Understanding the

FAS report

SALINITY AND SODICITY

FAS Agricultural Laboratory

Introduction

Soil salinity and sodicity are crop limiting conditions associated with the excess build-up of free salts (salinity) or excess sodium (sodicity). The FAS Agricultural Laboratory at SASRI undertakes routine soil salinity and sodicity analysis to identify the extent of the salinity or sodicity problem, while providing gypsum recommendations in the case of sodicity problems. This guide provides assistance on interpreting the salinity and sodicity report.

For details on irrigation water quality for soil health, see SASRI Information sheets:

- **5.11 Properties of saline/sodic soils and their reclamation.**
- **5.12 Water quality for soil health,**

For guidance on filling the submission form, see FAS booklet:

- **How to fill the soil salinity and water sample submission form.**

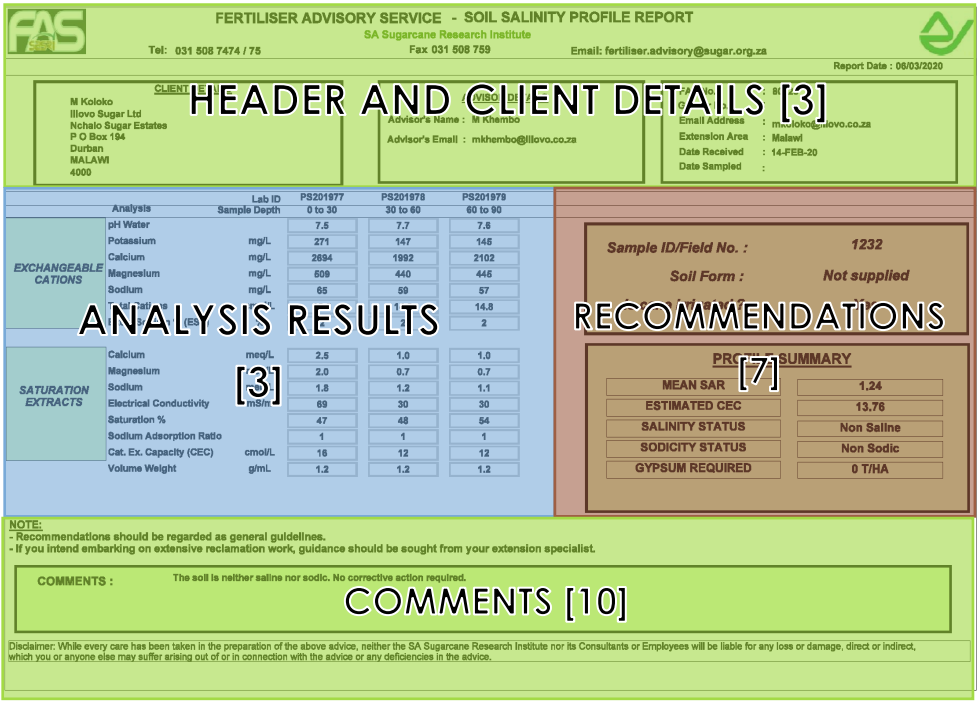
These are available from the Knowledge Hub at www.sasri.org.za

Salinity and sodicity report contents

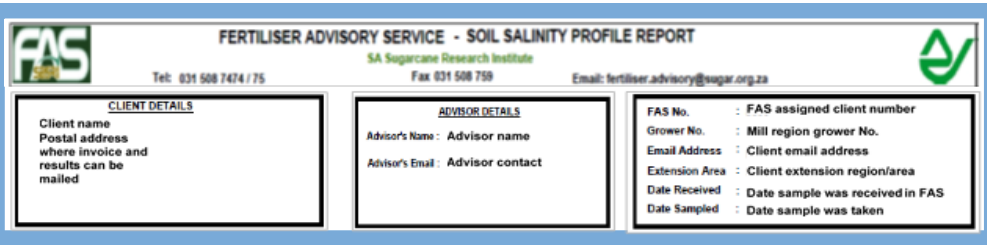
This booklet provides guidance on interpreting the salinity and sodicity report. Gypsum recommendations are provided for samples with sodicity problems.

Click the report menu or blocks below to navigate.

Page numbers in [ ]



Header and client details



These boxes reflect information on the submission form when a client submits a salinity or sodicity sample for analysis.

