

# VETIVER GROWTH AS AFFECTED BY PETROLEUM PRODUCTS



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# **INTRODUCTION**

**A large quantity and variety of petroleum products are normally needed for the operation of mines.**

**While larger mines usually have proper treatment plant for the waste petroleum products on site**

**At smaller mines, these wastes are usually untreated and cause offsite pollution to local environment particularly on drainage lines and local streams.**

**While Vetiver Phytoremediation Technology can not breakdown and/or remove these wastes, but if it can be grown on these contaminated sites, it can phytostabilise them to prevent offsite pollution**

**The following is the result of a small trial at a small gold mine in Australia**

# Adaptability Range of Vetiver Grass in Australia and other Countries

Adverse Soil Conditions	Australia	Other Countries
Acidity	pH 3.3	pH 4.2 (with high level soluble aluminium)
Aluminium level (Al Sat. %)	Between 68% - 87%	80%-87%
Manganese level	> 578 mgkg <sup>-1</sup>	
Alkalinity (highly sodic)	pH 9.5	pH 12.5
Salinity (50% yield reduction)	17.5 mScm <sup>-1</sup>	
Salinity (survived)	47.5 mScm <sup>-1</sup>	
Sodicity	33% (exchange Na)	
Magnesicity	2 400 mgkg <sup>-1</sup> (Mg)	
Heavy Metals		
Arsenic	100 - 250 mgkg <sup>-1</sup>	
Cadmium	20 mgkg <sup>-1</sup>	
Copper	35 - 50 mgkg <sup>-1</sup>	
Chromium	200 - 600 mgkg <sup>-1</sup>	
Nickel	50 - 100 mgkg <sup>-1</sup>	
Mercury	> 6 mgkg <sup>-1</sup>	
Lead	> 1 500 mgkg <sup>-1</sup>	
Selenium	> 74 mgkg <sup>-1</sup>	
Zinc.	>750 mgkg <sup>-1</sup>	

## Threshold levels of heavy metals to vetiver growth as compared with other species

Heavy Metals	Threshold levels in soil (mgKg <sup>-1</sup> )		Threshold levels in plant (mgKg <sup>-1</sup> )	
	Vetiver	Other plants	Vetiver	Other plants
Arsenic	100-250	2.0	21-72	1-10
<b>Cadmium</b>	<b>20-60</b>	1.5	<b>45-48</b>	<b>5-20</b>
Copper	50-10	Not available	13-15	15
<b>Chromium</b>	<b>200-600</b>	<b>Not available</b>	<b>5-18</b>	<b>0.02-0.20</b>
Lead	>1 500	Not available	>78	Not available
<b>Mercury</b>	<b>&gt; 6</b>	<b>Not available</b>	<b>&gt;0.12</b>	<b>Not available</b>
Nickel	100	7-10	347	10-30
<b>Selenium</b>	<b>&gt;74</b>	<b>2-14</b>	<b>&gt;11</b>	<b>Not available</b>
Zinc	>750	Not available	880	Not available

# **Gympie Eldorado Gold mine**

**Gympie gold field is one of the largest gold producing district of Australia in the 1800s.**

**In those days both open cut and underground minings were used in the district by mostly small operators.**

**Now only Eldorado is operating by underground mining and it is a very small gold mine by Australian standard**

**Vetiver was first planted here in 1997, 1998 and 2000 for:**

- erosion, sediment control and rehabilitation of tailings**
- containing waste rock dump**
- filter strips to trap contaminated sediment from storage ponds.**
- offsite pollution control of waste petroleum products on contaminated locations.**

## **Variety of petroleum products used at this mines**

- **Drilling oil: for machine to bore holes for blasting**
- **Hydraulic oil: various hydraulic machinery**
- **Engine (sump) oil: trucks and pumps**
- **Diesel fuel: trucks and pumps**

