figure 1. A mob of dairy cows causing severe treading damage under wet conditions

Not all stock treading was negative in the first year. For example, on moist soil (less than 40% water content) and medium stocking (150 head/ha/day for 24 hours every 4-6 weeks), legume growth was enhanced by cattle hooves breaking up the browntop turf and creating niches for white clover to exploit. This however did not persist into the second year.

Factors affecting the severity of treading

A number of factors influence the degree of soil compaction caused by animal treading. These include:

a. Soil water content

Soil water content is the most important factor affecting the severity of compaction. Under very wet conditions puddling occurs causing serious damage to the soil close to the surface, as well as the pasture plants themselves. At or near field capacity, where the soil is plastic, soil compaction often occurs. Whilst this damage is not always visible at the surface, it can occur to considerable depth (greater than 10cm). Removal of stock from pasture during and shortly after heavy rainfall can, therefore, significantly reduce treading damage.

b. Treading Pressure

Because of their weight, cattle impose a greater treading pressure on the soil surface than sheep. The calculated pressures imposed by sheep are around 100 KPa compared to 200-400 KPa for cattle. As a result, the pressures imposed by cattle hooves can be significantly more damaging to soil structure than those associated with sheep. Increasing the grazing intensity with either animal will increase the degree of compaction and soil disturbance suffered.

c. Soil Type and Initial Structure



Figure 3. The orange mottling and gleying colours within the profile indicate poor drainage and care would be required for grazing with heavy stock under wet conditions.

Different soil types can tolerate different intensities of treading before becoming damaged. Some differences are due to differences in drainage characteristics. Those that are well drained, drain more rapidly after rain and are, therefore, susceptible to severe compaction for much shorter periods. Weakly structured soils with low strength are most susceptible to compaction. Newly cultivated paddocks and those recently resown or aerated generally have low strength and should not be heavily stocked when wet.

On grazed hill country, treading and the resulting disturbance of surface soil can result in increased losses of soil and nutrients through erosion and runoff. Erosion losses generally increase with increasing grazing intensity and are greater under cattle than sheep.



Figure 4. Hill country soils are also prone to pugging damage from heavy cattle under wet conditions.

Practices to Limit Treading

Management options that could be considered in developing an on-farm strategy for wet soils susceptible to cattle treading damage include:

a. Utilise the different soil types and land management units on the farm

Make use of differences in the physical properties of soils (eg drainage, bearing strength) and land slope and aspect (eg sunny faces) to protect those soils most susceptible to treading damage in vulnerable months. This requires having a good understanding of the physical robustness of the soils and necessitates the inclusion of soil management in the feed budgeting exercise. As the areas of robust soils or land management units decrease there is a greater need to introduce flexibility into the stock management policy during vulnerable periods of the year.

b. Off-pasture standing areas

Feeding pads, tracks and lane-ways, are options that are generally only available to intensive beef producers and those in the dairy industry. Natural metal based pads, such as stream beds and banks, are not an option because of the effects on water quality. Woodlots planted for soil conservation or timber production may be an option for standing livestock off pastures during susceptible periods. Another option is intensive drainage of small areas.

c. Livestock Policy

In setting a farm livestock policy the sheep to cattle ratio, the ratio of young to older cattle, and the livestock buying and selling policy have implications for the possibility of damage to the soil by stock treading at critical periods. These considerations should be an integral part of the decision making process. Off-farm grazing is an option that at present is only available to the dairy sector.

d. None of the above apply

Where all soils are susceptible to physical damage and none of the above options apply there are few options available to livestock farmers. Consideration should be given to the following:

- Spreading the stock classes most likely to cause treading damage over the whole farm. However, this raises stock management issues such as the difficulty in controlling intake at pinch periods, which often coincide with the wettest parts of the year.
- Restricting treading damage to a small part of the farm and using mechanical amelioration (aeration) methods to restore pasture. This is probably not a long-term option given the need for the pastoral sector to be able to demonstrate their commitment to sustainable land use.
- Targeting a specific part of the farm to carry those heavy cattle likely to cause the most damage at critical times each year. Paddocks could be ranked on their previous treading damage and their inherent susceptibility to treading. This approach would again require the inclusion of soil management in the feed budgeting exercise.
- The most practical option is to prepare pastures in advance using knowledge that continuously-grazed sheep pastures are dense and resilient to one or two cattle treadings in any one year. This option could be combined with the third option of targeting specific parts of the farm at critical times of the year.

Remedial Actions

Over-drilling or oversowing, cultivation and cropping, and aeration are practical methods to overcome damage to soil on some classes of land. Mob stocking with sheep in summer to restore the soil surface is another option. Protecting the area from further damage in the following years is likely to minimise the long-term problems.