Decay and Low Sustainability Of Fruit Trees

Because of high-frequency irrigation under drip and microsprinkler

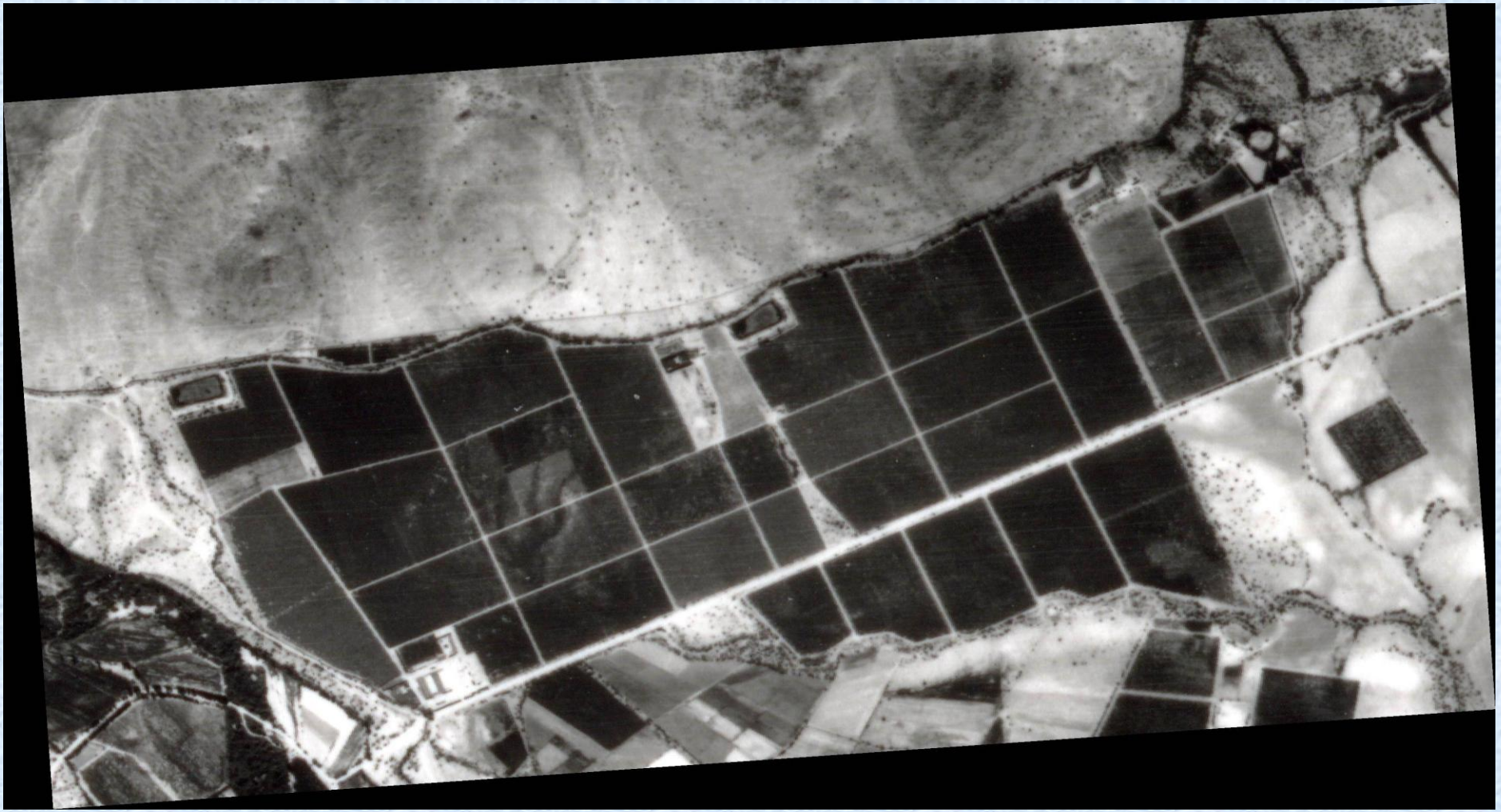
Antonio Lobato

Consulltant

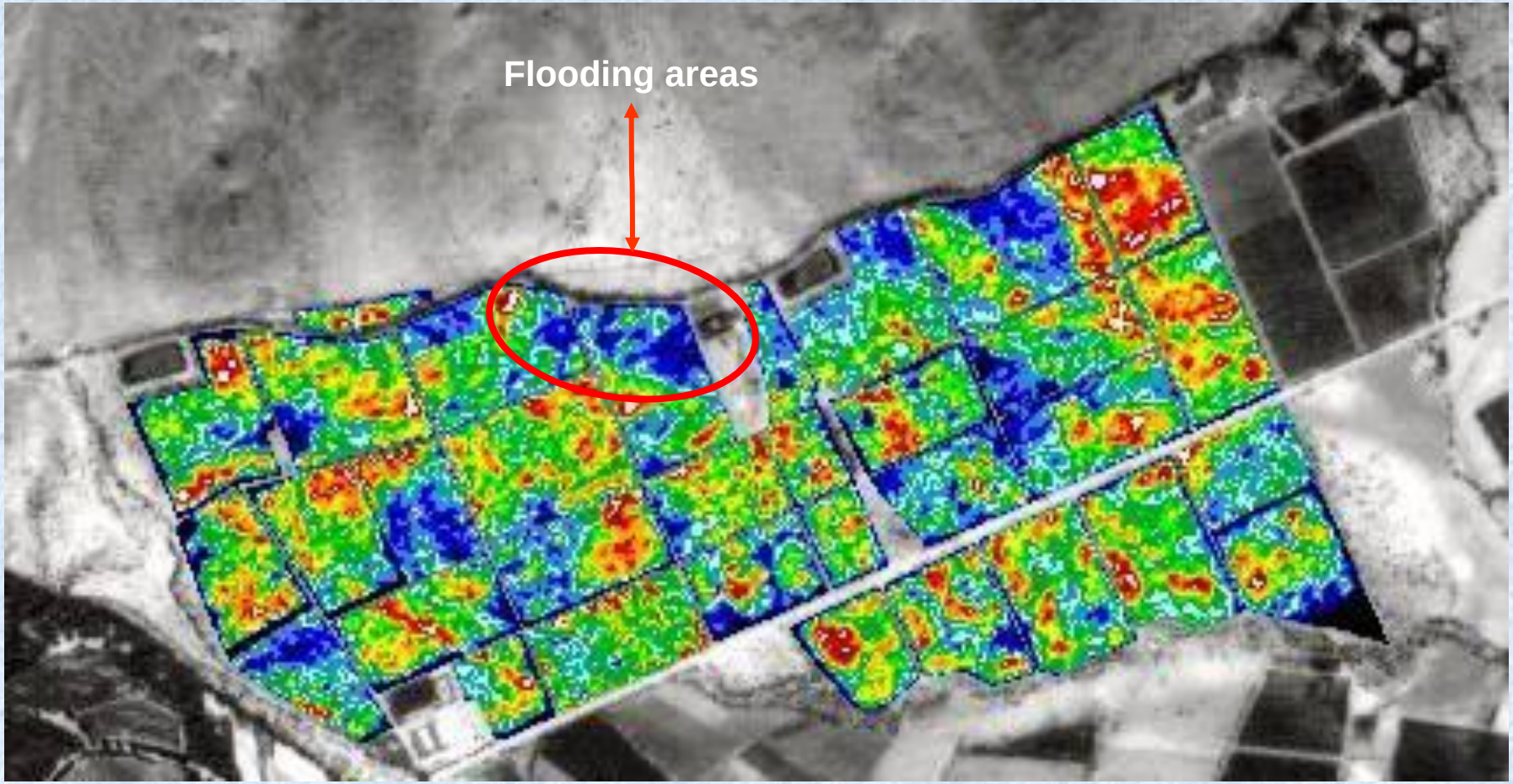
Decay of Vines in Copiapó Valley

Decay of vines in Aconcagua Valley

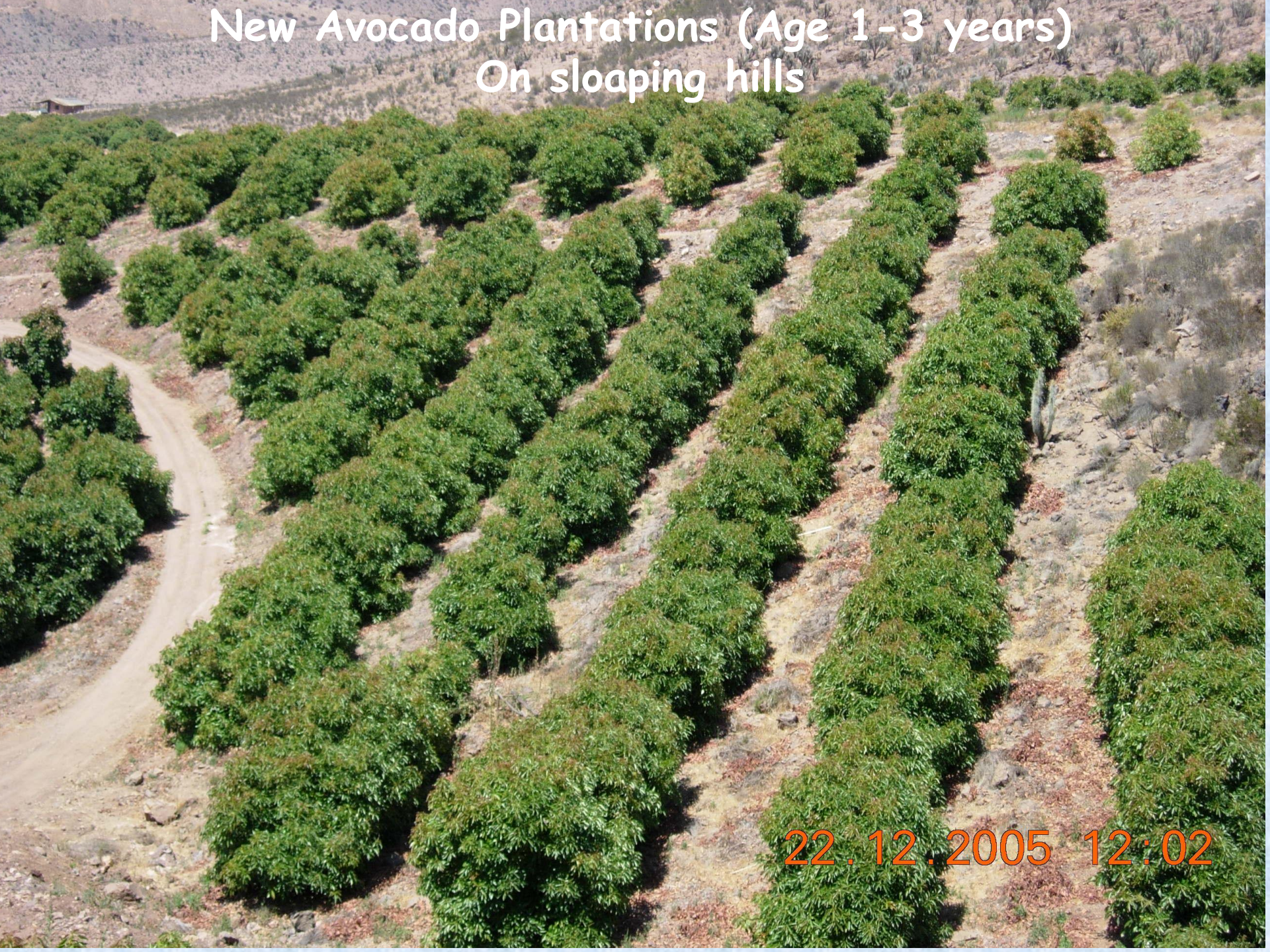
Aerial Analysis of Plantations in Punitaqui
Limarí Valley



Aerial Analysis of Table Grape Parronal
Limarí Valley
(Chlorophyll Degradation)



Old Avocado Tree (Age 60 years), Mexícola Variety
San Esteban County, Aconcagua Valley


New Avocado Plantations (Age 1-3 years)
On sloaping hills
22.12.2005 12:02


Avocado Plantations (Age 3-5 years)
On sloaping hills
22.12.2005 12:11


New Avocado Plantations (Age 5-7 years)
On sloaping hills
22.12.2005 12:11


New Avocado Plantations (Age 7-10 years)
On sloaping hills
22.12.2005 12:11

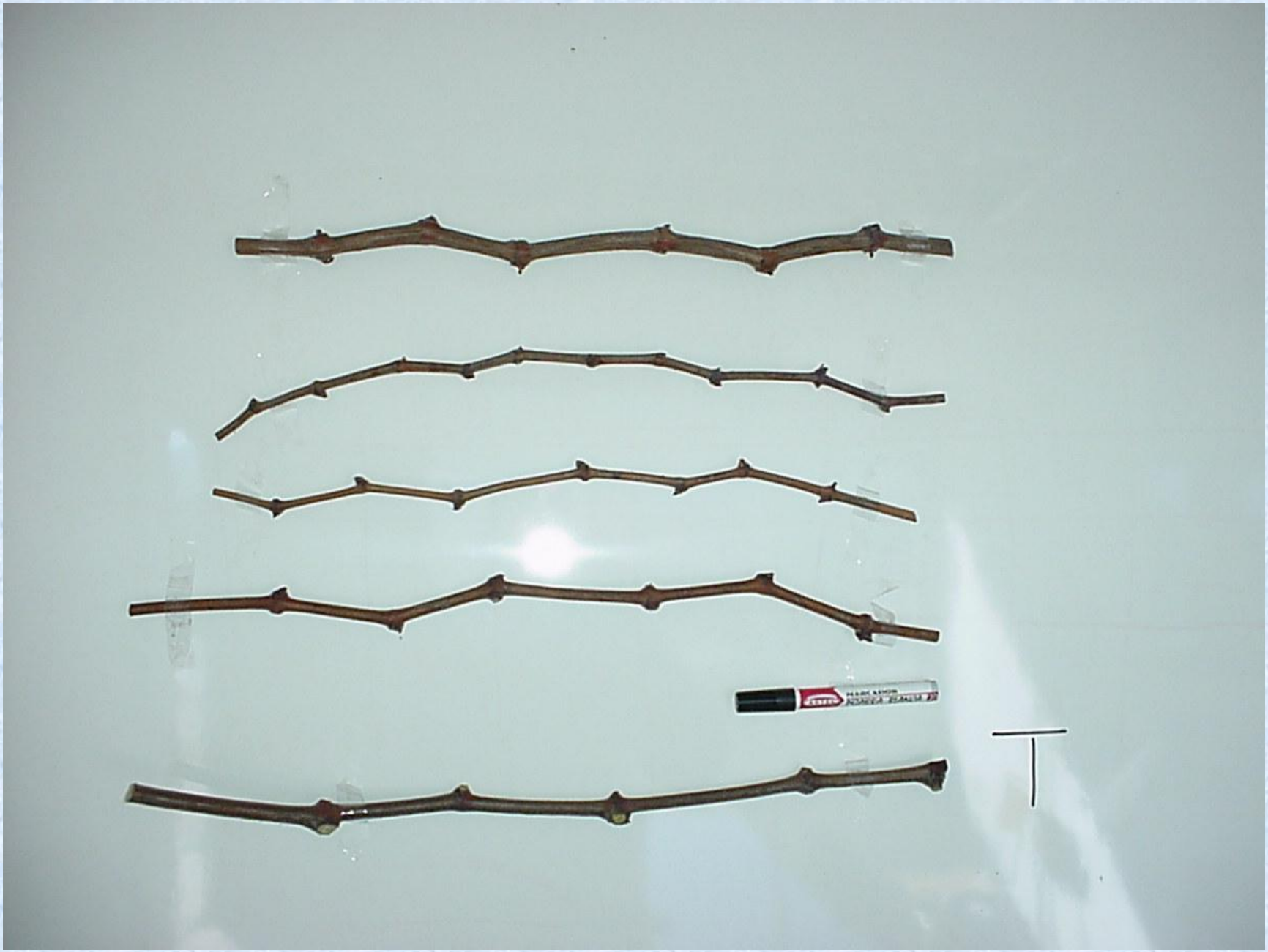

Result after 10 years of high-frequency irrigation
Is this a good practice in fruit tree production?
22.12.2005 12:04