## **Treatments**

**Two treatments were conducted:**

- **Soil saturated with contaminant collected at locations: 100**
- **Soil saturated with contaminant collected at locations mixed with 50% of good soil: 50**

# Typical contaminated location by engine oil spill at machinery service station





**Diesel fuel spill at  
fuel depot**

**Runoff of spills  
from different  
sites**





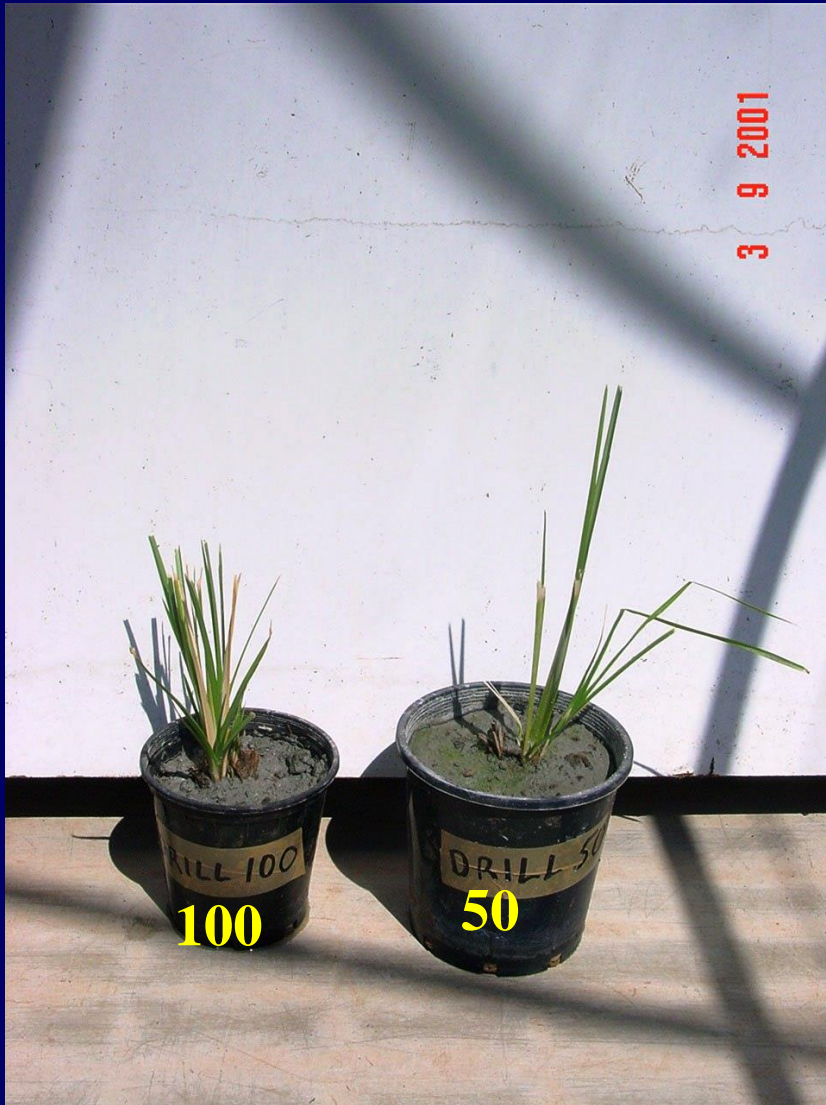
# Typical petroleum wastes collected on drainage line



