

EFFECT OF SOIL SALINITY ON VETIVER GROWTH



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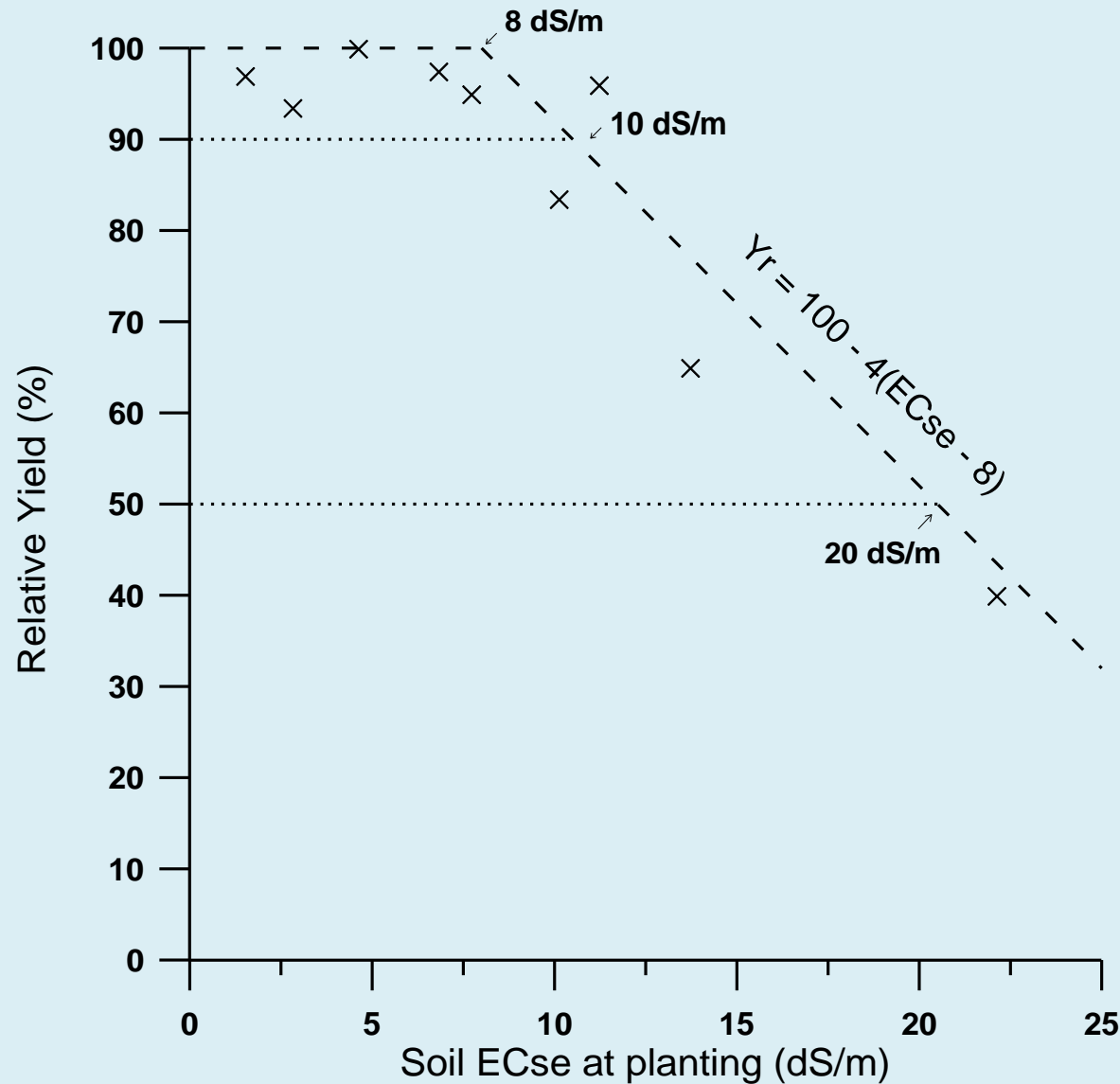
INTRODUCTION

Due to its extraordinary morphological and physiological characteristics, Vetiver grass has become the choice species for phytoremediation of both water and land contaminated by both inorganic and organic pollutants

Although Vetiver is relatively highly tolerant to salinity as compared with some common crop and pasture species, its effectiveness in phytoremediation is sometimes affected under highly saline conditions

However, this limitation can sometimes be overcome by manipulating the planting conditions during establishment phase, as shown in this presentation.