Simptoms and Indicators of Decay and Low Sustainability

In fruit trees

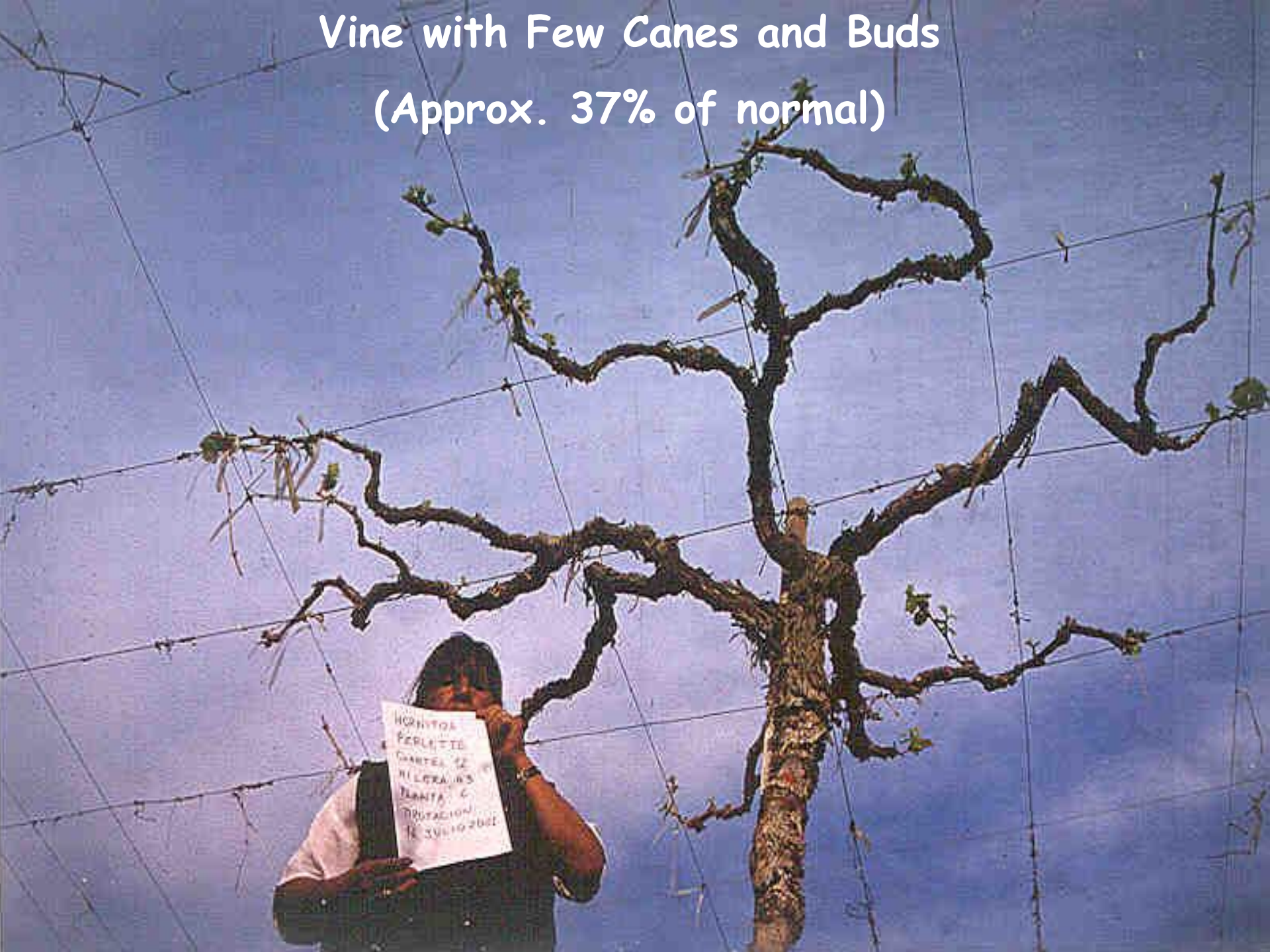
1. Simptoms of foliage with low vigor and low vegetative development
2. High Concentration of foliar Manganese as an indicator of flooding and lack of oxygen on root zone.
3. Coloration and abnormal growth of primary roots and fine roots.
4. Varying Levels of Salinity at Different Soil Depths, and the Presence of Reductive Conditions of Grey Color.
5. Presence of Indicator Plants.

Simptoms of Lack of Oxygen on Canes of Vines

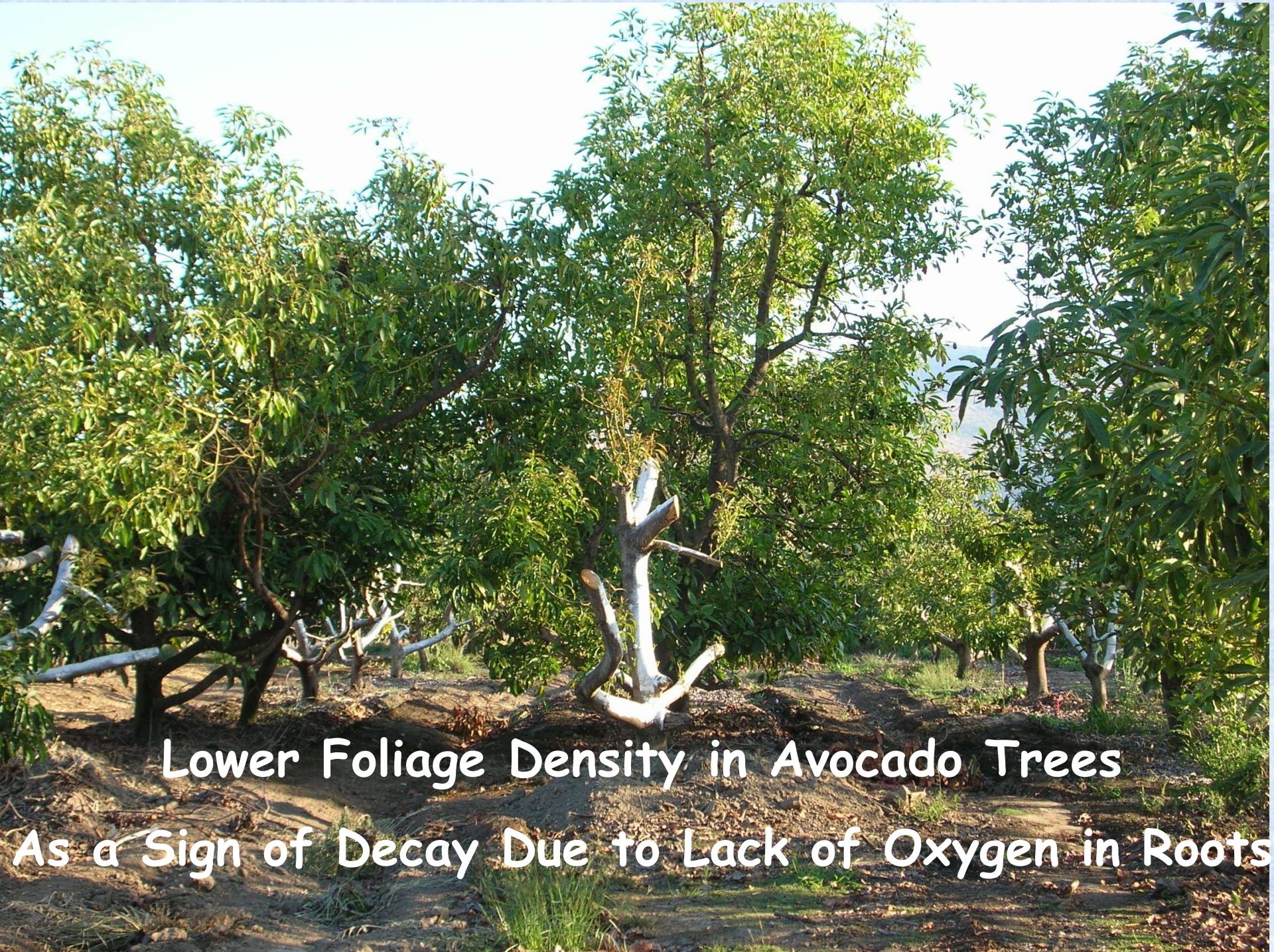


Vine with Few Canes and Buds

(Approx. 37% of normal)



Decreasing Cane Thickness as a Sign of Decay in Vines Due To Lack of Oxygen in Roots


Lower Foliage Density in Avocado Trees
As a Sign of Decay Due to Lack of Oxygen in Roots

Simptoms and Indicators of Decay and Low Sustainability

In fruit trees

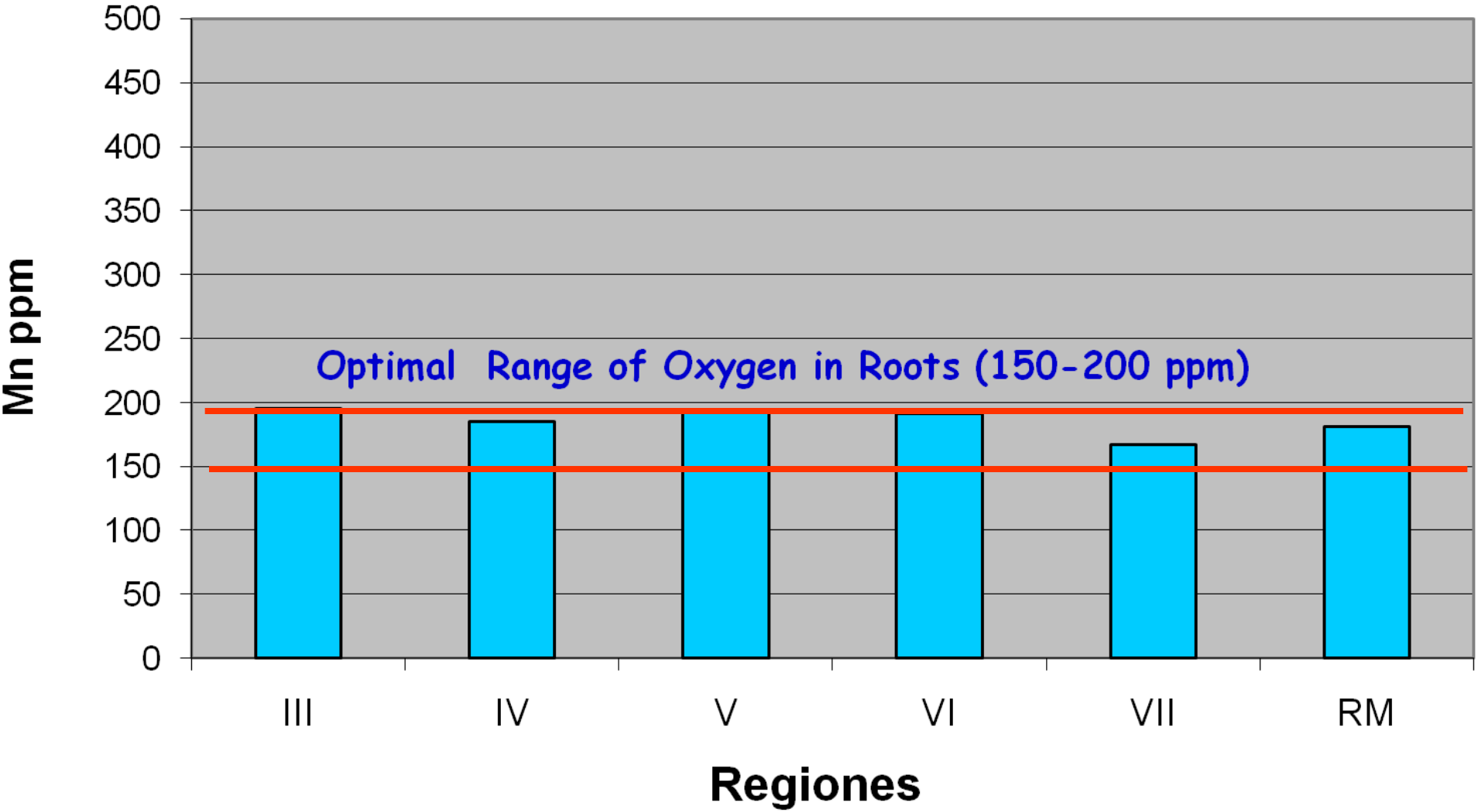
1. Simptoms of foliage with low vigor and low vegetative development
2. High Concentration of foliar Manganese as an indicator of flooding and lack of oxygen on root zone.
3. Coloration and abnormal growth of primary roots and fine roots.
4. Varying Levels of Salinity at Different Soil Depths, and the Presence of Reductive Conditions of Grey Color.
5. Presence of Indicator Plants.

