

Salinization

Why does it occur and what can you do about it?

By Anna Mouton

LEFT Salt accumulation on the surface of soils affected by severe salinization.

"I saw another case of salinization only yesterday," says Louis Reynolds, director at Fruitful Crop Advice, a consulting service specialising in fertilisation, irrigation and the establishment of new orchards. "The trees didn't look too bad but production has fallen by about twenty percent."

Salinization is a general term for the accumulation of salts in soil. These salts consist of ions that damage plants and affect soil structure when present in high concentrations. Most people think of salt as sodium and chloride, but other ions such as magnesium and calcium also cause salinization.

"The primary impact of salinization is water stress — the same signs as a plant that isn't getting enough water," explains Reynolds. Increased salts in the soil make it difficult for the plant to take up water even when the soil is wet. The free flow of water through the plant is essential for transpiration.

"The water shortage means that it can't cool itself and that's why you typically see scorching of the leaf edges," clarifies Reynolds. Production losses can occur even when plants don't show leaf scorching. Water stress due to salinization will also lead to smaller fruit. Severe salinization can kill trees due to direct toxicity of the ions in the soil.

WHAT CAUSES SALINIZATION?

"The source of the salts is either our geology — ancient salts in our rock formations — or directly from the sea," says Dr Willem de Clercq, senior researcher with the Water Institute at Stellenbosch University. "With agriculture a lot of brackish water runs off into rivers — in the Berg River system the main culprit is dryland agriculture. In the Breede River system most of the salts come from the Bokkeveld shales that occur north of the river."

The contribution of irrigated agriculture to salt levels in rivers is limited. "Initially irrigated agriculture does put salts into the rivers. But it only takes about three years of irrigation before your soils have the same salinity profile as your irrigation water — the original salts have been washed out," says De Clercq.

Even areas where the geology doesn't promote salinization can still develop problems. "We have a considerable amount of salt that comes in from the sea. Our measurements show that you get up to thirty kilograms per hectare recharge every year as far inland as Riebeeck Kasteel." Salinization in some areas derives entirely from sea salt.

In an ideal world rainfall would flush excess salts from the soil into the rivers and then to the sea, but during drought, flushing is reduced. The water table may drop so far that brackish river water infiltrates adjacent soil. "If we pump too much groundwater

Salinization ABCs

A

SALT ADDITION

from three main sources is an ongoing process

- ❶ **Ocean:** salt-laden precipitation or wind
- ❷ **Irrigation:** brackish river or ground water
- ❸ **Geology:** bedrock contains salt

B

SALTS BUILD UP

when pure water is lost to the atmosphere by two primary routes

- ❶ **Transpiration:** water loss by leaves
- ❷ **Evaporation:** water loss from soil

C

POOR DRAINAGE

keeps salts in the root zone due to

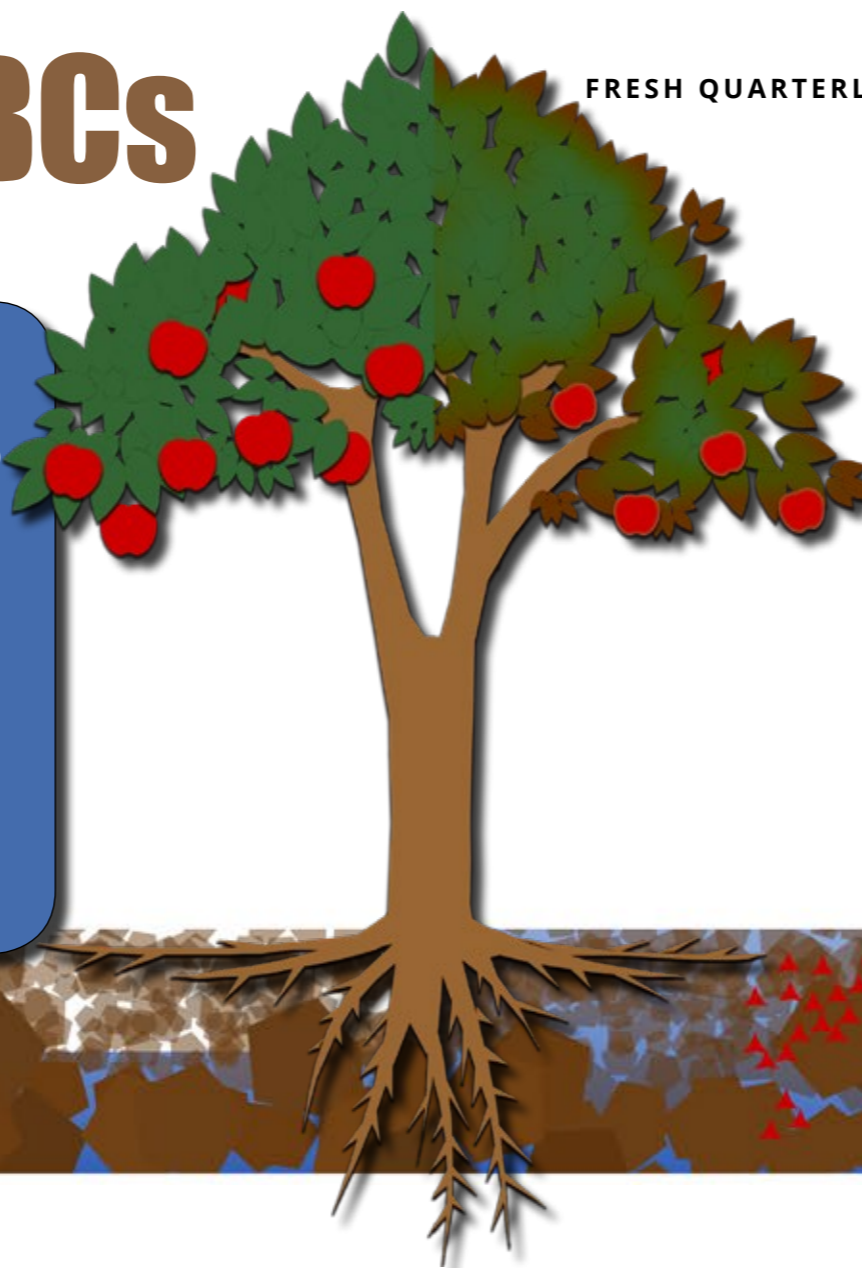
- ❶ **Waterlogging:** prevents salts leaching
- ❷ **Water table:** high level lifts salts into root zone