BASIC RESEARCH ON SALT TOLERANCE OF VETIVER GRASS



Critical level:
(where growth
was first affected)

8dS/m

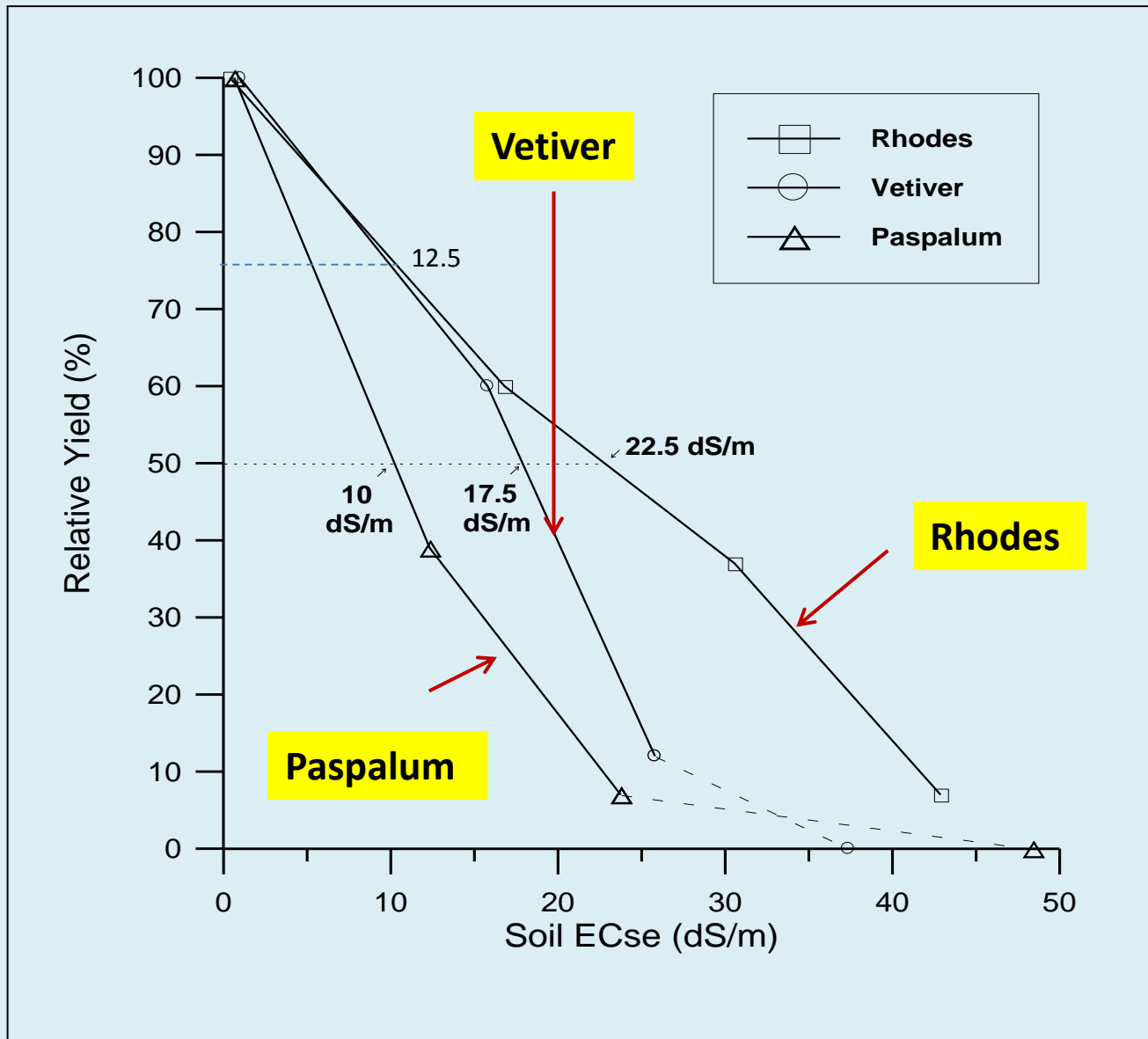
**10% growth
reduction at**