Typical Foliar Analysis of Decayed Grape Vines

VARIEDAD			Thompson 1	Flame seedless	Red Globe	Superior	RANGO ADECUADO
N-TOTAL	(N)	%	3.48	3.04	3.10	3.05	2.00 - 2.40
FOSFORO	(P)	%	0.33	0.37	0.34	0.34	0.14 - 0.45
POTASIO	(K)	%	1.06	0.67	0.97	0.97	0.95 - 1.20
CALCIO	(Ca)	%	1.96	2.50	1.43	1.54	1.50 - 2.40
MAGNESIO	(Mg)	%	0.28	0.31	0.24	0.22	0.25 - 0.60
ZINC	(Zn)	ppm	24	23	25	23	30 - 50
MANGANESO	(Mn)	ppm	305	405	425	450	20 - 300
FIERRO	(Fe)	ppm	151	177	170	133	60 - 100
COBRE	(Cu)	ppm	9	6	9	7	3 - 20
BORO	(B)	ppm	26	34	28	23	35 - 100

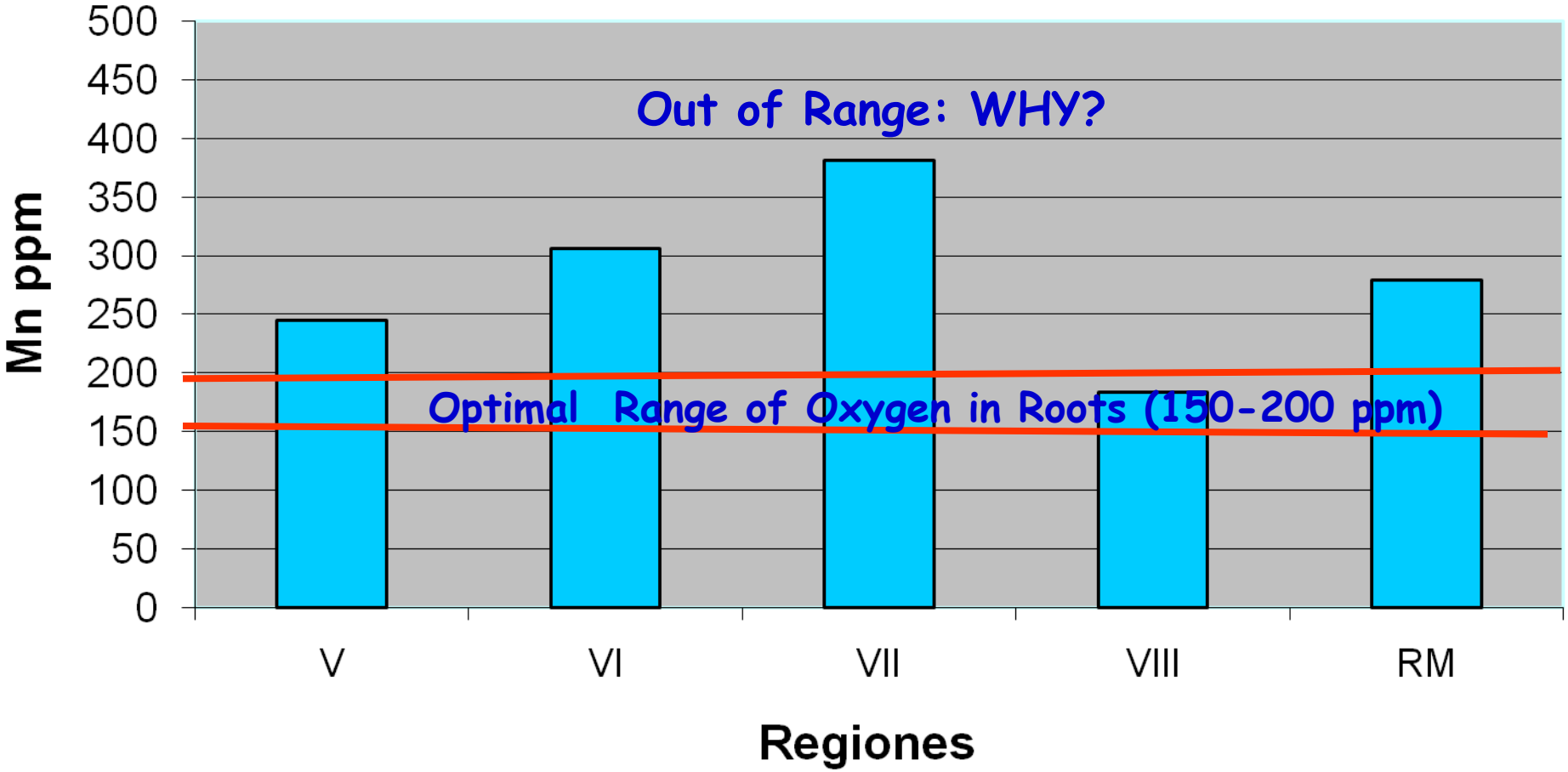
Foliar Maganese Concentration on Petiols of Table Grapes in Full Bloom Stage

(Each Bar represents an average of about 20 growers)

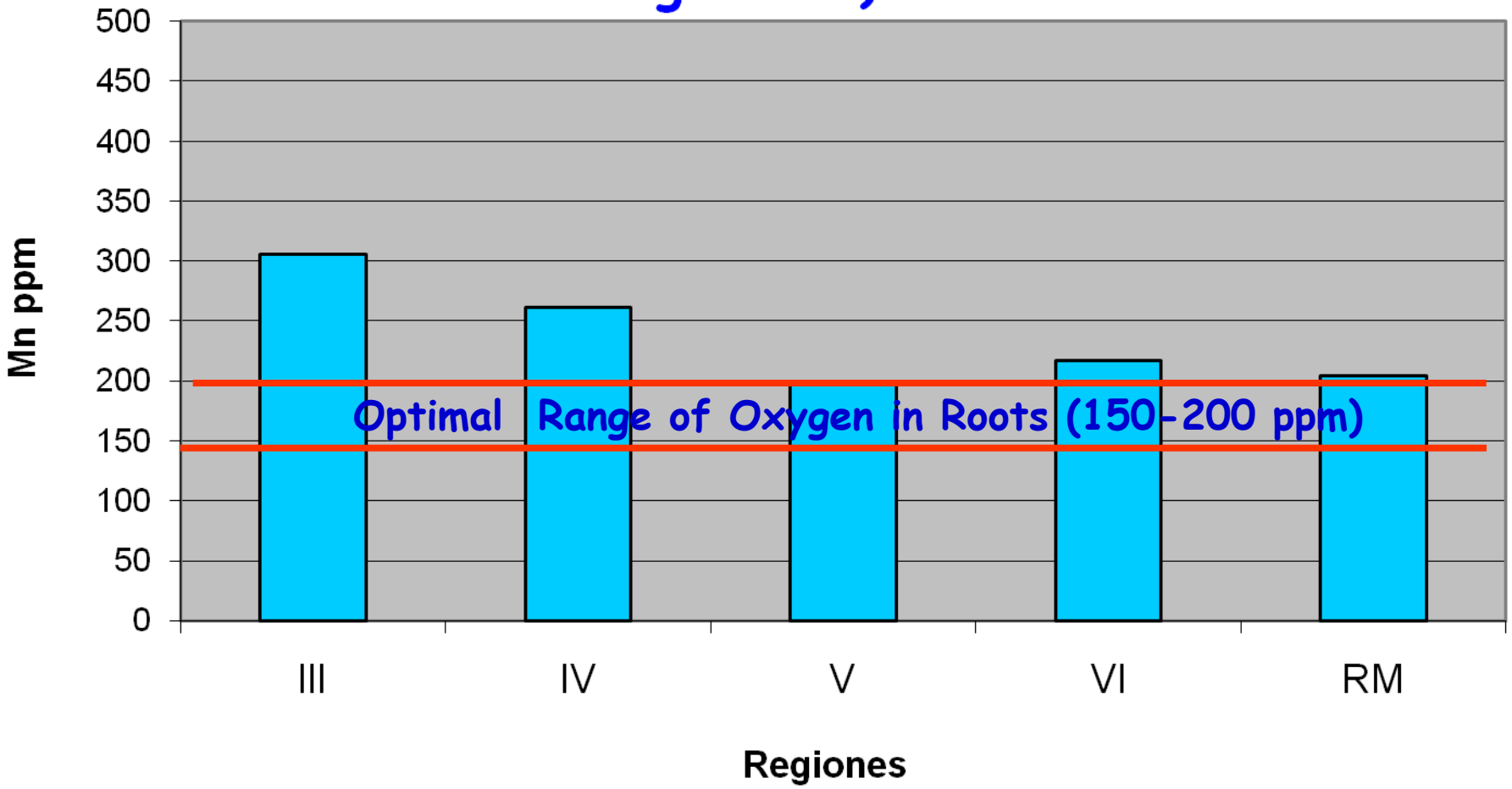


Foliar Maganese Concentration on Petiols of Grape Vines in Full Bloom Stage

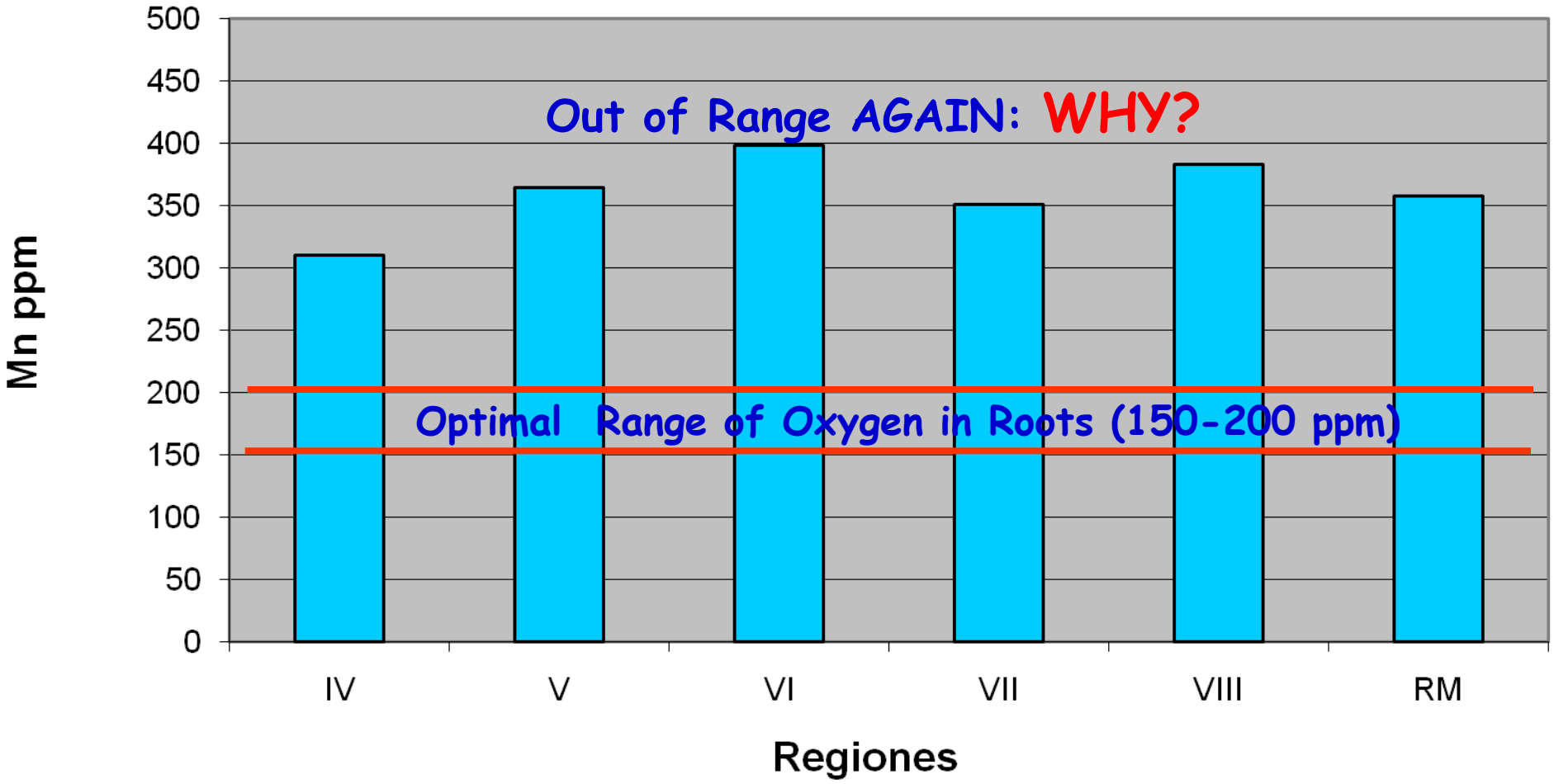
(Each Bar represents an average of about 20 growers)



Foliar Maganese Concentration on leaf Blade of Table Grapes in Veraison Stage (Each Bar represents an average of about 20 growers)



Foliar Maganese Concentration on Leaf Blades of Grape Vines in Veraison Stage (Each Bar represents an average of about 20 growers)



High Concentration of foliar Manganese as an indicator of flooding and lack of oxygen on root zones in Avocado Trees.

CASO 1

Localidad : La Ligua

Especie : Palto Hass
Tejido : Hoja

Fecha muestreo : 20-03-2006 F.Ingreso : 24-03-2006
F.del informe : 03-04-2006

Identificación Cuartel		:	Sector 5	Rango Adecuado*
Variedad		:	Hass	
Edad		:	5	
Nº de Laboratorio		:		
Nitrógeno total	(N)	%	1,89	2,00 - 2,50
Fósforo	(P)	%	0,19	0,10 - 0,25
Potasio	(K)	%	0,55	0,75 - 2,00
Calcio	(Ca)	%	1,13	1,00 - 3,00
Magnesio	(Mg)	%	0,51	0,25 - 0,80
Zinc	(Zn)	ppm	95	30 - 150
Manganeso	(Mn)	ppm	**770** ←	**30 - 500**
Hierro	(Fe)	ppm	75	50 - 200
Cobre	(Cu)	ppm	9	5 - 15
Boro	(B)	ppm	18	40 - 100

Plants with Severe Decay

*Rango adecuado variedad Hass. Epoca de muestreo: marzo-abril. Tejido: hojas de 5 a 7 meses de edad del brote de primavera sin fruto.

High Concentration of foliar Manganese as an indicator of flooding and lack of oxygen on root zones in Avocado Trees.

CASO 2

Localidad : **Combarbala**

Especie : Palto Hass
Tejido : Hoja

Fecha muestreo : 24-03-2006 F.Ingreso : 24-03-2006
F.del informe : 03-04-2006

Identificación Cuartel			Sector 2	Sector 4		Rango Adecuado*
Variedad		:	Hass	Hass		
Edad		:	5	5		
N° de Laboratorio		:				
Nitrógeno total	(N)	%	2,31	2,02		2,00 - 2,50
Fósforo	(P)	%	0,16	0,18		0,10 - 0,25
Potasio	(K)	%	0,98	1,09		0,75 - 2,00
Calcio	(Ca)	%	1,81	1,40		1,00 - 3,00
Magnesio	(Mg)	%	0,47	0,33		0,25 - 0,80
Zinc	(Zn)	ppm	59	73		30 - 150
Manganeso	(Mn)	ppm	**1160** ←	**820**	Plants About to Die	**30 - 500**
Hierro	(Fe)	ppm	67	66		50 - 200
Cobre	(Cu)	ppm	7	9		5 - 15
Boro	(B)	ppm	37	35		40 - 100

*Rango adecuado variedad Hass. Epoca de muestreo: marzo-abril. Tejido: hojas de 5 a 7 meses de edad del brote de primavera sin fruto.

