

# MANAGING ERODED SOILS FACT SHEET

## When lack of ground cover and low rainfall combine, wind erosion can occur

### Using soil testing to determine a nutrition management plan specific to eroded soils in the southern region

#### KEY POINTS

- Losing just one millimetre of topsoil equates to 12 tonnes per hectare and can result in yield losses of between one and six per cent.
- Long-term soil nutrient management is important as many critical nutrients need to be replaced as fertiliser.
- Soil testing can help determine phosphorus and nitrogen budgets for eroded soils.
- Re-evaluation of production zones prior to soil testing is important as erosion may have changed nutrient distribution, resulting in new high and low production zones.
- It is recommended that at least 20 per cent of the farm is soil tested each year, to allow for comparable results year-on-year.
- Cover crops or stubble retention provides soil coverage without disturbing the top layer of soil.

Photo: AgCommunicators



Soil erosion after a bushfire.

#### Introduction

Dry conditions coupled with severe wind events during 2018 and 2019 caused significant erosion within some southern region cropping paddocks.

Erosion can cause a range of effects, from large dust storms which move soil particles hundreds of kilometres, to small wind events which only move finer fractions of soil a few metres across the paddock surface.

During erosion, the topsoil of paddocks settles in places where the wind slows, such as around fencelines and trees,

while the finer fractions can continue moving, resulting in uneven paddocks.

Wind erosion occurs when there are wind speeds strong enough to dislodge the soil particles on a susceptible soil surface, such as areas with little ground cover.

The removal of valuable topsoil rich in key soil nutrients and organic matter is detrimental to soil and crop performance.

Losing just one millimetre of topsoil is the equivalent to losing up to 12 tonnes of soil per hectare and can result in a one to six per cent yield loss.

#### Nutrition of eroded soils

Soil testing is the first step in developing long-term soil nutrient management plans. Pre-sowing soil testing is important as many critical nutrients can be applied as fertiliser at seeding.

Soil phosphorus and nitrogen levels in eroded paddocks are highly variable due to the nature of wind erosion.

In the highly eroded areas, the previous subsoil constraints will now become the topsoil limitations.

However, in areas where there was no crop growth in the previous season,

there is a chance the soil will have a higher nutrient status as nutrients applied as fertiliser will not have been utilised by the crop, resulting in carryover.

## Phosphorus

In most cases soil phosphorus levels are maintained with annual fertiliser applications. However, erosion can deplete the pool of phosphorus as it is often concentrated in the topsoil and is relatively immobile.

Research has found that only 3 to 10 per cent of fertiliser phosphorus is taken up by the plant in the year of application, with the remainder going into the soil phosphorus pool.

Applying fresh phosphorus in the drill row can improve phosphorus uptake in developing plants and can increase crop yield.

When determining a phosphorus budget, the amount of plant available phosphorus in the soil profile at the start of the season should be considered along with the soil's phosphorus buffering index and the amount applied compared to the likely crop uptake and removal in grain or other products.

Trials conducted in drought-affected areas of South Australia and Victoria in 2019 with investment from the Grains Research Development Corporation (GRDC) showed that low production zones can be associated with low extractable phosphorus.

However, adequate phosphorus levels determined through soil testing indicated that only replacement fertiliser strategies were required in some cases. (Table 1).

## Nitrogen

Nitrogen is a more mobile nutrient in the soil than phosphorus and is mostly stored in organic matter in the topsoil. Although topsoil erosion will reduce the amount of available nitrogen, mineral nitrogen may still be available deeper in the soil profile.

There can be significant carryover of fertiliser nitrogen applied in the previous year and increased mineralisation of nitrogen from soil organic matter after the drought.

The GRDC study also found the soil nitrogen status can be higher in low-production zones. This is often caused by a soil constraint or an unidentified

phosphorus deficiency, suggesting the low crop yields of the previous season resulted in nitrogen carryover. In some cases these levels of carryover nitrogen were enough to grow wheat crops which yielded two tonnes per hectare without any fertiliser nitrogen (Table 1).

Sand dunes have very low organic carbon (OC) levels but may have reasonable nitrogen levels due to carryover after low production seasons. Low OC indicates these systems need to be heavily reliant on nitrogen fertiliser inputs to meet crop demand in a good season.