10dS/m

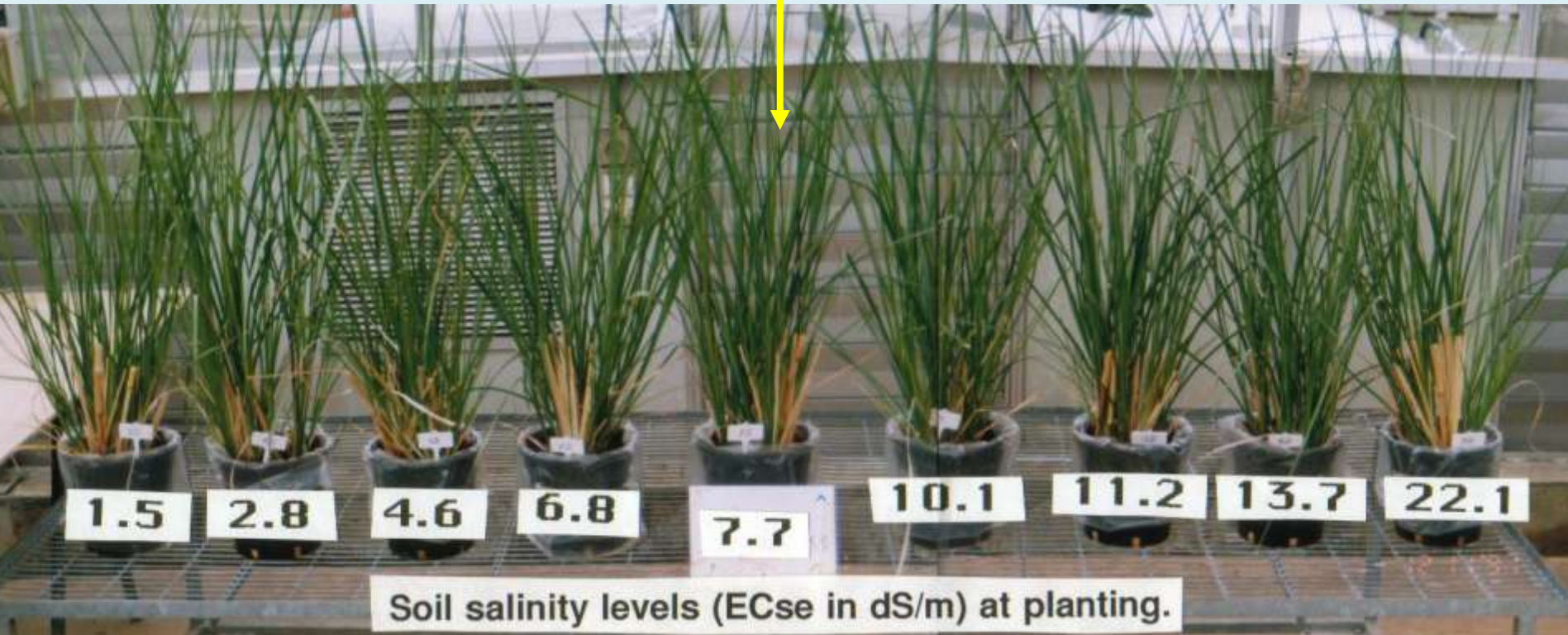
**50% growth
reduction at**

20dS/m

Comparative study on salt tolerance of Vetiver grass versus two other salt tolerant pasture grasses