Foliar Analysis of Plants with Normal Levels of Manganese Concentration as a Result of Very Good aereation in the Root System

CASO 3

Localidad : **La Ligua**

Especie : Palto Hass
Tejido : Hoja

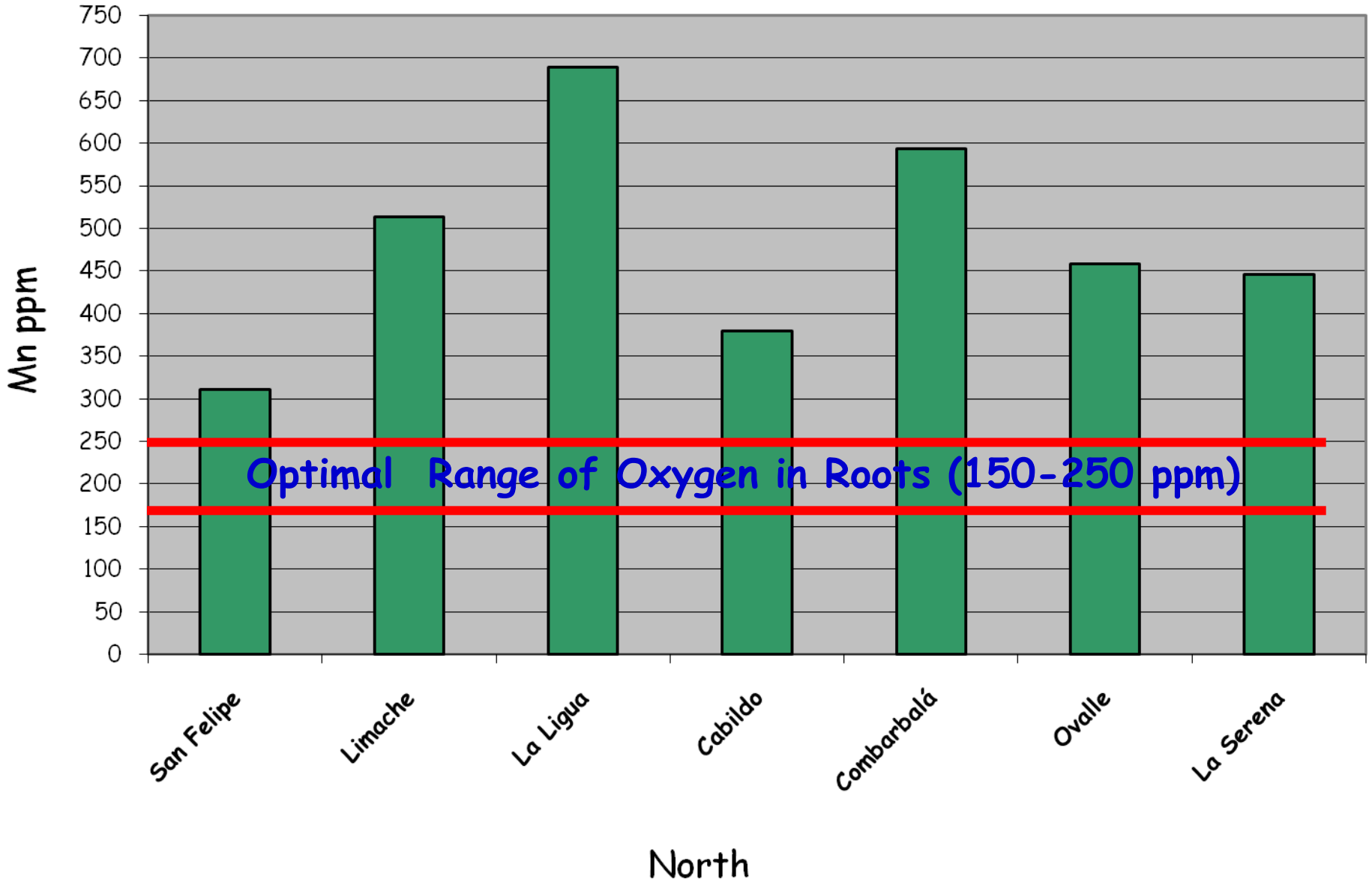
Fecha muestreo : 20-03-2006 F.Ingreso : 24-03-2006
F.del informe : 03-04-2006

Identificación Cuartel		:	Sector 4		Rango Adecuado*
Variedad		:	Hass		
Edad		:	7		
N° de Laboratorio		:			
Nitrógeno total	(N)	%	2,10		2,00 - 2,50
Fósforo	(P)	%	0,22		0,10 - 0,25
Potasio	(K)	%	1,40		0,75 - 2,00
Calcio	(Ca)	%	1,89		1,00 - 3,00
Magnesio	(Mg)	%	0,60		0,25 - 0,80
Zinc	(Zn)	ppm	55		30 - 150
Manganeso	(Mn)	ppm	**210** ←	Normal Plants	30 - 500
Hierro	(Fe)	ppm	110		50 - 200
Cobre	(Cu)	ppm	9		5 - 15
Boro	(B)	ppm	49		40 - 100

*Rango adecuado variedad Hass. Epoca de muestreo: marzo-abril. Tejido: hojas de 5 a 7 meses de edad del brote de primavera sin fruto.

Foliar Maganese Concentration on Leaf Blades of Avocado Trees in Different Growing Regions of Chile

(Each Bar represents an average of about 20 growers)



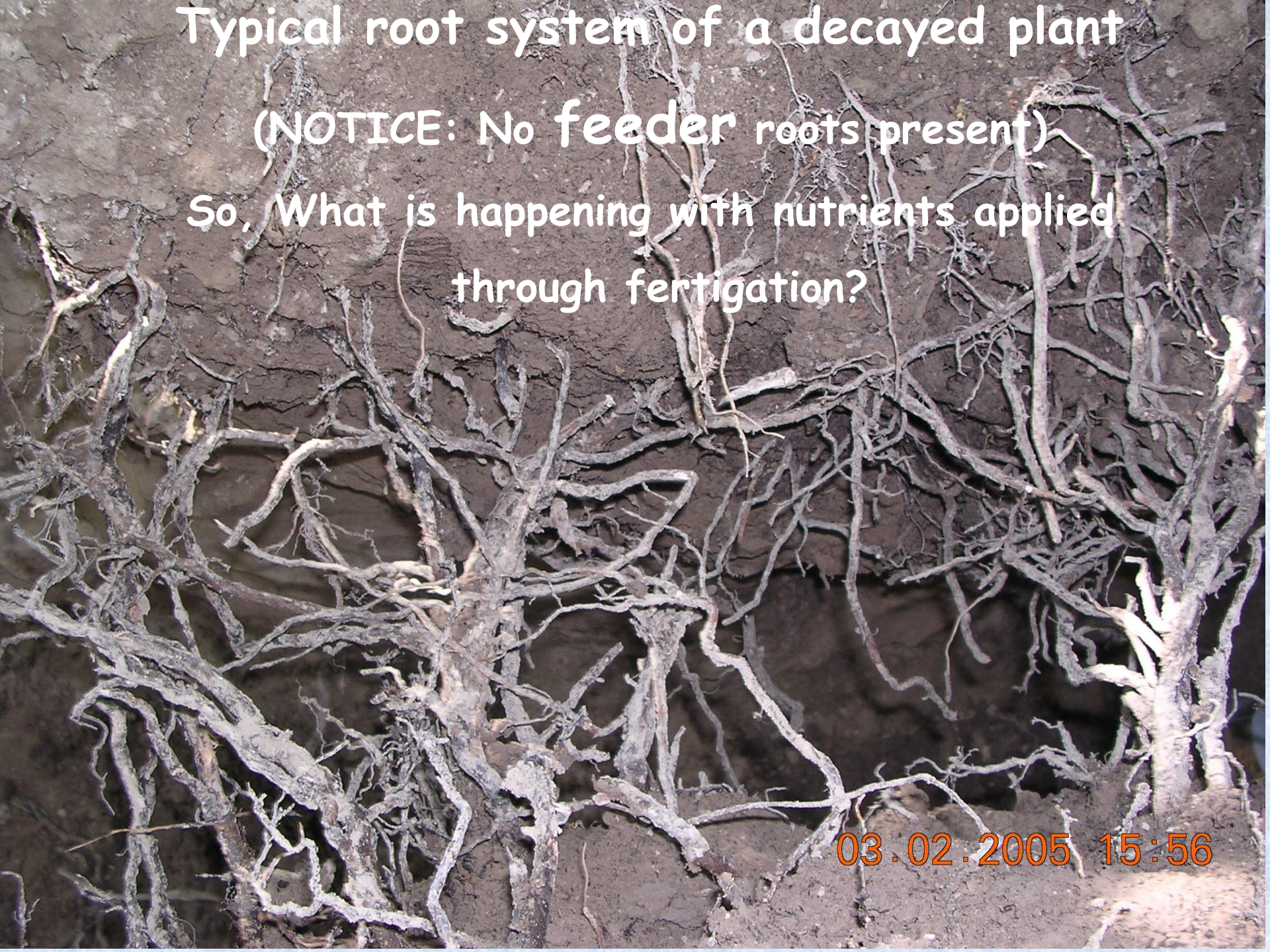
Simptoms and Indicators of Decay and Low Sustainability

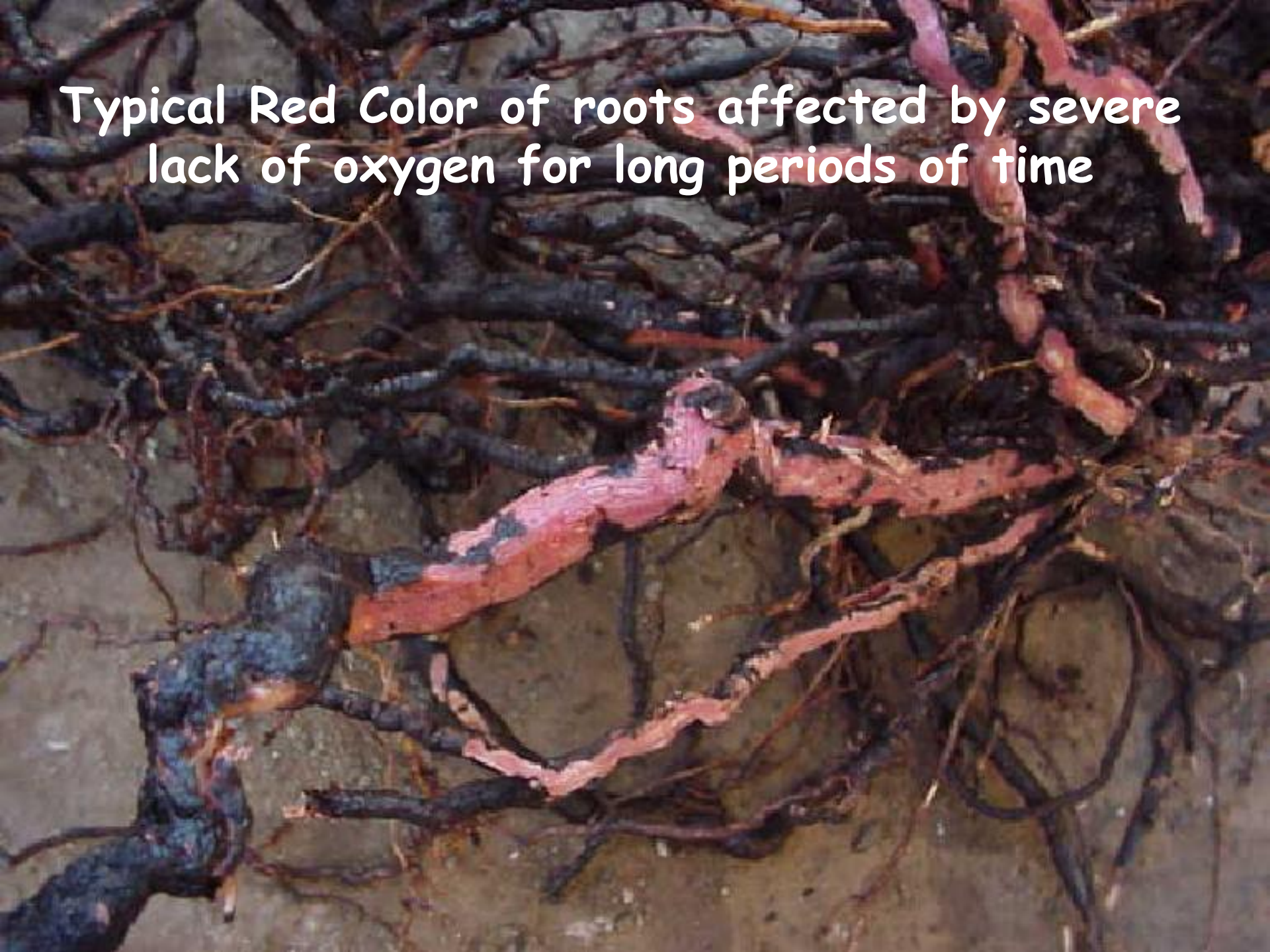
In fruit trees

1. Simptoms of foliage with low vigor and low vegetative development
2. High Concentration of foliar Manganese as an indicator of flooding and lack of oxygen on root zone.
3. Coloration and abnormal growth of primary roots and fine roots.
4. Varying lLevels of Salinity at Different Soil Depths, and the Presence of Reductive Conditions of Grey Color.
5. Presence of Indicator Plants.


What is happening under the soil of these decayed plant


Washing away soil particles to expose
the root system

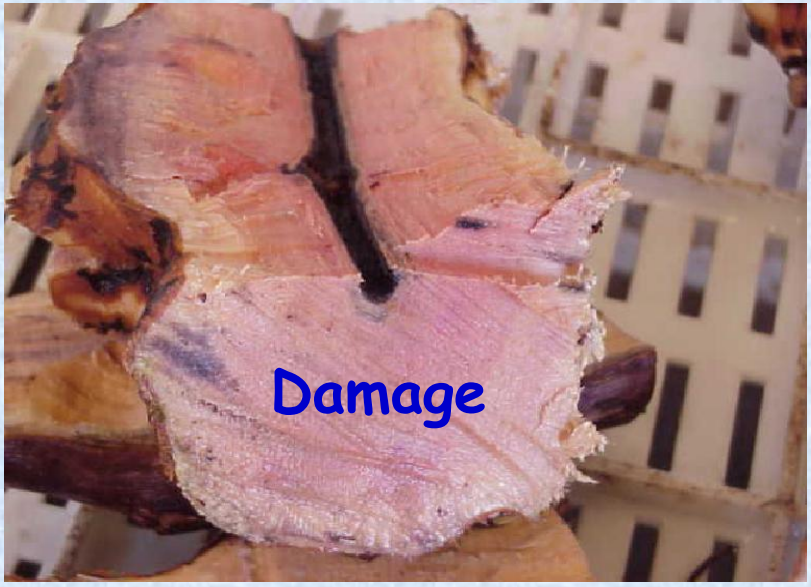

Typical root system of a decayed plant
(NOTICE: No feeder roots present)
So, What is happening with nutrients applied through fertigation?
03.02.2005 15:56

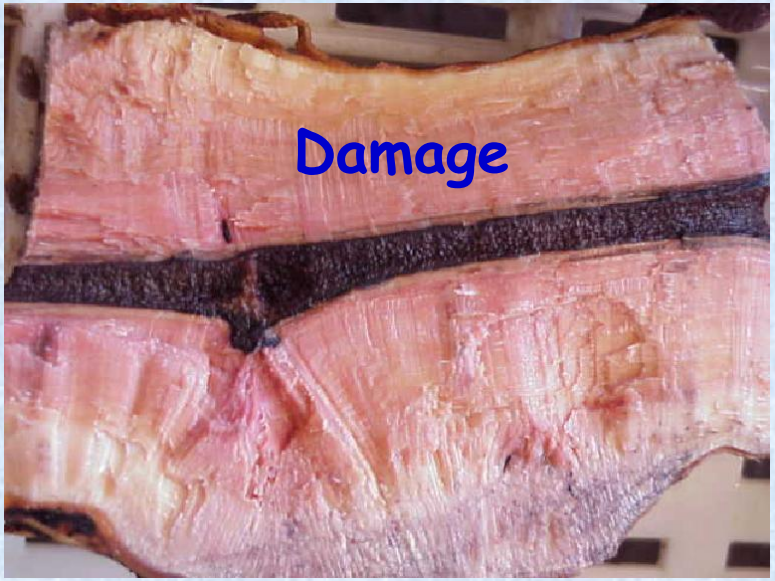

Typical Red Color of roots affected by severe
lack of oxygen for long periods of time