Analysis results

	Analysis	Lab ID / Sample Depth	PS192853 0 to 30	PS192854 30 to 60	PS192855 60 to 90
EXCHANGEABLE CATIONS	pH Water		8.2	8.5	8.1
	Potassium	mg/L	520	518	478
	Calcium	mg/L	4778	4333	6085
	Magnesium	mg/L	2279	3243	3085
	Sodium	mg/L	2827	4628	5048
	Total Cations	cmol/L	56.3	69.8	79.0
	Exch. Sodium % (ESP)	%	22	29	28
SATURATION EXTRACTS	Calcium	meq/L	10.1	6.7	28.8
	Magnesium	meq/L	13.3	12.3	31.8
	Sodium	meq/L	30.4	39.7	57.2
	Electrical Conductivity	mS/m	501	545	875
	Saturation %		172	186	182
	Sodium Adsorption Ratio		9	13	10
	Cat. Ex. Capacity (CEC)	cmol/L	38	44	43
	Volume Weight	g/mL	1.2	1.3	1.2

An FAS Lab ID is assigned to each sample (unique number prefixed with "PS"). For each sample depth, a measure of Exchangeable Cations using a salt extraction is provided, as well as a measure of soluble cations from saturated paste extracts (Saturation Extracts). Recommendations (Profile Summary) and agronomic comments (Comments) are based on soil test values for that profile.

pH Water: This is an indicator of the acidity or alkalinity and used as a diagnostic criteria to distinguish if a soil is sodic or not. The classification criteria for a sodic soil is pH water >8.5, though values approaching >7.5 should monitored more closely (with SAR) as this indicates potential future sodicity problems.

Exchangeable base cations (K, Ca, Mg and Na): The exchangeable concentration of Ca, Mg, K and Na in the water is used to determine the total cations and exchangeable sodium percentage (ESP). In salt affected soils this value also includes the soluble cations (free cations) in the soil, thus may represent an over-estimation of the true exchangeable cations.

Total cations: This is the sum of available major cations (Ca, Mg, Na, K). This value is used in the determination of the ESP value.

Exch. Sodium % (ESP): This is the amount of Na expressed as a % of the total cations, an indication of the sodicity of a soil:

$$ESP\ (\%) = \left(\frac{\text{Exchangeable sodium}}{\text{Total cations}} \right) X\ 100$$

Values above 7% are considered potentially problematic and deserve closer attention. Heavy, poorly draining clay soils are more susceptible to the effects of sodicity than well drained soils. Where irrigation is taking place, or in in low lying areas with water accumulation, and heavy clay soils, this value must be monitored for potential sodicity impacts.

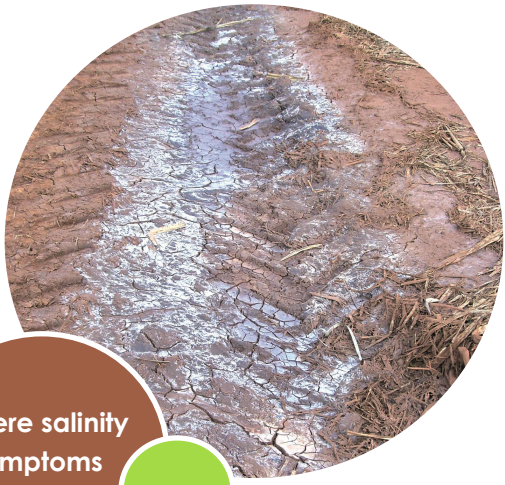
Soil salinity and sodicity are primarily diagnosed using the amount of soluble salt in the soil.

Soluble Calcium and Magnesium (meq/L): Indicates the amount of soluble Ca + Mg in solution. Excess amounts can lead to salinity problems, reflected in an excessively high electrical conductivity value.

Soluble Sodium (meq/L): Excess soluble Na is associated with sodic conditions that lead to structural degradation, particularly of clay soils. The concentration of soluble Na relative to Ca + Mg is an indication of the potential risk of sodicity (See Sodium Adsorption Ratio below).

Electrical conductivity (EC; mS/m): An indicator of the amount of soluble salts in the soil. Excess soluble salts can lead to water stress in plants (osmotic stress). Values approaching 200 mS/m suggest development of saline soil conditions, while >400 mS/m are considered saline.

Saturation %: The amount of water required to make the saturated paste. This value varies depending on clay content and type in the sample, and usually increases with sample depth (as clay content increases). It is useful to convert this value to a mass basis.



Severe salinity symptoms in soil.

Sodium Adsorption Ratio (SAR): An indicator of the potential negative effects of Na in the water (representing the proportion of Na to Ca + Mg, on a charge concentration basis). It is calculated as follows:

$$SAR = \frac{\text{Sodium}}{\sqrt{\text{Calcium + Magnesium} \div 2}}$$

The critical SAR value depends on soil type. Where this is not supplied a default critical SAR value >6 is used to indicate development of a sodic condition.

Cat. Exchange capacity (CEC, cmol/L): This is the cation exchange capacity adjusted for the amount of soluble cations (Ca, Mg and Na) in the soil. It is used in determining the gypsum requirement of sodic soils.