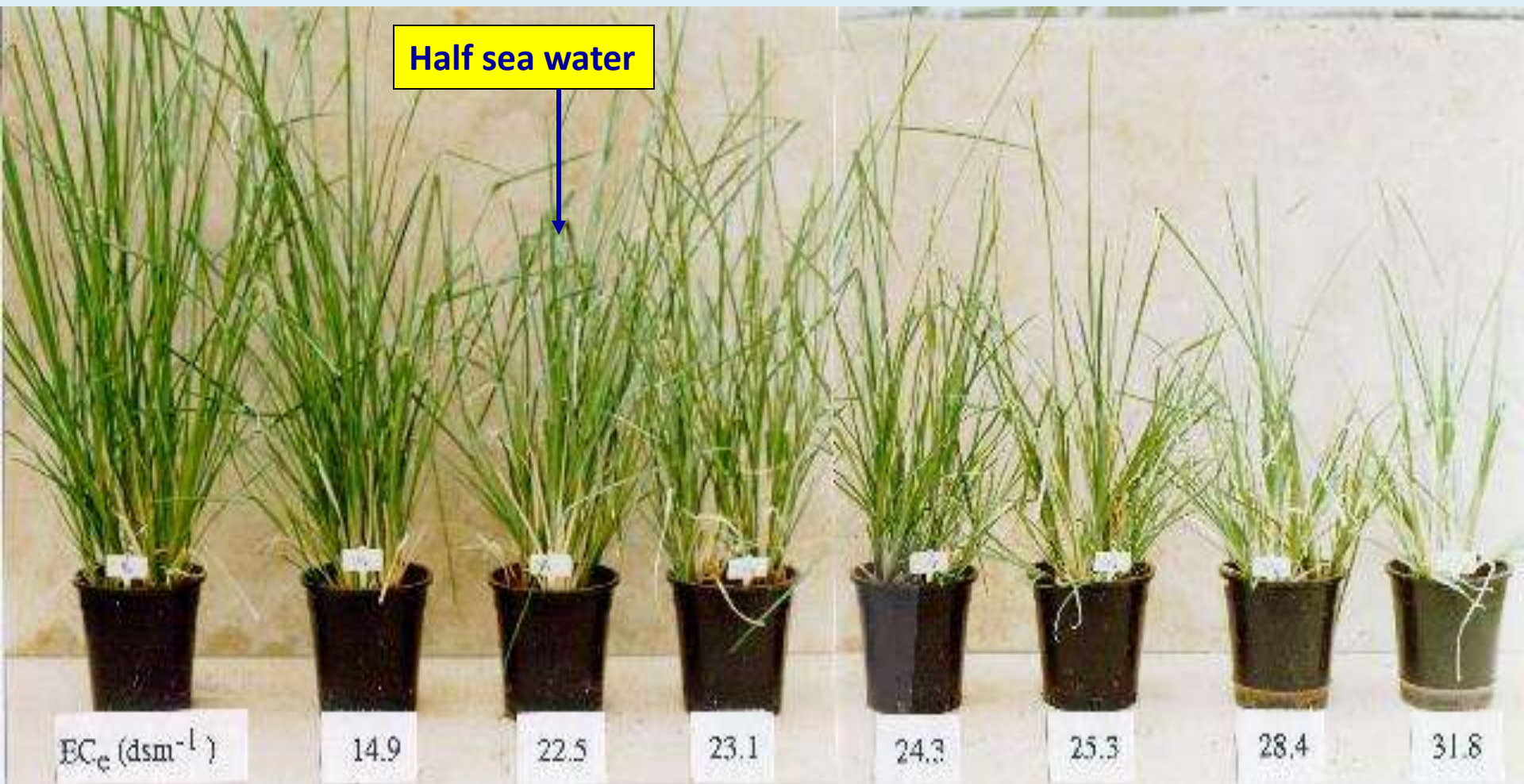
Threshold level = 8dS/m



Growth was visibly reduced from level higher than approximately higher than 10dS/m

Note: (dS/m = mS/cm = mmho/cm)

Salinity of sea water is approximately 45dS/m



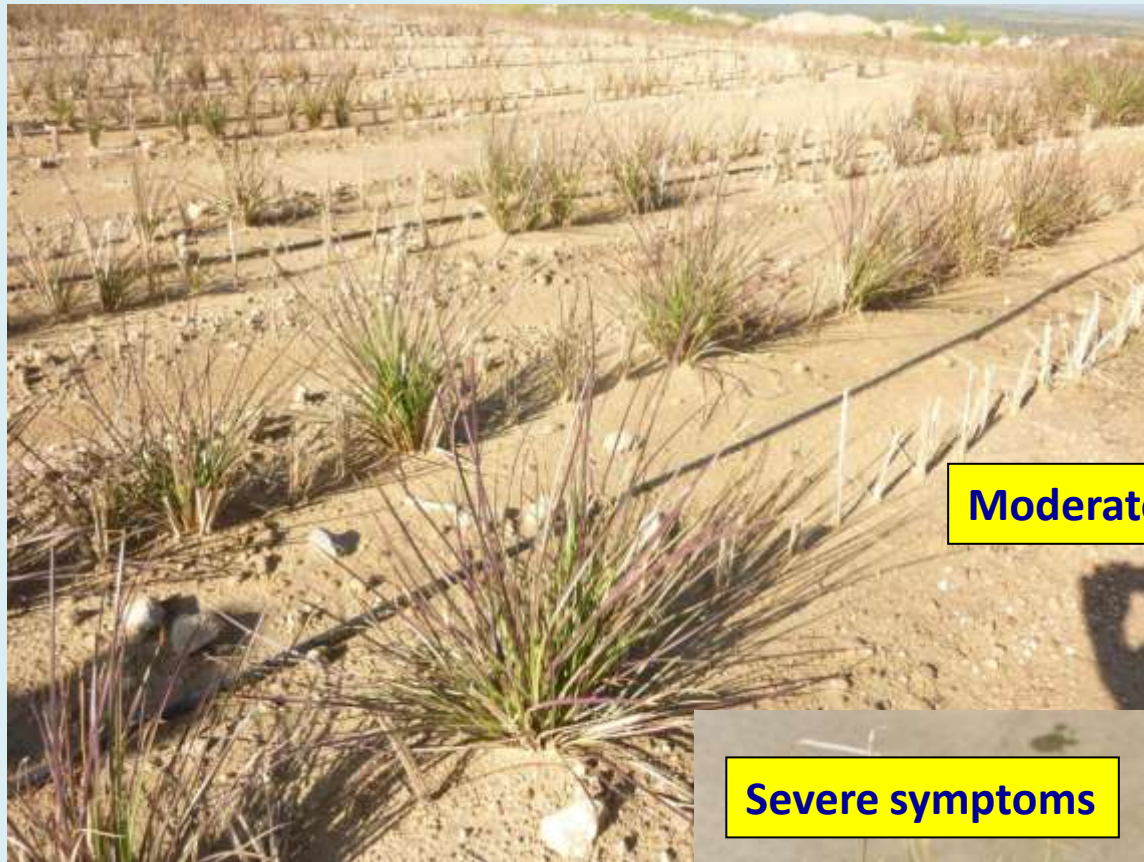
Salt tolerance level of Vetiver grass as compared with some crop and pasture species grown in Australia.