Creating a nitrogen budget can help growers track and estimate how much nitrogen is needed for a growing crop.

This involves understanding the soil nitrogen available at sowing, estimating the likely amount of net mineralisation in-crop and then determining the additional amount of fertiliser nitrogen required to achieve the yield target.

The amount of mineralised nitrogen available to the crop will depend on the soil organic matter content, when the season break occurs, soil type and paddock history.

**Table 1. Mean nutrition results for 18 paddocks that experienced soil erosion sampled in three zones represented by dune, mid-slope and swale.**

Sampling Zone		OC %	Profile Mineral N kg N/ha	*N yield potential t/ha	Colwell P mg/kg	PBI	#DGT P ug/L
Sand - Dune	Mean	<b>0.27</b>	<b>69</b>	<b>1.72</b>	<b>19</b>	<b>20</b>	<b>75</b>
	Minimum	0.08	30	0.75	11	13	20
	Maximum	0.34	183	4.58	32	38	153
Mid Slope	Mean	<b>0.44</b>	<b>81</b>	<b>2.01</b>	<b>20</b>	<b>34</b>	<b>77</b>
	Minimum	0.18	37	0.93	11	12	22
	Maximum	0.92	210	5.25	29	93	186
Flat - Swale	Mean	<b>0.70</b>	<b>150</b>	<b>3.75</b>	<b>25</b>	<b>62</b>	<b>79</b>
	Minimum	0.45	67	1.68	11	16	24
	Maximum	1.11	246	6.15	51	112	167

\*N yield potential calculated based on requiring 40 kg N/ha per tonne grain/ha. #DGT critical range for wheat is 48-70 ug/L.

Photos: AgCommunicators



Sampling from different production zones allows identification of soil constraints throughout the paddock.

## Fertiliser application

Soil testing is essential to determine fertiliser application rates and management strategies, especially after wind erosion events. The need for nitrogen and phosphorus applications on areas of erosion may be lower than anticipated.

Eroded soil is typically sandy in nature with low OC, and can struggle with buffering high rates of fertiliser or herbicides. For this reason, reducing chemical input on eroded soils can reduce soil stress and ensure the soil continues to be fertile.

When costs are an issue following droughts, a short-term option is to reduce nitrogen and phosphorus inputs at sowing. Top-dressing nitrogen can be considered later in the season in response to crop growth.

## Soil testing

Soil testing is integral in managing eroded soils, as the results can help determine the levels of nutrients within the new zones created by wind erosion throughout the paddock.

The most accurate way to estimate these levels is to regularly soil test.

Devising a soil testing strategy is important as most paddocks have areas of varying productivity due to several factors including soil type and topography. Therefore, determining high and low production zones using yield and soil maps and normalised difference vegetation index (NDVI) data is crucial.

Although growers may have already established production zones in a paddock prior to a wind erosion event,

redetermining these zones is important as erosion may have changed nutrient distribution, resulting in new high and low production zones.

By considering where soil has moved from and to, across the paddock and farm, and using data sets such as Normalised Difference Vegetation Index (NDVI) or soil imaging, new production zones can be determined.

Sampling from different production zones, rather than across a paddock transect, allows identification of possible soil constraints throughout the paddock.

As soil nutrients found in-row can inaccurately represent paddock nutrient availability, growers should also ensure samples are taken inter-row as this will provide more accurate results and recommendations for the season ahead.

Often growers do not have the capacity to soil test each year, so it is common practice to test each paddock every four to five years on a rotational basis.

It is recommended that at least 20 per cent of the farm is soil tested on a

rotational basis to monitor long-term changes in soil fertility across the whole farm.

It is important to understand subsoil constraints, such as compaction, acidity, boron and sodicity levels, particularly where topsoil has been lost. These will constrain root growth and the uptake of fertilisers and may result in a build up of soil nutrient levels.

## Management of eroded soils

Management of eroded soils will depend on the seasonal outlook and severity of the damage which has already occurred (Table 2).

Cover crops and stubble retention provides soil coverage without disturbing the top layer of soil. However, it may be impossible to retain soil cover in some regions due to dry conditions.