Volume weight: Volume weight indicates the sample density or the mass of soil per unit volume. This value is used in the CEC adjustment calculation and is useful to convert reported units to alternative forms.

Note: In soils that are not salt affected, Total Cations provides a good indicator of the CEC, however in the presence of excess soluble salts Total Cations tends to overestimate the CEC. To provide a more accurate estimate of the actual soil CEC the soluble salts are excluded in determining the CEC. Thus in non-saline or non-sodic soils the Total Cations value will be similar to the estimated CEC given in the Saturation paste section. Where there is high Saturation extract salt levels, the estimated CEC tends to be lower than the Total Cations.

Recommendations

Sample ID/Field No. :	*1232*
Soil Form :	*Not supplied*
Is cane irrigated ?	*Yes*

PROFILE SUMMARY

MEAN SAR	1.24
ESTIMATED CEC	13.76
SALINITY STATUS	Non Saline
SODICITY STATUS	Non Sodic
GYPSUM REQUIRED	0 T/HA

This consists of two boxes on the right of the report and a comments box at the bottom of the report. The upper right box indicates your own sample identification from where the sample was collected. This is relevant for your own records.

The lower right box ("Profile Summary") presents some summary parameters derived from the test values and classifies the soil for salinity or sodicity. Where the soil is classified as sodic a gypsum recommendation is also given. Each is described in more detail below.

Mean SAR: For the calculation of gypsum requirements the mean SAR of the 0 to 30 and 30 to 60 cm samples is used and reported.

Estimated CEC: For the calculation of gypsum requirements the mean CEC of the 0 to 30 and 30 to 60 cm samples is used and reported.

Salinity Status: This indicates if the soil is saline or not using the electrical conductivity classification criteria in the table on the next page (with some management consideration provided).

EC (saturated paste extract, ECe) (mS/m)	Classification	Management considerations
0-200	Non-saline	Ideal, though it is important to ensure drainage remains adequate and that the site is not irrigated with poor quality water. Monitor changes overtime to detect increases.
200-400	Slightly saline	Salinity starting to become a problem and will lead to slight to moderate yield declines as EC increases. Minor evidence of salt crusting on soil surface when soil dries. Ensure adequate drainage and regularly flush soil profile with clean water. Check water quality regularly.
400-600	Moderately saline	Salinity can lead to large yield declines with evidence of salt deposits on dry soil surfaces. Installation of drainage is key to removing excess salt, while flushing with good quality water is key. It is likely the poor water quality may be a contributor to the excess salt, so regular water quality testing and possibly water treatment may be required. Incorporation of organic amendments are also useful to improve drainage.
>600	Highly saline	High salinity will lead to death of stools. White crusts on dried soils will be common. Remediate as above, though this may take a considerable amount of time to resolve. Seek expert advice to design and implement remedial practices.

Sodicity status: This provides an indication of the sodicity status of the soil and are classed as follows:

ECe (mS/m)	pH Water	SAR	Sodicity classification	Management considerations
<400	<8.5	<6	Non-sodic	Gypsum not required, though evaluate for salinity status
>400	<8.5	<6	Non-sodic	Gypsum not required, though salinity will be a problem.
>400	<8.5	>6	Saline-Sodic	Initial indication of soil structural degradation becoming evident, with combination of surface salt deposits, soil crusting and poor infiltration. Gypsum may be required to displace excess sodium. Ensure adequate drainage and flushing with clean water after gypsum treatment.
<400	>8.5	>6	Sodic	Strong evidence of soil structural degradation, often seen as black soil coating ("Swartbrak" - caused by the dissolving of organic matter at high pH), crusting, water logging and excess runoff. Gypsum (incorporated) is required to displace excess sodium while adequate drainage is essential along with flushing with clean water. Incorporation of organic amendments helps to alleviate drainage and infiltration problems

Gypsum required: This is the recommended rate of gypsum to supply sufficient Ca to displace excess Na in the soil with the aim of lowering the SAR to below the critical threshold value. A maximum of 10 t/ha is permitted in a single application.

Comments

NOTE:
- Recommendations should be regarded as general guidelines.
- If you intend embarking on extensive reclamation work, guidance should be sought from your extension specialist.

COMMENTS :	The soil is neither saline nor sodic. No corrective action required.

This provides agronomic comments relevant to the recommendation provided. Gypsum incorporation guidelines are given, as well as guidance on the water required to dissolve and leach the gypsum into the soil profile

IMPORTANT NOTE

In any saline and/or sodic soil condition it is essential that adequate subsurface drainage is provided to flush excess salts out of the rooting zone. Without adequate drainage salt problems cannot be effectively remedied.