Species	Soil EC _{se} (dSm ⁻¹)	
	Saline Threshold	50% Yield Reduction
Bermuda Grass (<i>Cynodon dactylon</i>)	6.9	14.7
Rhodes Grass (C.V. Pioneer) (<i>Chloris guyana</i>)	7.0	22.5
Tall Wheat Grass (<i>Thynopyron elongatum</i>)	7.5	19.4
Cotton (<i>Gossypium hirsutum</i>)	7.7	17.3
Barley (<i>Hordeum vulgare</i>)	8.0	18.0
Vetiver (<i>Chrysopogon zizanioides</i>)	8.0	20.0

***EC_{se} stands for Electrical Conductivity of Soil Extract - a measurement of salinity level in the soil, which is considered more accurate as it takes into account soil texture such as sandy, loam or clay**

Symptom of saline toxicity.

Mature leaves turn red or purple first then dried up from the tip and gradually extended to the leaf base



Moderate symptoms



Severe symptoms





Although shoot growth was affected at EC=12mS/m, root growth was relatively unaffected in both depth and bulk



EFFECTS OF SALINITY ON VETIVER GRASS GROWTH UNDER VARIOUS FIELD CONDITIONS

**The following photos will show the effects of salinity on
Vetiver growth under:**

- **Saline runoff conditions in the Dominican Republic**
- **Dry land salinity conditions in Australia**
- **Wetland conditions in Australia**

Saline Runoff Conditions

Gueric Boucard's vetiver plantation (for oil production) in the Dominican Republic. Runoff water from an adjacent salt mine contaminated the low areas of the plantation. Vetiver growth was affected by this salt intrusion and varied with the salinity level in the soil

Photo Credit: Gueric Boucard



Very healthy and good growth near the channel on soil with **EC= 8.0 mS/cm** and adequate water supply. No symptoms of salt toxicity.



Very good growth on soil with **EC= 10.3 mS/cm** but started showing slight symptoms of salt toxicity on some plants.



On soil with **EC= 13.4mS/cm**, reasonably good growth , but showing symptoms of salt toxicity



On soil with **EC= 42.1mS/cm** most plants failed to establish. Some survived but growth was severely affected