Typical Red Color of wine grape roots affected by severe flooding and lack of oxygen for long periods of time
Abnormal upward growing pattern
Strube-Dieckmann
23 10:07


Next Step: Beginning of Necrotic Tissue on secondary roots because of diseases

Damage on the inner part of the grape crown as a result of long periods of flooding and lack of oxygen

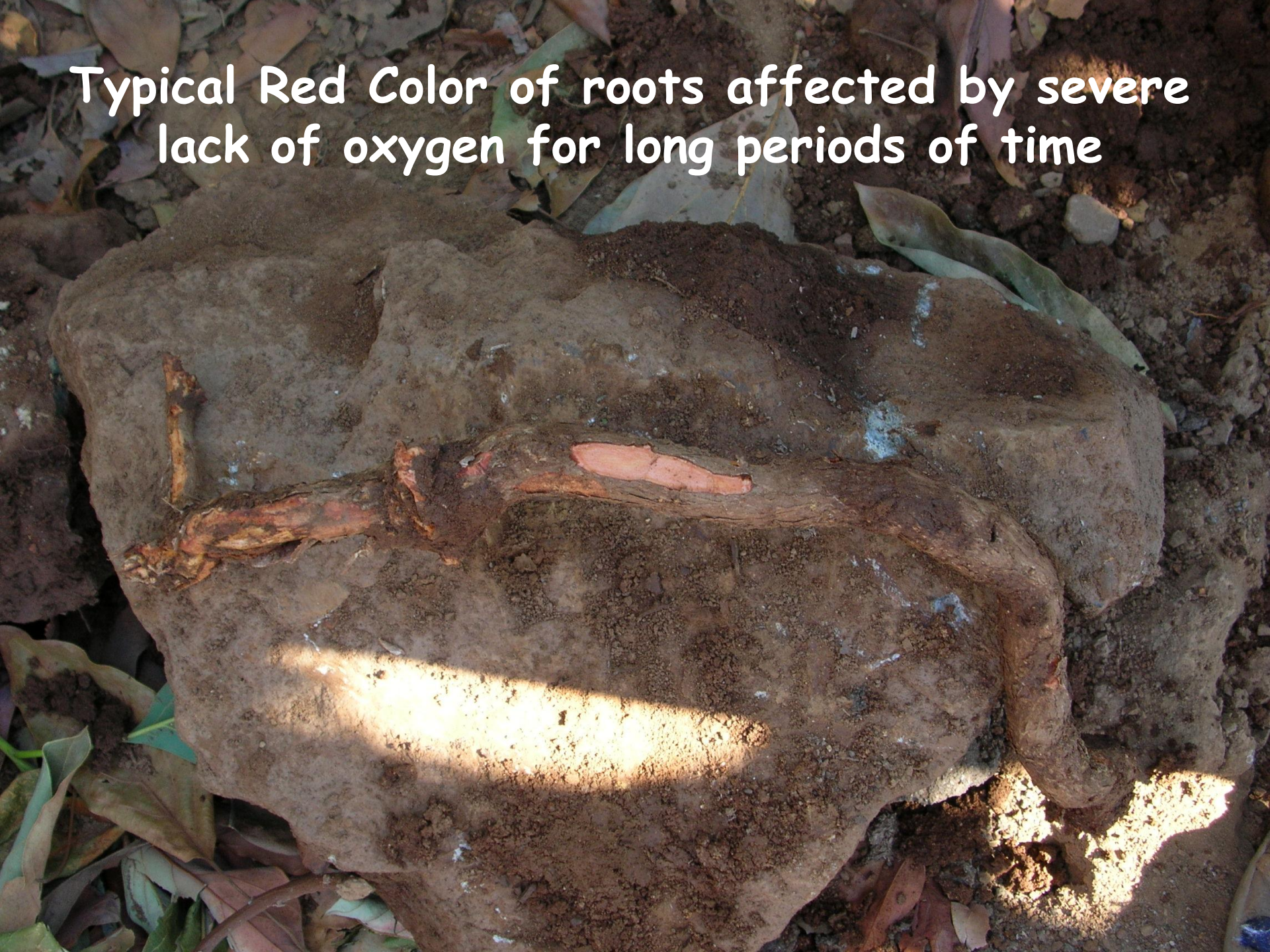


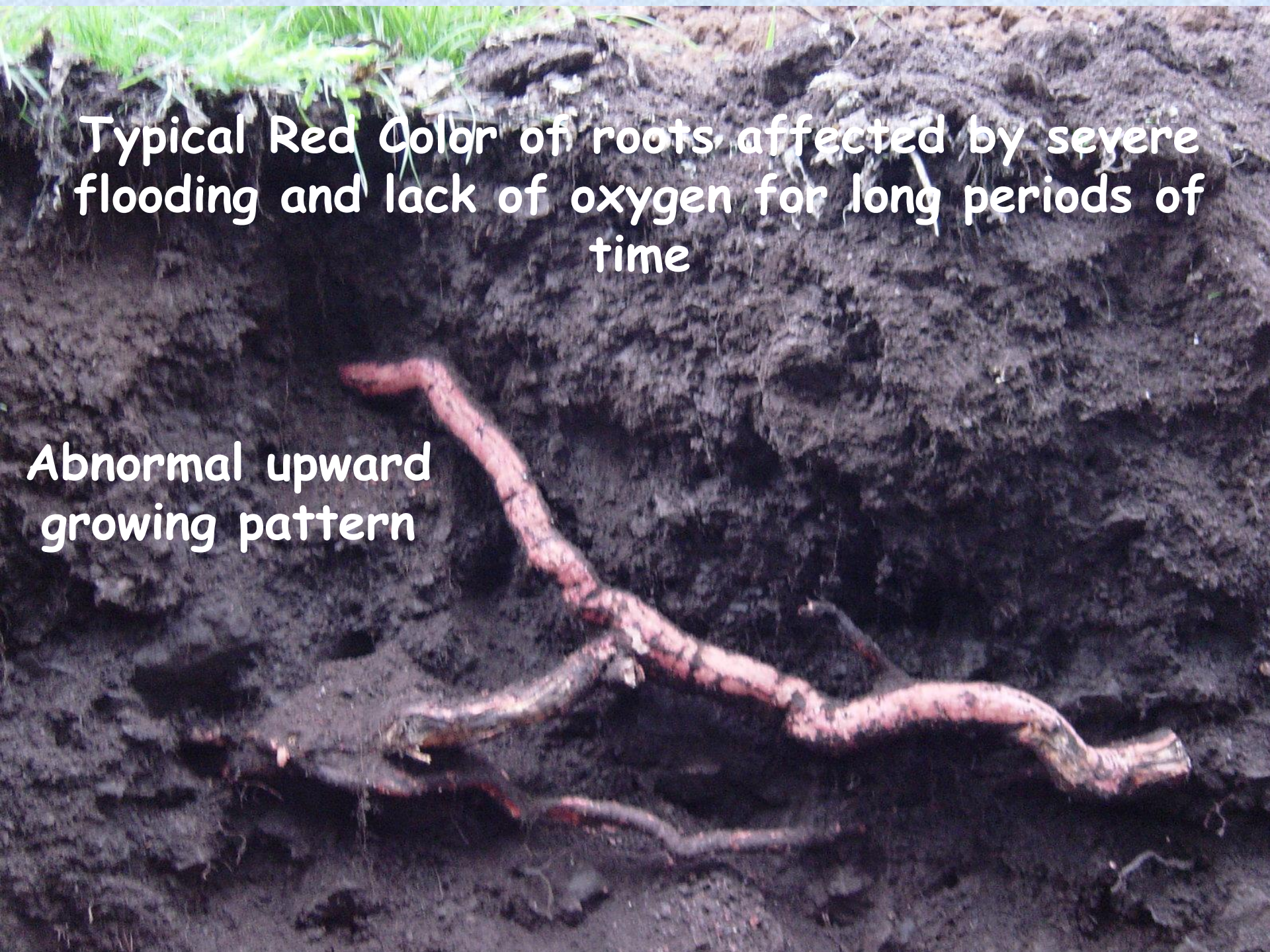


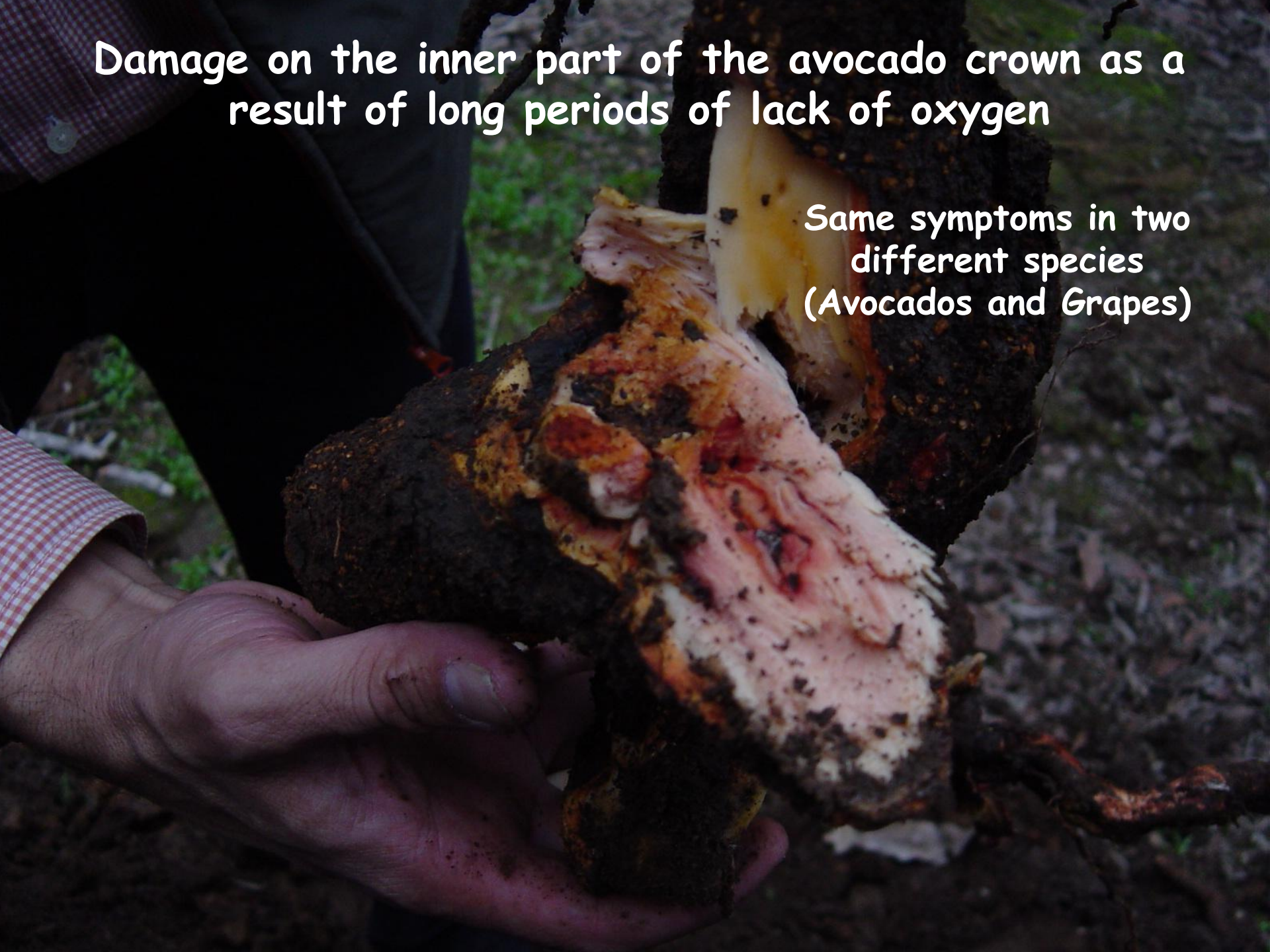

Typical Red Color of roots affected by severe lack of oxygen for long periods of time
Plum Tree Root System


What happened in avocado trees?


Fine roots with weak cuticle
12.13.2004 12:22


Typical Red Color of roots affected by severe lack of oxygen for long periods of time


Typical Red Color of roots affected by severe flooding and lack of oxygen for long periods of time
Abnormal upward growing pattern


Damage on the inner part of the avocado crown as a result of long periods of lack of oxygen
Same symptoms in two different species (Avocados and Grapes)


15.02.2006
Blueberries?


Normal Root System

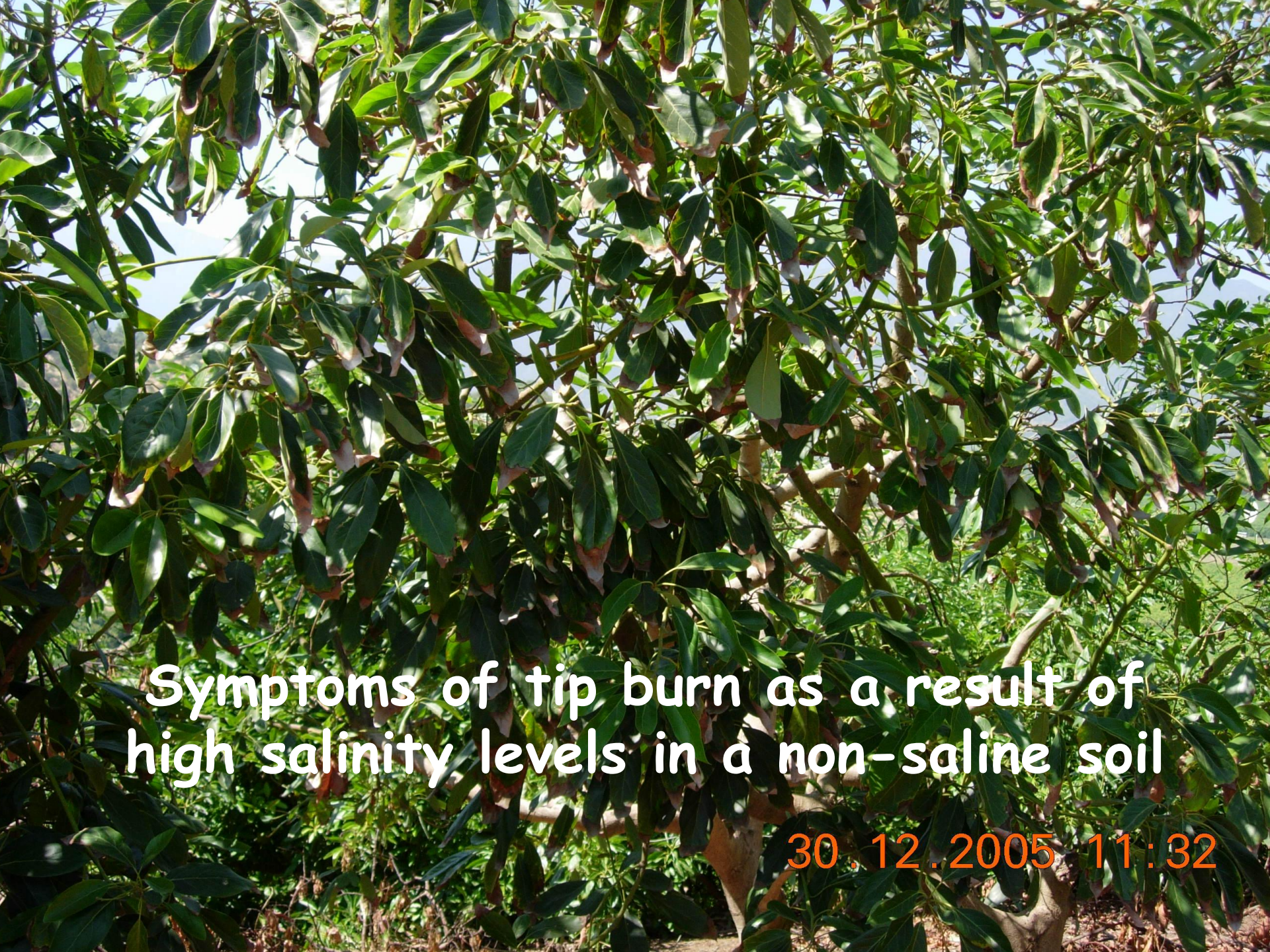

Typical Red Color of roots affected by severe lack of oxygen for long periods of time
24.01.2006

Gradients of red coloration throughout time affected by lack of oxygen

Simptoms and Indicators of Decay and Low Sustainability

In fruit trees

1. Simptoms of foliage with low vigor and low vegetative development
2. High Concentration of foliar Manganese as an indicator of flooding ann lack of oxygen on root zone.
3. Coloration and abnormal growth of primary roots and fine roots.
4. Varying Levels of Salinity at Different Soil Depths, and the Presence of Reductive Conditions of Grey Color.
5. Presence of Indicator Plants.