In these situations, stock should be removed, particularly from sandhills.

Growers may look to cultivate if the soil

**Table 2. Various soil types and appropriate soil erosion management strategies (PIRSA Rural Solutions).**

Soil type	Treatment
Sand, loamy sand, clayey sand > 1m depth	<b>Avoid disturbing soil in any way.</b> Import clay; spread, level and incorporate into topsoil (clay spreading).
Sand over clay – clay within 1m of surface	Remove surface soil to expose clay; extract clay; spread, level and incorporate into sand (clay spreading).
Sand over clay – clay within 60cm of surface	Rip into clay layer; bring clay to surface; level and incorporate (delving).
Sandy loam to heavy clay	Rip or cultivate to leave clods on surface.



Photo: Alistair Lawson, AgCommunicators.



Cultivation can roughen the soil surface and reduce the velocity of wind but this is not recommended for sandy soils (see Table 2).

type is suitable (see Table 2), or spread clay to reduce drift.

Watching paddocks drift can be heartbreaking, but it is best to concentrate on the future and look at putting new soil management plans in place.

Understanding the soil structure and texture of the paddock, along with soil nutrition through soil testing, are key steps in developing a management plan for eroded soils.

Being proactive and focusing on a soil management plan will ensure growers are prepared for the risk of wind erosion in the future.

## Cover crops

Areas where the topsoil has eroded away will be low in organic matter. Planting a crop which produces high biomass such as barley will provide rapid cover.

If the soil is limited by sodicity, boron and/or salinity, barley will be the most reliable cover crop.

When sowing in eroded areas, seeding depth control is very important as the soil surface is likely to be loose.

In the areas where the topsoil has accumulated, the soil may need to be spread out prior to sowing.

## Retaining stubble

Having some ground cover by retaining stubble – even a small amount – is an effective way to reduce the amount of wind erosion in the future as it reduces wind speed at the soil surface.

At least 50 per cent ground cover is recommended to minimise the risk of erosion (Figure 1), although tall standing stubble is more effective than loose trash.

Stubble retention also has other benefits including improved soil structure,

moisture infiltration and conservation, provision of nutrients and soil microbiology.

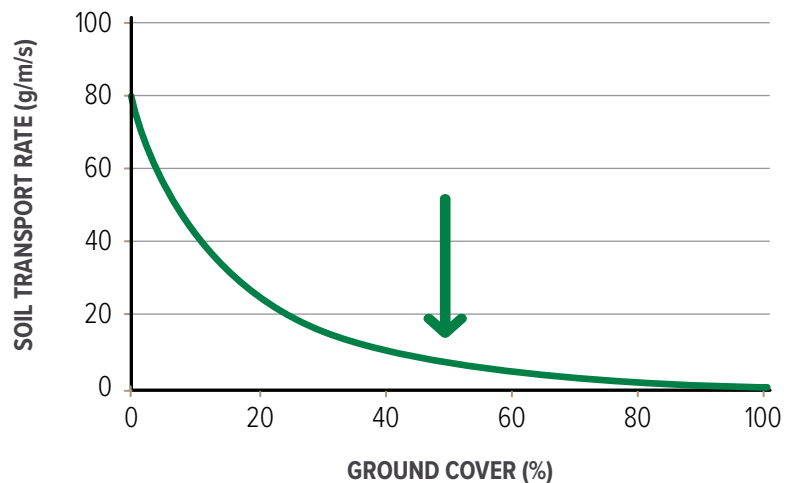
## Cultivation

Emergency measures can reduce the risk of wind erosion by stabilising the soil until protective cover can be re-established.