Vetiver failed to establish , all dead on soil with $EC= 46.3mS/cm$



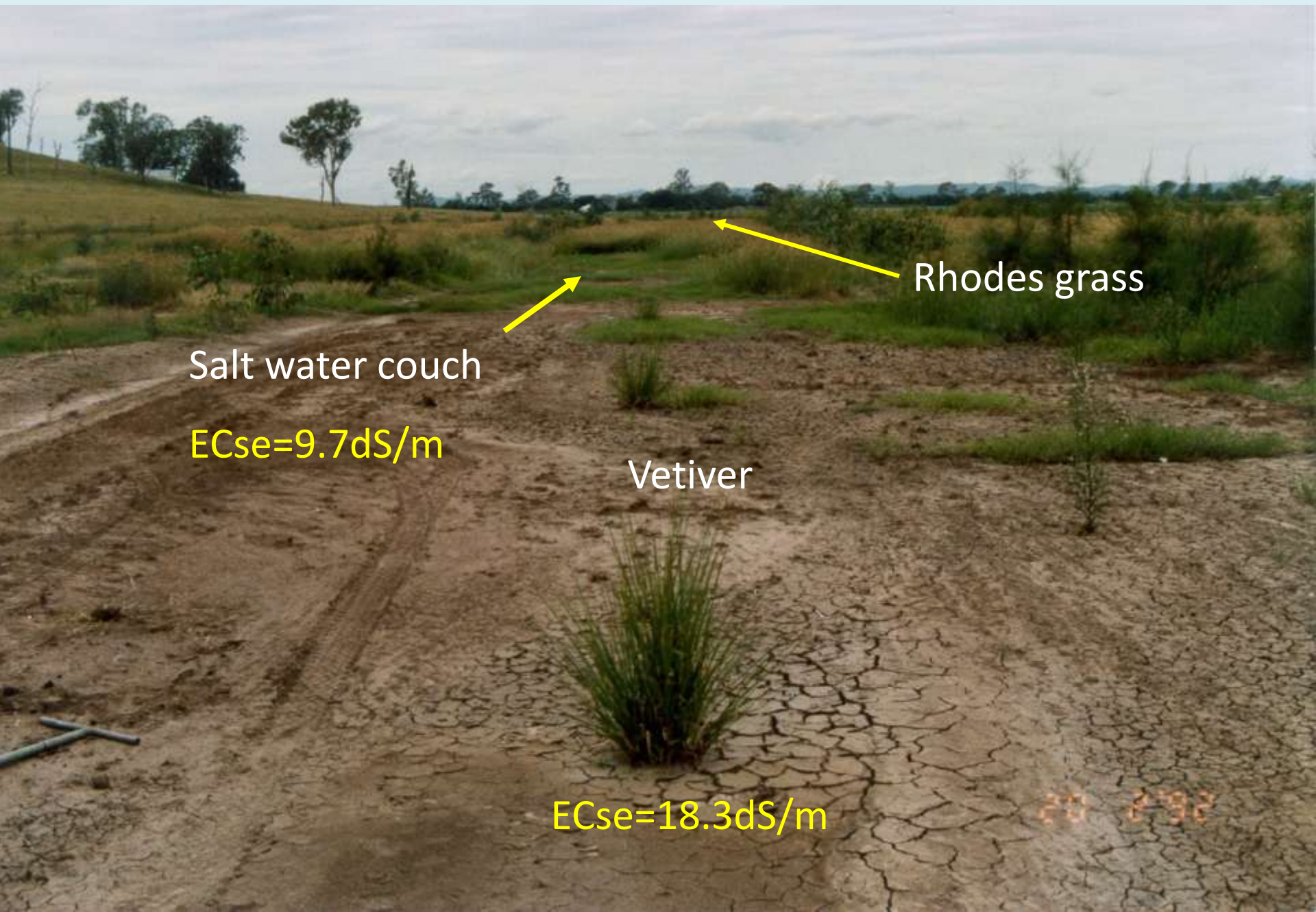
Under Dry land Salinity Conditions in Australia

Dry land salinity is caused by the rising of saline underground water to the surface as a result of deforestation

Under natural conditions, percolating rain water is taken up by deep rooted trees such as Eucalyptus keeping the water table deep in the soil profile. But when these trees are removed, the deep water table will rise to the surface. If the water is saline, even at a very low salinity level, evaporation over time will bring the salt to the top soil horizon and in severe case to the soil surface.

This will result in a highly saline top soil and much less saline in lower horizon