Symptoms of tip burn as a result of
high salinity levels in a non-saline soil
30.12.2005 11:32


3 different colors in a uniform soil profile as a result of different water contents
03.05.2005 09:15


2007 5 9

Blueberries

Simptoms and Indicators of Decay and Low Sustainability

In fruit trees

1. Simptoms of foliage with low vigor and low vegetative development
2. High Concentration of foliar Manganese as an indicator of flooding and lack of oxygen on root zone.
3. Coloration and abnormal growth of primary roots and fine roots.
4. Varying Levels of Salinity at Different Soil Depths, and the Presence of Reductive Conditions of Grey Color.
5. Presence of Indicator Plants.


12.13.2004 16:32


Moss
01/10/2004


12.13.2004 16:35

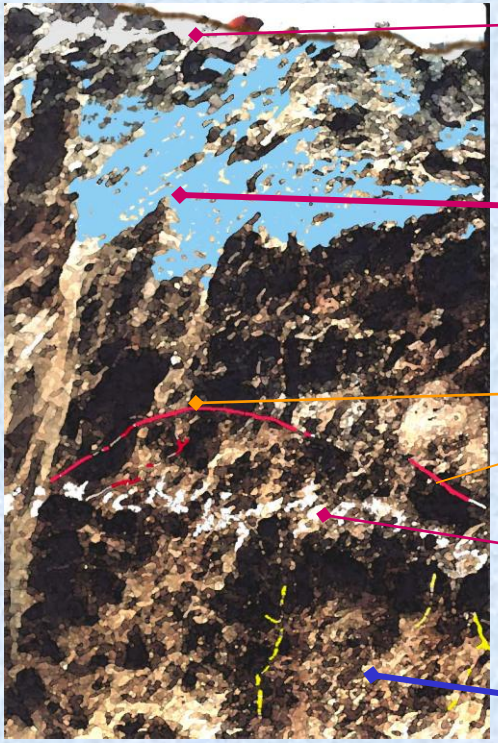
Reasons for decay and low sustanability

1. Irrigation technique
2. Physical and chemical fertility of the soil
3. Physiological response of roots
4. Agronomic quality of irrigation water
5. Diseases and plantation problems
6. Abnormal wetting patterns of soils under drip irrigation

Short and frequent irrigation

The paradigm of irrigation and its effect on the mid and long term.

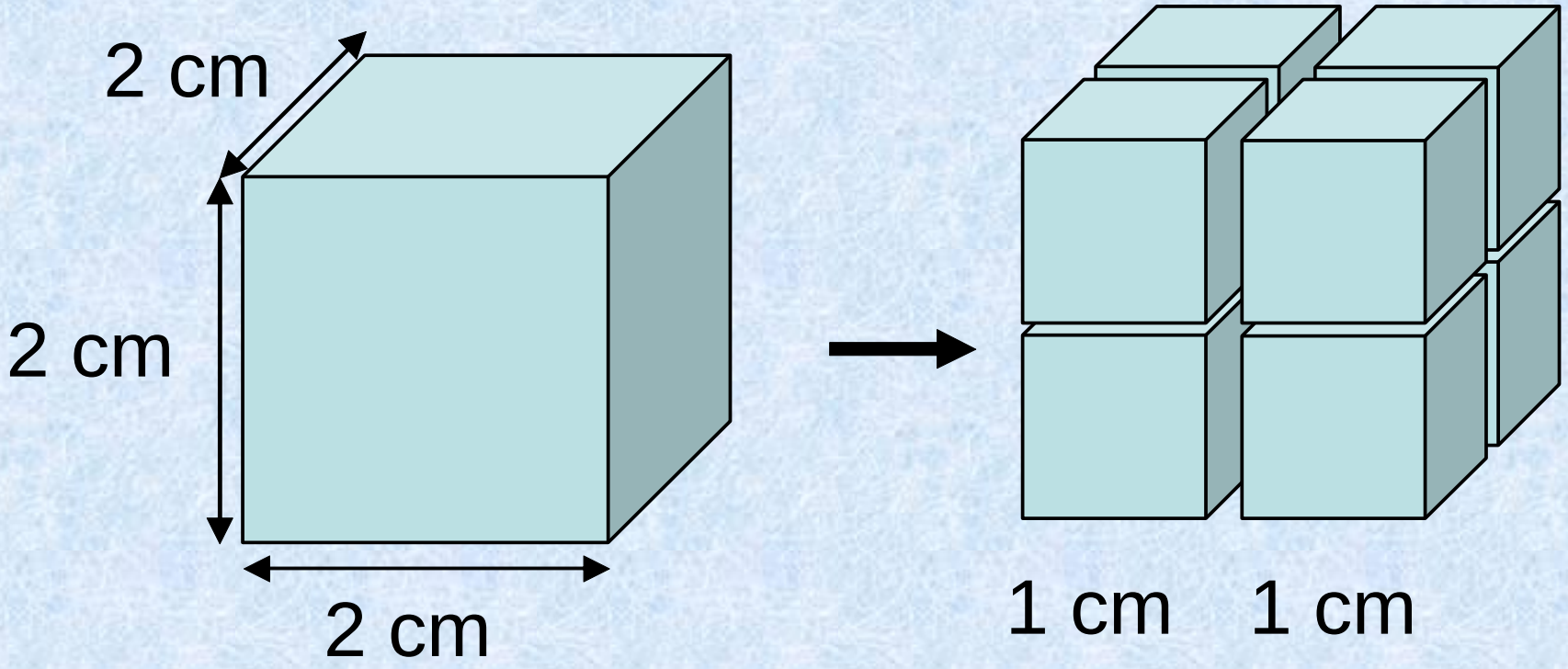
Anoxia Soil crusting



Reasons for decay and low sustanability

1. Irrigation technique
2. Physical and chemical fertility of the soil
3. Physiological response of roots
4. Agronomic quality of irrigation water
5. Diseases and plantation problems
6. Abnormal wetting patterns of soils under drip irrigation

Volume and specific surface relationship

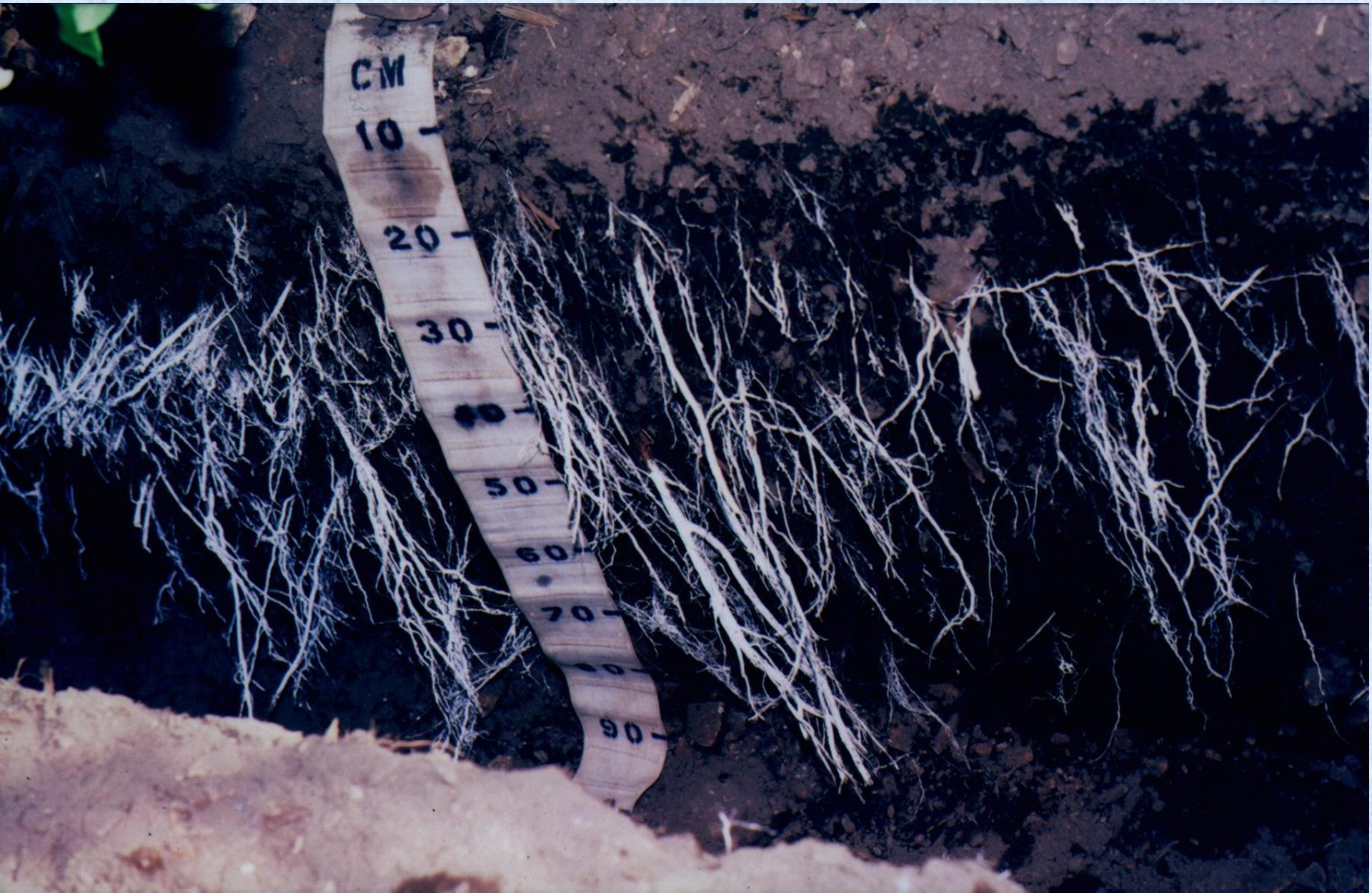


Surface: 2x2x6= 24 cm²

1x1x6x8 = 48 cm²

This soil was prepared at too low soil water levels. The structures seen here are the direct result. Roots do not penetrate these structures.

A well prepared soil.



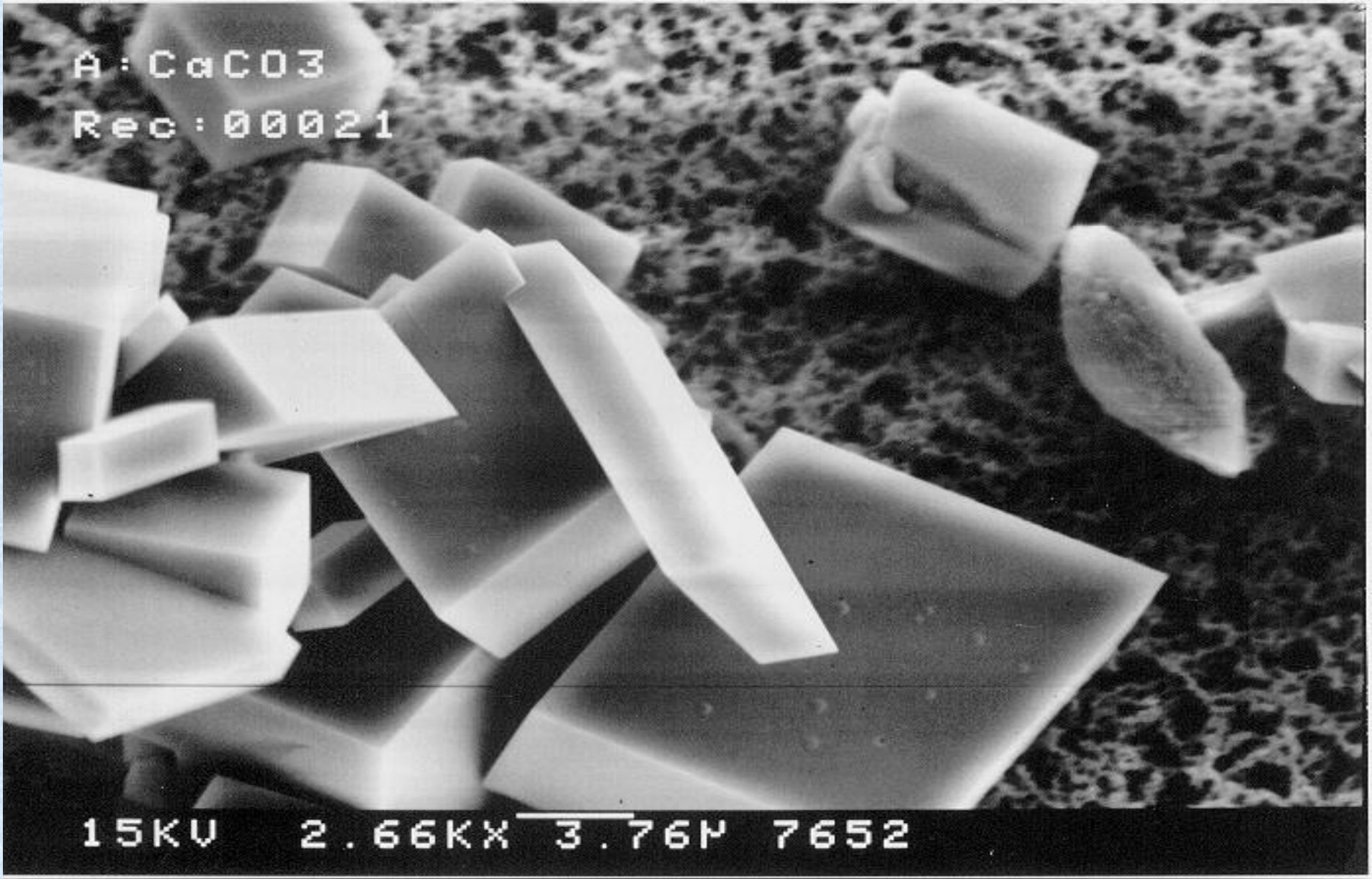
Loss of volume of soil and physical fertility