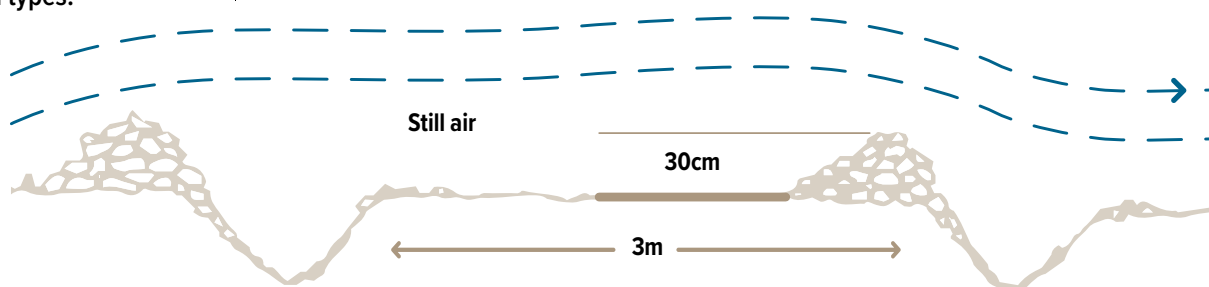
The aim of these treatments is to roughen the soil surface and reduce the velocity of wind sweeping over the land (Table 2).

Creating a 30-centimetre high ridge of clods on sandy loam to clay soils can help

**FIGURE 1.** Having some ground cover is an effective way to reduce the amount of wind erosion, slowing wind speed between crop rows.



**FIGURE 2. Creating a 30-centimetre high ridge of clods can provide three metres of soil protection in a paddock on suitable soil types.**



protect the soil surface for a distance of about three metres behind the ridge (Figure 2).

The amount of clay in the soil will determine its ability to form clods and protect the paddock from wind erosion.

In soils that have enough clay in the subsoil – greater than 20 per cent – roughening or ridging the paddock surface via deep or aggressive tillage can be effective in retaining topsoil. The success of this depends on the soil type, with clay soils more likely to hold.

On particularly sandy soils, an armouring layer of heavier, coarser particles which are more resistant to erosion may form

following an erosion event. It may be best to leave the soil rather than disturbing it with machinery, vehicles or animals to ensure the seal remains intact for some protection.

### Clay Spreading

Clay may be spread on soils to improve soil texture to reduce the risk of erosion and improve soil fertility and water holding capacity.

Incorporation of clay on sandy soils also overcomes water repellency.

However, claying is a major operation with significant costs, and hence requires careful planning. See Useful Resources for more details.

### MORE INFORMATION

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### GRDC RESEARCH CODE

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### USEFUL RESOURCES & REFERENCES

**GRDC, Stubble Initiative** <https://grdc.com.au/stubble-initiative>

**GRDC, Soil Testing YouTube** [video playlist](#)

**GRDC Spread, Delve, Spray, Invert: A best practice guide to the addition of clay to sandy soils** [https://grdc.com.au/\\_\\_data/assets/pdf\\_file/0035/75698/grdcspreaddelvespadeinvertpdf.pdf](https://grdc.com.au/__data/assets/pdf_file/0035/75698/grdcspreaddelvespadeinvertpdf.pdf)

**PIRSA Rural Solutions, Emergency measures to curb wind erosion fact sheet** [https://www.pir.sa.gov.au/\\_\\_data/assets/pdf\\_file/0009/328869/Emergency\\_Measures\\_to\\_curb\\_wind\\_erosion\\_RSSA\\_FS\\_20180911.pdf](https://www.pir.sa.gov.au/__data/assets/pdf_file/0009/328869/Emergency_Measures_to_curb_wind_erosion_RSSA_FS_20180911.pdf)

**NSW Department of Primary Industries, Saving soil – A landholder’s guide to preventing and repairing soil erosion** <https://www.dpi.nsw.gov.au/agriculture/soils/erosion/saving-soil>

**Mallee Sustainable Farming, Stubble Management: A guide for Mallee Farmers** [https://www.msfp.org.au/wp-content/uploads/GEE-A5-Stubble-Guide-low\\_res.pdf](https://www.msfp.org.au/wp-content/uploads/GEE-A5-Stubble-Guide-low_res.pdf)

**WA Department of Agriculture and Food, Report card on sustainable natural resource in agriculture: wind erosion** <https://www.agric.wa.gov.au/report-card-conditions-and-trends/report-card-sustainable-natural-resource-use-agriculture-western>

**GRDC Tackling Soil Amelioration for Variable Soil Types handbook** <https://grdc.com.au/tackling-amelioration-on-variable-soil-types/>

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