# Drilling oil at planting



# Drilling oil one week after planting



# Drilling oil five weeks after planting



# Drilling oil seven weeks after planting

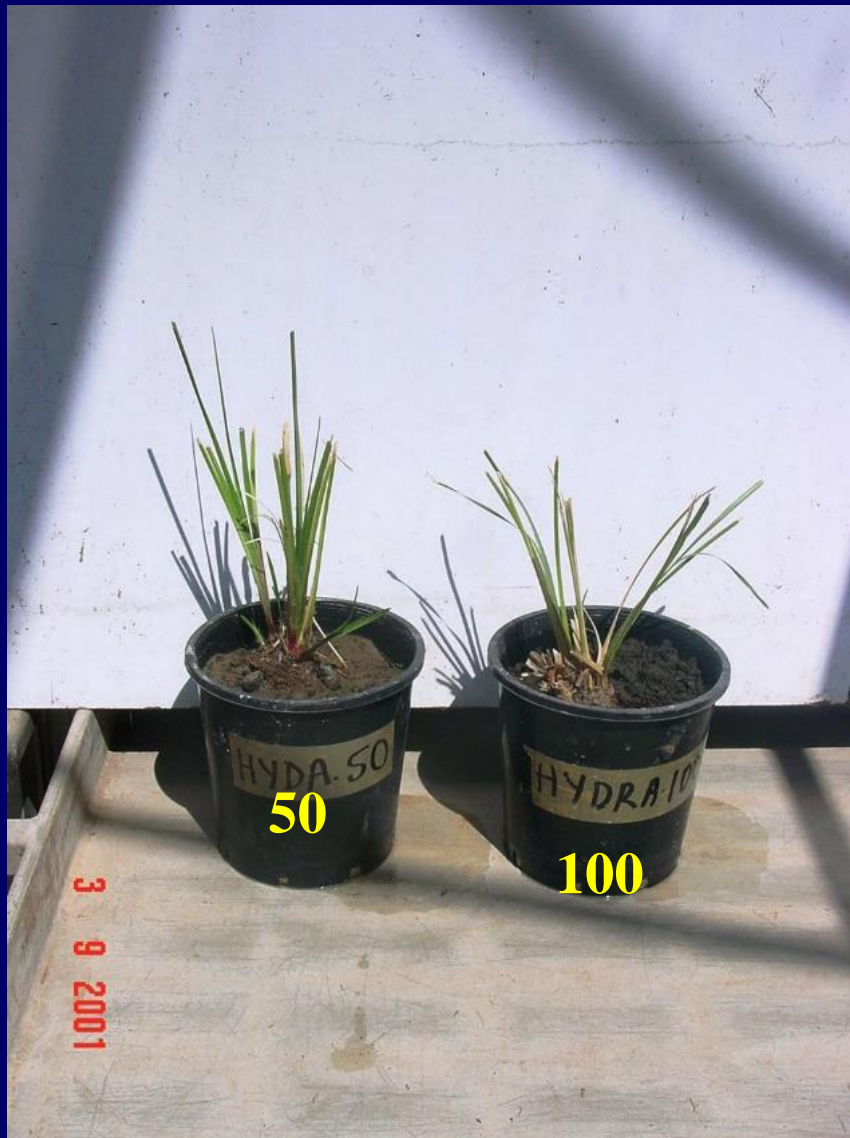


# Hydraulic oil at planting



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Hydraulic oil one week after at planting



Hydraulic oil five weeks after at planting



# Diesel fuel at planting



**Diesel fuel one week  
after at planting**



**Diesel fuel five weeks  
after at planting**





# Comparison between Hydraulic oil and Diesel fuel at seven weeks after planting





**Comparison between Diesel fuel, Drilling oil and Hydraulic oil at 6 months after planting**

**50**  
**Diesel**

**100**  
**Drilling oil**

**50**  
**Hydraulic oil**

# Comparison between Drilling oil and Diesel fuel at 6 months after planting



# CONCLUSION

**The above slides clearly showed that:**

- **Diesel fuel is the most toxic Petroleum product to Vetiver growth. At saturation concentration -100- It killed Vetiver in 5 weeks. At 50% concentration -50- Vetiver survived at 7 weeks but died 6 months after planting.**
- **Hydraulic oil at saturation concentration -100- killed vetiver 5 weeks after planting. But at 50 concentration it did not affect Vetiver growth after 6 months**
- **Drilling oil at saturation concentration -100- did not affect vetiver growth after 6 months**