06.10.2006 11:30


06.10.2006 09:57


Soil crusting as impediment for water infiltration

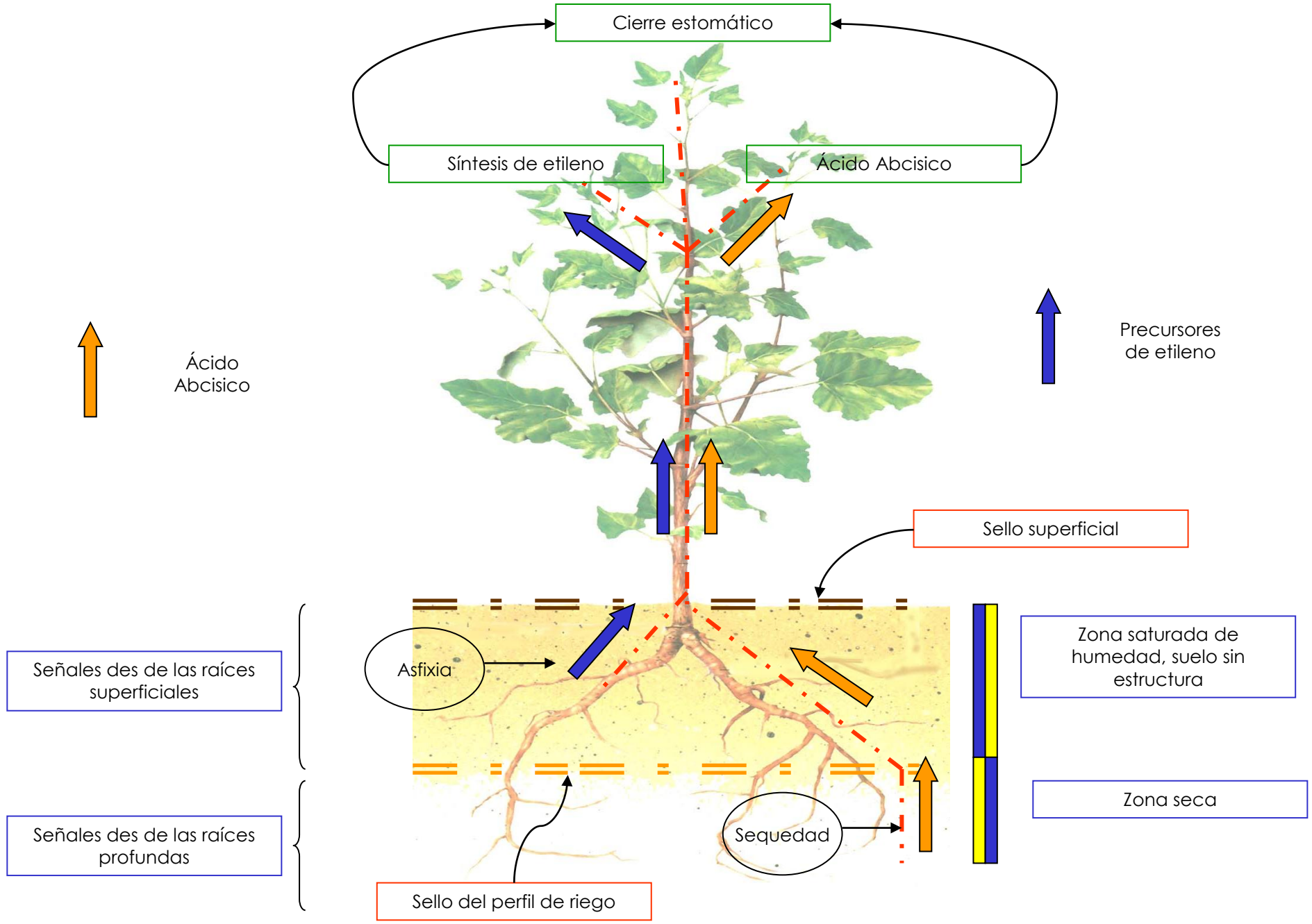
Calcium carbonate crystals



Citrus
Standing Water in a Severely Compacted Field

Reasons for decay and low sustanability

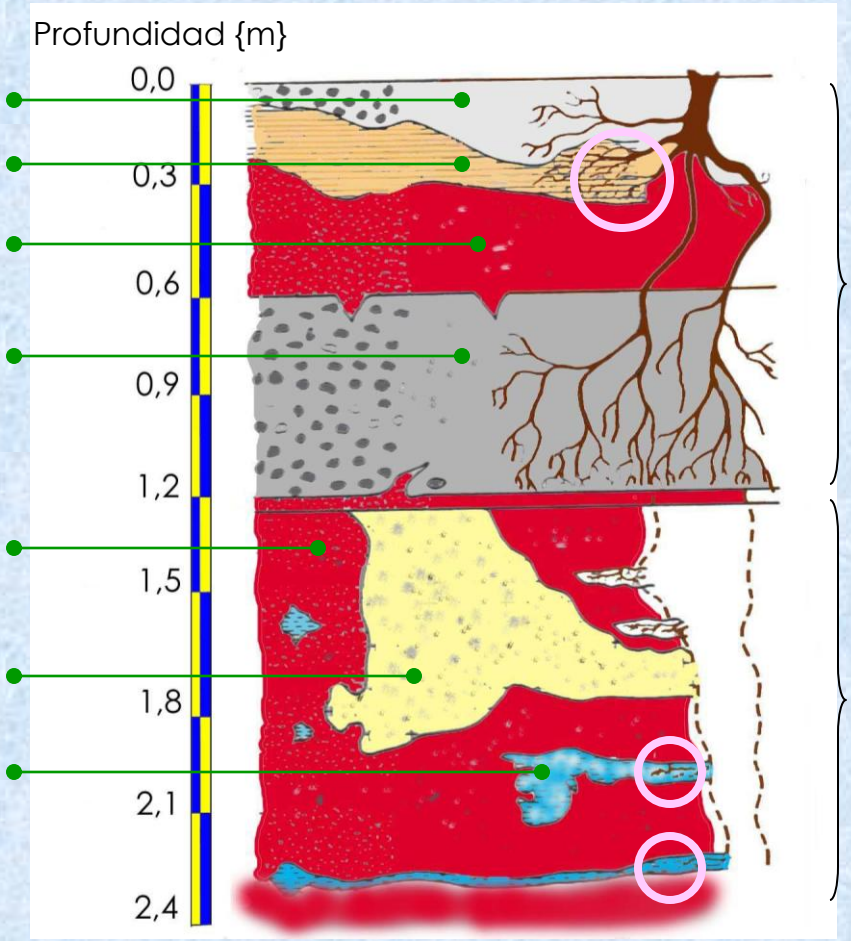
1. Irrigation technique
2. Physical and chemical fertility of the soil
3. Physiological response of roots
4. Agronomic quality of irrigation water
5. Diseases and plantation problems
6. Abnormal wetting patterns of soils under drip irrigation


Cierre estomático
Síntesis de etileno
Ácido Abcisico
Ácido Abcisico
Precursores de etileno
Sello superficial
Señales des de las raíces superficiales
Asfixia
Zona saturada de humedad, suelo sin estructura
Zona seca
Señales des de las raíces profundas
Sequedad
Sello del perfil de riego

Pattern of growth in grape vine roots

Suelo

VID



Arena gravillosa

Marga aportada

Arena concretada (Fe alto)

Arena gravillosa

Arena concretada (Fe alto)

Arena amarilla

Arena gris azulada (Fe bajo)

Zona de raicillas abundantes

Raíces gruesas "continuas"

Raíces gruesas "no continuas"

Soil Profile Saint-Julien


Grape vine roots up to 6 meters depth
23.10.2008


2007 5 9


2007 5 9


2007 5 9

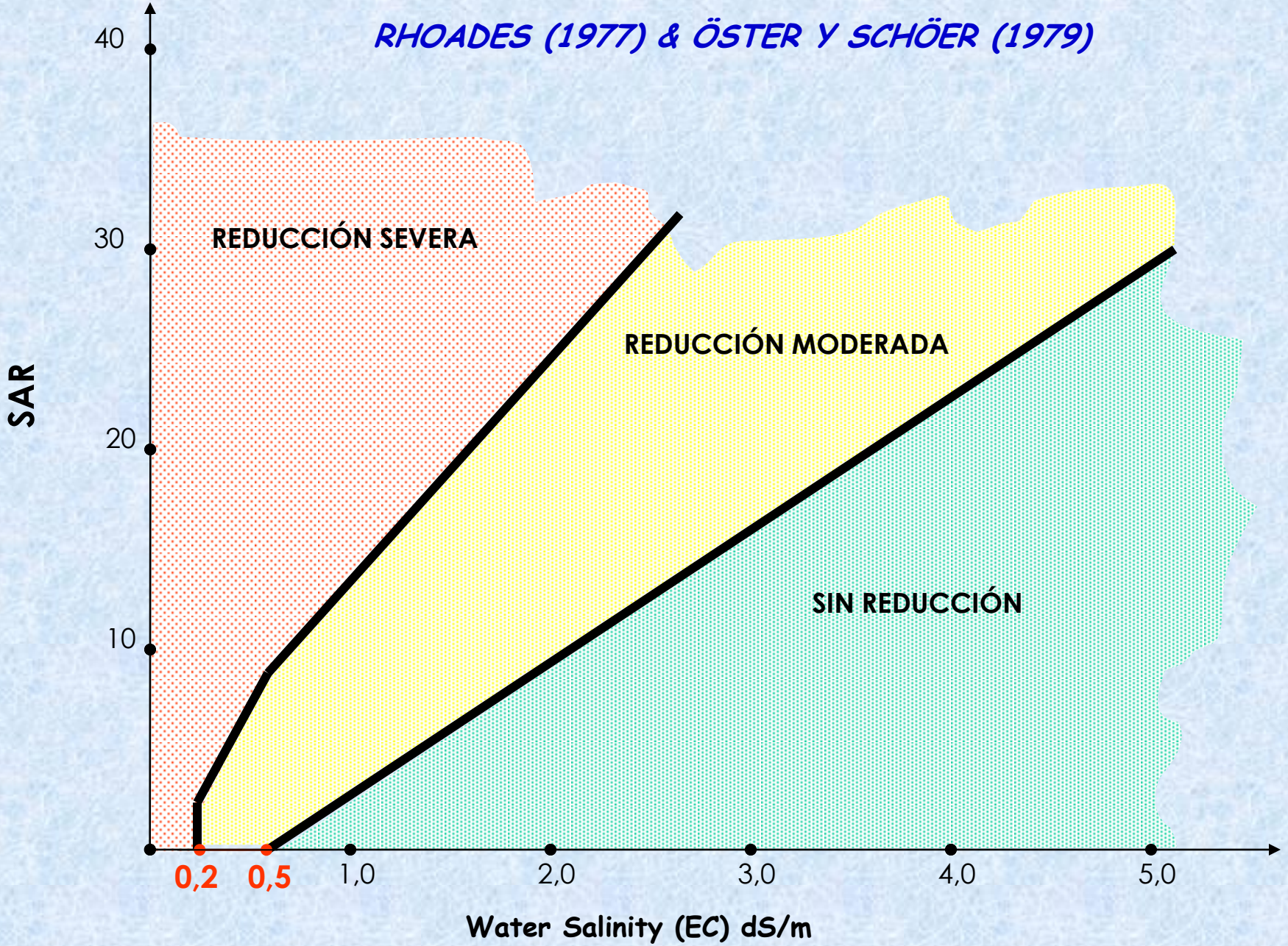

6 5 2007

Reasons for decay and low sustanability

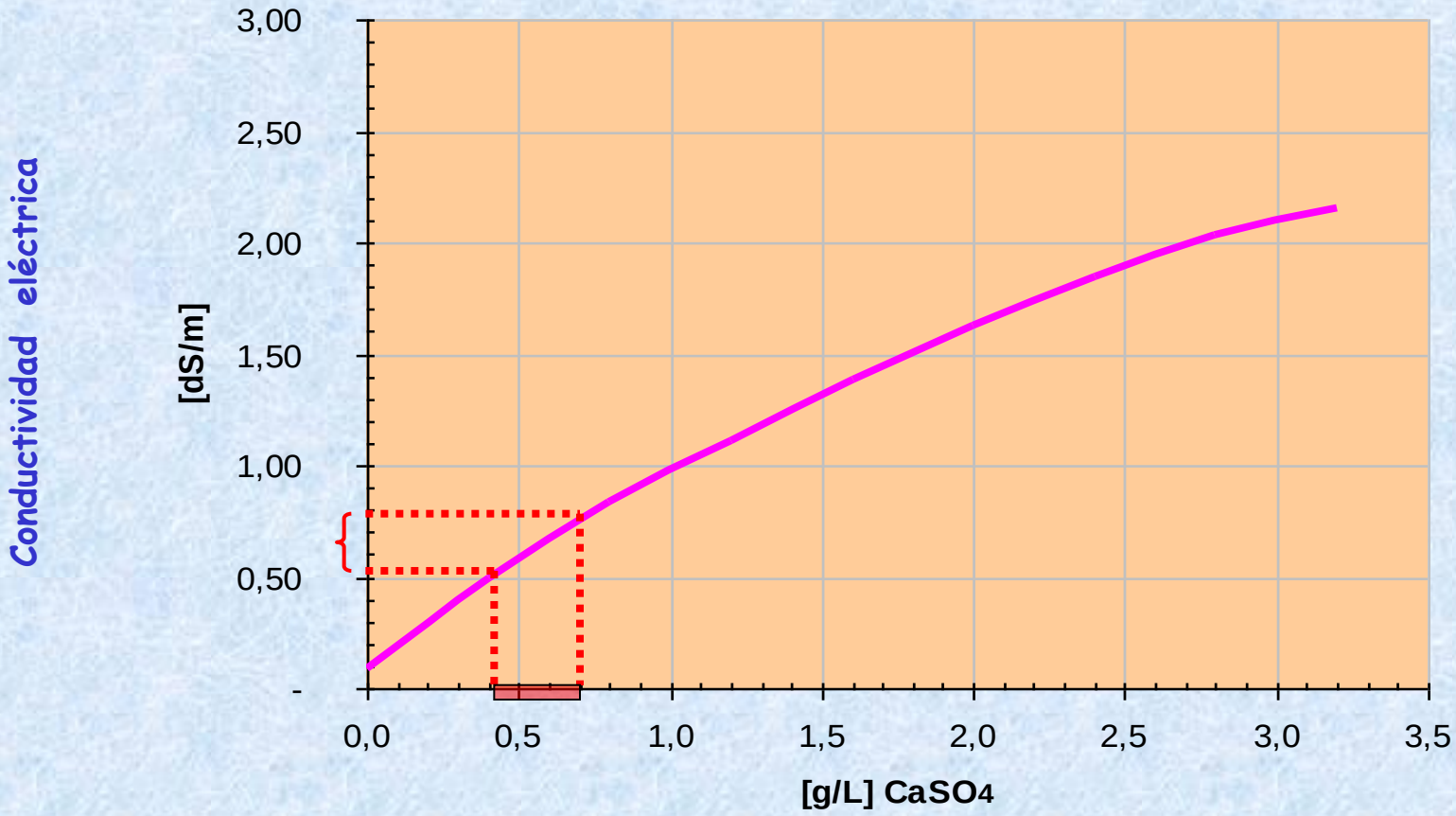
1. Irrigation technique
2. Physical and chemical fertility of the soil
3. Physiological response of roots
4. Agronomic quality of irrigation water
5. Diseases and plantation problems
6. Abnormal wetting patterns of soils under drip irrigation

Infiltration reduction of irrigation water depending on salt content

RHOADES (1977) & ÖSTER Y SCHÖER (1979)



Effect of gypsum as ammedment applied through water irrigation in Lontué river because of low salt contents (VII Region, Chile)



Reasons for decay and low sustanability

1. Irrigation technique
2. Physical and chemical fertility of the soil
3. Physiological response of roots
4. Agronomic quality of irrigation water
5. Diseases and plantation problems
6. Abnormal wetting patterns of soils under drip irrigation

What is the evolution of these plants in the future?