D

TREES STRUGGLE

to take up water from brackish soil. The results are

- ❶ **Heat stress:** browning of leaf edges
- ❷ **Lower yields:** smaller fruit and increased sunburn



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from the river's aquifer, the river stops flowing and feeds the water table," explains De Clercq. "This affects salt transport. Every point where you abstract ground water is a point to which you're drawing salts."

Brackish groundwater will lead to brackish soils if used for irrigation. Brackish groundwater also causes salinization when the water table rises after heavy rains. "If you're in a low spot and the water table rises and you haven't provided drainage, then the brackish water pushes up into the root zone and there's damage to plants."

IRRIGATION STRATEGIES TO COMBAT SALINIZATION

Brackish irrigation water will add salt to soil over time, because the salts remain when pure water is taken up by plants or evaporates from the soil surface. The only way to remove salts from the soil is by flushing. "You need to over-irrigate by around fifteen to twenty percent," advises Reynolds. "Your

"If you have good drainage your soil quality won't become any worse than your water."

soil quality will become as poor as your water, but if you have good drainage it won't become any worse than your water — good drainage is important."

Reynolds recommends installing drains in new orchards. "Not just for wet spots — usually drains are to remove wetness but here you want to remove salts. And if you know you have a salinization problem, earth up the soil in new orchards. You'll have a better chance of pushing the salts out of the root zone."

When irrigating it's important to ensure that water penetrates the soil. Reynolds suggests using low-delivery micro-jets or drip irrigation rather than high-delivery micro-jets. De Clercq observes that salt concentration in the soil will tend to increase away from the point of water delivery. This can cause problems after summer rainfall.

"The salts accumulate between the rows and the rain washes it back into the root zone. So if you have saline conditions and you see there's rain coming you need to irrigate heavily to protect the root zone," says De Clercq.

MORE WAYS TO MANAGE SALINIZATION

Both De Clercq and Reynolds stress the importance of mulch. Surface evaporation and changes in soil temperature are critical in bringing salts to the topsoil and mulch reduces evaporation while cooling the soil. Saline soils are more prone to forming a crust that obstructs infiltration of water whereas a mulch increases water infiltration. Greater water

infiltration carries salts away from the root zone.

"You also need to look at your fertilisers," says Reynolds. "Don't use potassium chloride on a brackish soil — rather use potassium sulphate or potassium nitrate. You want to use a chloride-free fertiliser even though it's more expensive."

Reynolds points out that the water quality in new boreholes should be tested before irrigation starts, so that appropriate management practices can be implemented. In cases where the soil has already been affected, gypsum — hydrated calcium sulphate — can be applied to displace sodium ions from soil particles. The resulting sodium sulphate is flushed from the soil with water which is removed by subsoil drainage.

"Salinization is not something that's going to be solved," concludes De Clercq. "You have to live with it. You must manage it well and ensure that your soil is covered and that you don't have runoff. Then you can control salinization even if you have to irrigate with slightly brackish water." **FQ**