Vetiver can tolerate almost twice as much salt as salt water couch



Salt water couch

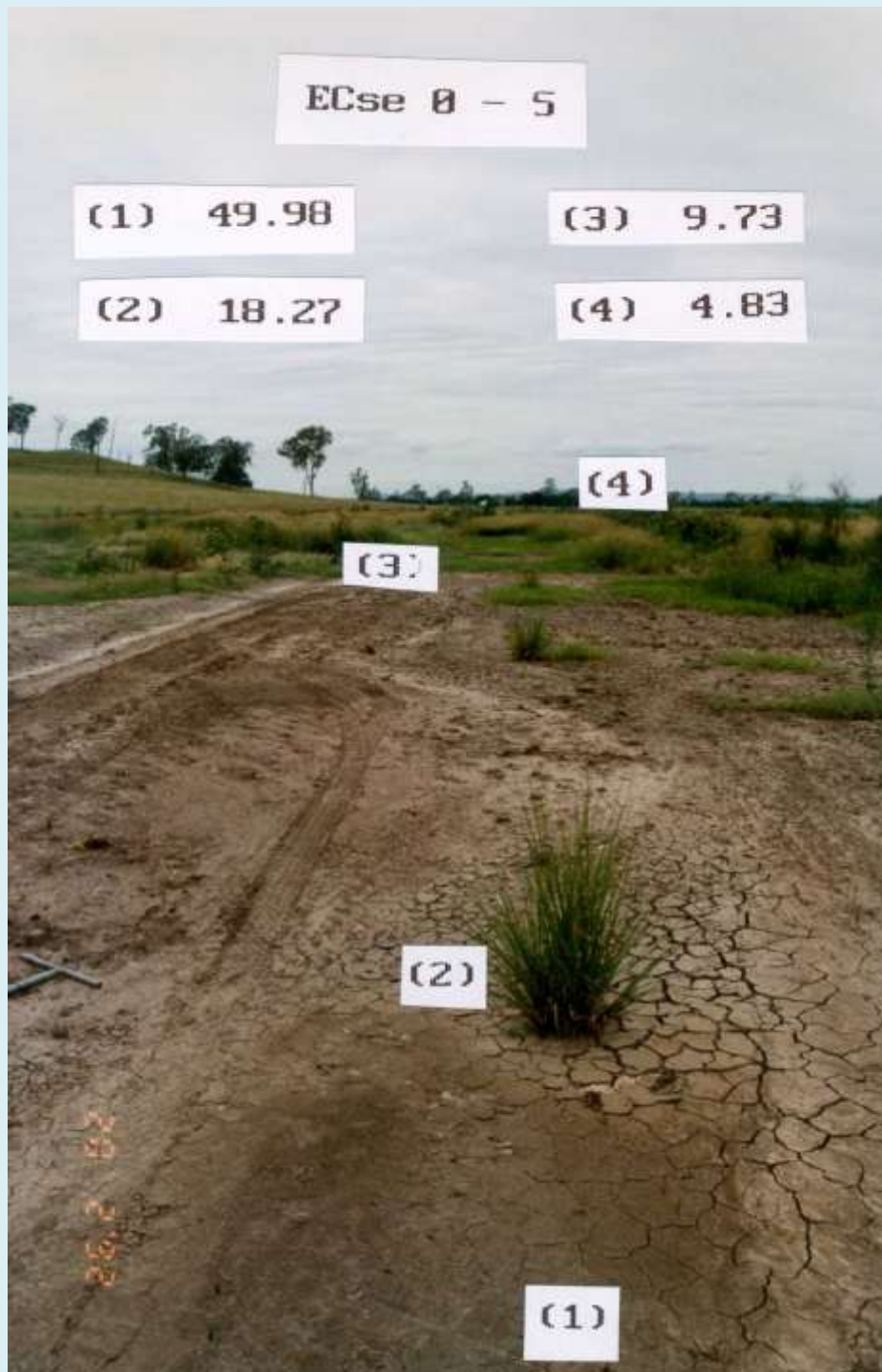
$EC_{se}=9.7dS/m$

Rhodes grass

Vetiver

$EC_{se}=18.3dS/m$

20 8 92



ECse 0 - 5

(1) 49.98

(3) 9.73

(2) 18.27

(4) 4.83

(4)

(3)

(2)

(1)

Soil salinity at 0-5cm depth:

- **Position 1:** EC = 49.98dS/m
Vetiver could not grow
- **Position 2:** EC = 18.27dS/m
Vetiver could grow
- **Position 3:** EC = 9.73dS/m
Vetiver could grow with salt water couch
- **Position 4:** EC = 4.83dS/m
Vetiver could grow with Rhodes grass



Salinity Dodging

Salinity level of a typical dry land salinity soil profile.

Note: Much less saline at 40-50cm depth.

Once its roots grew past the topsoil layer, Vetiver had no trouble growing on less saline ground water.

A typical extreme dry land salinity site with very high saline top soil where only salt bush could grow in Western Australia





**Soil EC_{se} = 46 dS/m and
pH = 7.1 - 7.7 at 0-20cm
depth. Note the salt
patches.**

**Initial drip irrigation is
needed during
establishment, helping its
roots to escape the highly
saline top soil layer**

Vetiver still thrived 4 weeks after planting



Under Tidal Brackish Wetland Conditions in Australia

Tidal wetland conditions are unique in having a fluctuating salinity level at different times during the tidal cycle, relatively low in high tide and very high during low tide, when saline water evaporates, concentrating the salt on the surface soil



Vetiver three months after planting

Vetiver growing among mangrove seedlings one year after planting

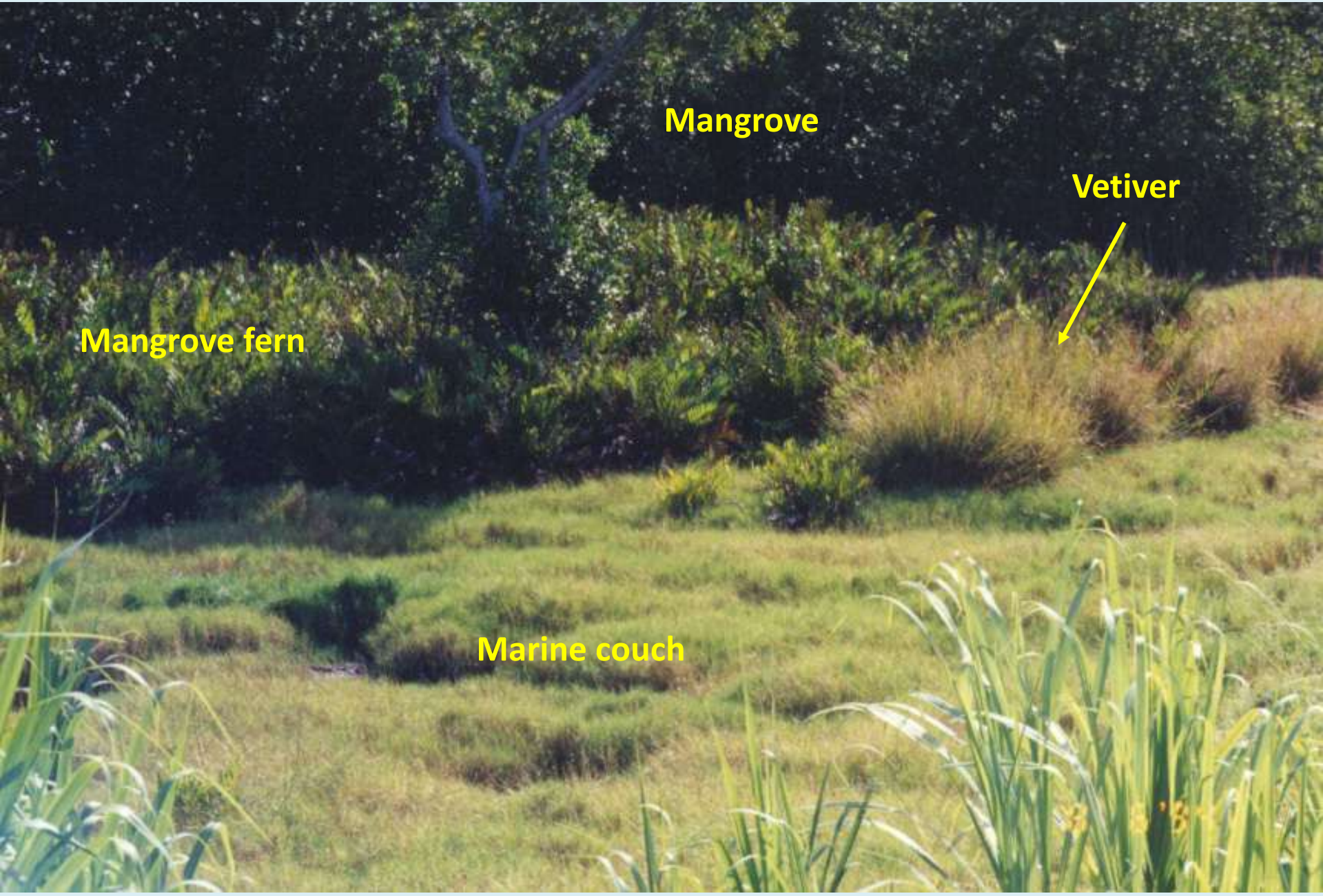


Vetiver

Mangrove seedlings

Saline toxic symptoms

In Fiji vetiver growing next to a mangrove swamp



Mangrove

Vetiver



Mangrove fern

Marine couch

EFFECTS OF SALINITY ON VETIVER GRASS GROWTH UNDER VARIOUS CONDITIONS

The above photos show the effects of salinity on Vetiver growth under various saline conditions:

- Under dry land salinity conditions, initial irrigation can enhance establishment by helping its roots 'dodging' the saline topsoil.
- Under tidal wetland conditions, vetiver can grow where mangrove seedlings grow.

Vetiver is really an amazing plant

THANK YOU