20.05.2006 10:43


RED GLOBE
CUARTEL 5
HAS. 2,46
3,5 X 1,50
4629 PLANTAS
AÑO 2000
17.05.2006 12:21


20.05.2006 10:44


San Juan Argentina


08.08.2007


Wine grape: severe attack of crown galls


Wine grape: severe attack of nematodes.

Grape Vine: Severe attack of Philoxera


08.09.2005 06:55


15.03.2006 17:16


15.03.2006 17:07

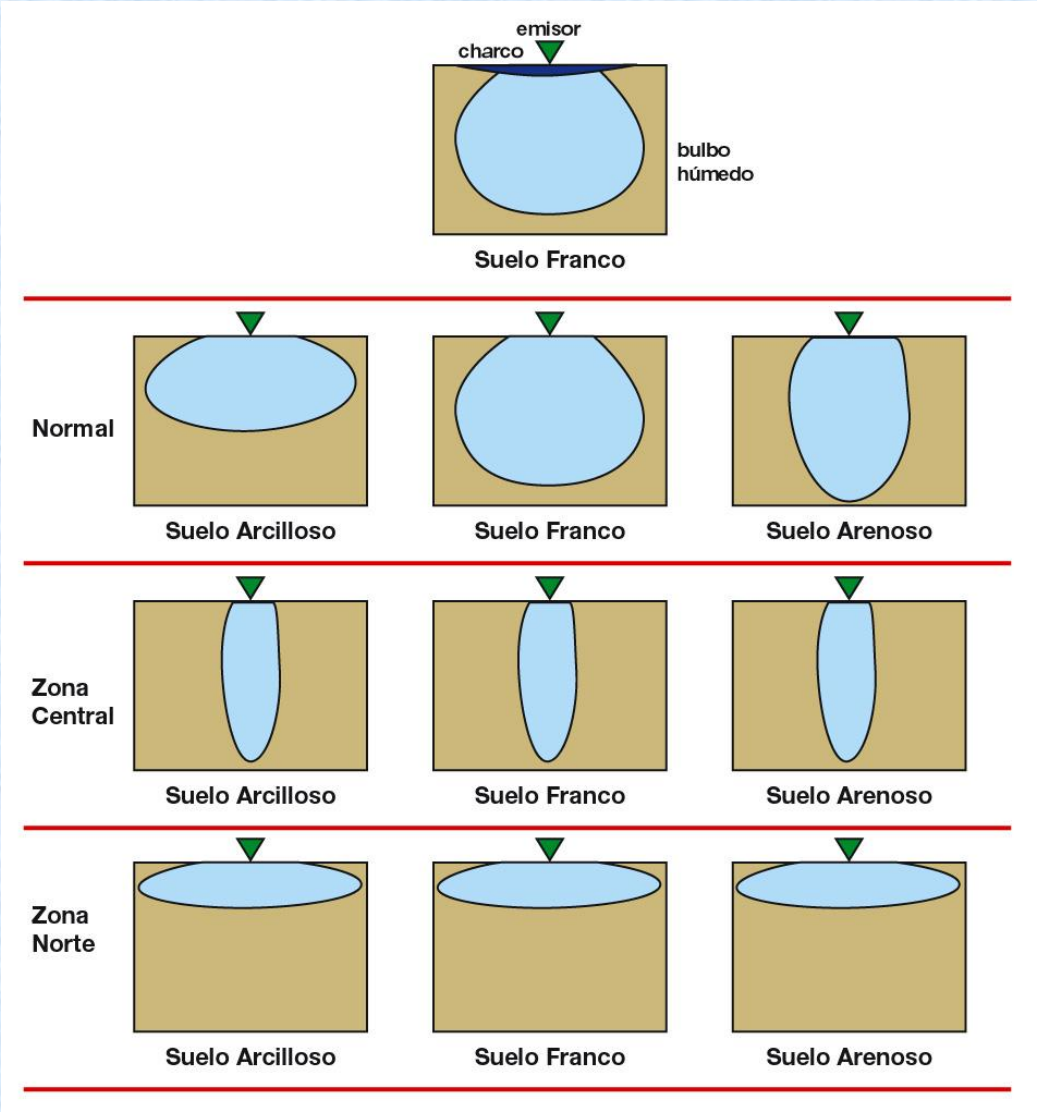

15.03.2006 17:08


20 11 2007

Reasons for decay and low sustanability

1. Irrigation technique
2. Physical and chemical fertility of the soil
3. Physiological response of roots
4. Agronomic quality of irrigation water
5. Diseases and plantation problems
6. Abnormal wetting patterns of soils under drip irrigation

Wetting pattern of Chilean soils
The great paradox



Well irrigated soil

Clay loam soil with a narrow wetting pattern under drip irrigation

Symptoms on foliage because of dry root zones in a full irrigated orchard

Grape Vines Planted in a sandy soil with 100% of wet soil Under drip irrigation

Soil profile
San Julián, Ovalle. Chile


31.03.2006 18:29


?
31.03.2006 16:35

Method for the Recuperation of Decayed Agricultural Plantations

(M.R.P.D.F.)

US Patent Granted 2005

Authors

Antonio Lobato
Eduardo Alonso

Basic principles of Method for the Recuperation of Decayed Agricultural Plantations

Irrigation

1. *"Irrigation period is for soils, and should be enough to reach the deepest roots. This is a fundamental tool in order to introduce oxygen to the soil profile."*

2. *"Irrigation frequency is for plants, and depends on the species, age, and the phenological stage."*

3. *"Water distribution should be applied sufficiently so as not to leave the roots in dry zones."*

Ammendments

1. *Sulfuric acid as a chemical tool to eliminate soil crusting and improve water infiltration.*

2. *Calcium sulfate as a tool to improve porosity and physical fertility of soils.*

Stimulation of New Root Growth

Use of Chitosan (poli-D-glucosamina) as a molocule which inducts SAR responses in plants such as an increase in the volume of roots.

Validation Experiment of the *Method for the Recuperation of Decayed Agricultural Plantations*

Experiment: Two methods of water application in grape vines. Muscat of Alexandria variety. Ovalle, 1996

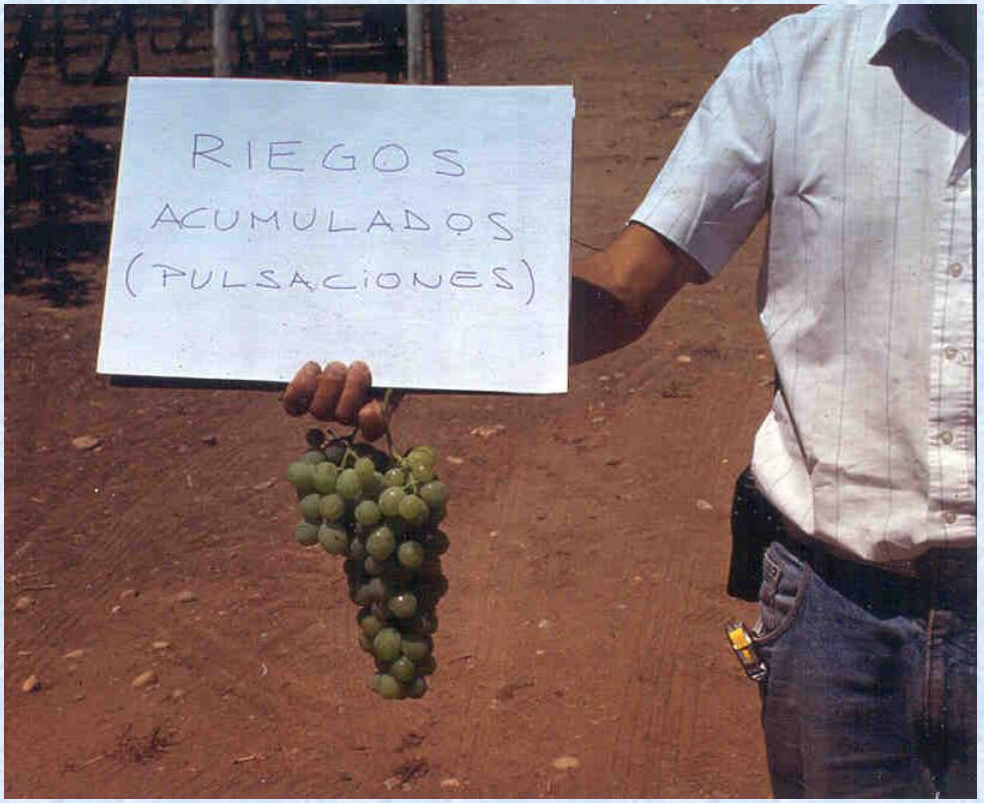
Soil Profile
San Julián, Ovalle

Daily irrigation according to the ETc

14 continuous hours of irrigation every 3 days

Cluster aspect under daily irrigation

Cluster aspect under new method



Both methods use the same amount of water but with absolutely different results !!!

Effect of Two methods of water application in grape vines. Muscat of Alexandria variety. Ovalle, 1996

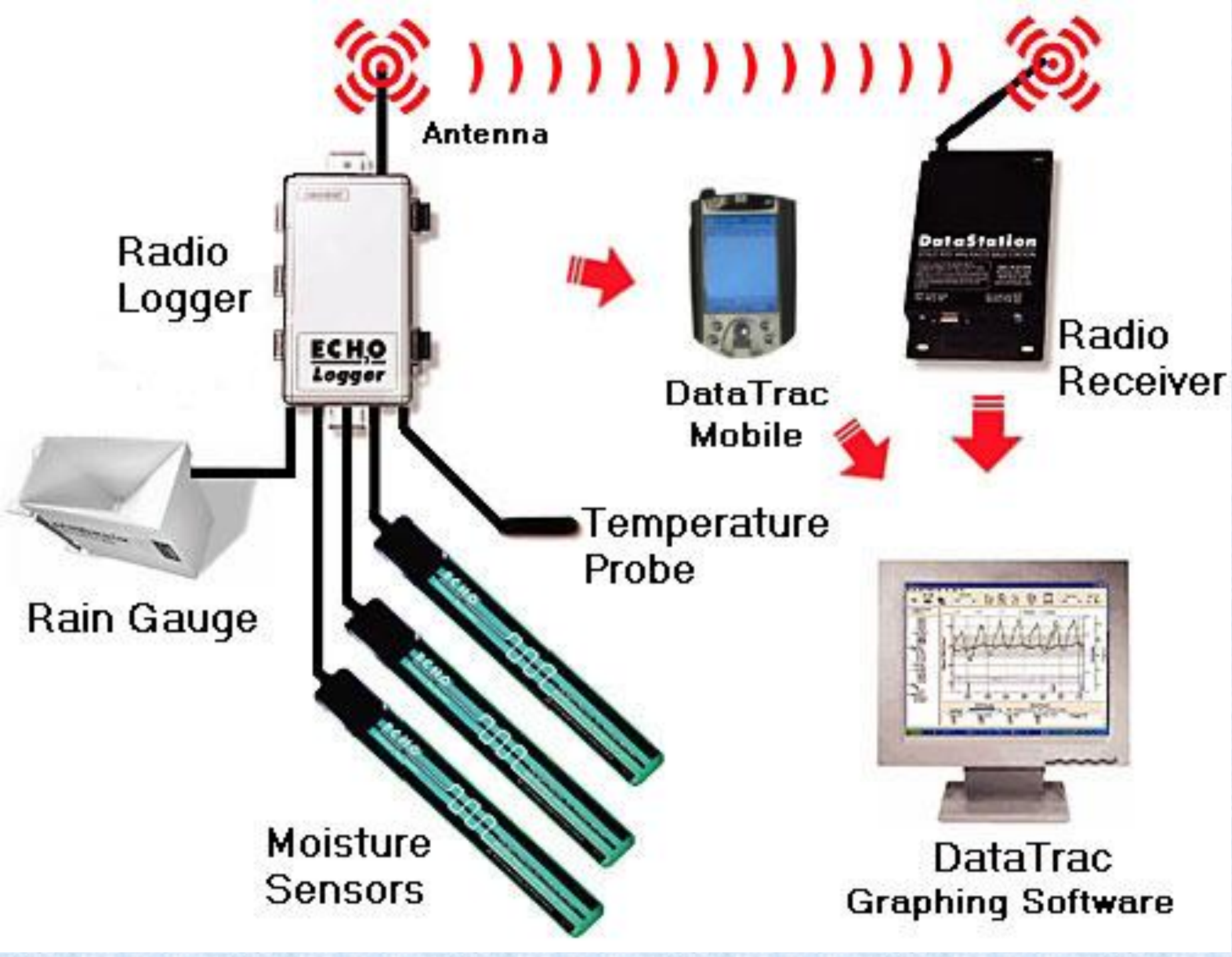
Treatment	Shoot growth (cm)	Yield/ plant (kg)	Bunches/ plant (N°)	Bunch Weight (kg)	Sugar content (°Brix)
Daily irrigation	47,11 a	19,76 a	73 a	270 a	21,2 a
Non daily irrigation	68,31 b	42,13 b	92 b	456 b	20,0 a

Letras iguales no difieren estadísticamente entre sí. Duncan $p<0.05$

Training of personnel in soil characteristics and root conditions during the irrigation period using the method analysis of Soil pit


Deep Soil Pit in order to observe wetting patterns, root growth,
under the new method


02.14.2008


Antenna
Radio
Logger
ECHO
Logger
DataTrac
Mobile
DataStation
Radio
Receiver
Temperature
Probe
Rain Gauge
Moisture
Sensors
DataTrac
Graphing Software

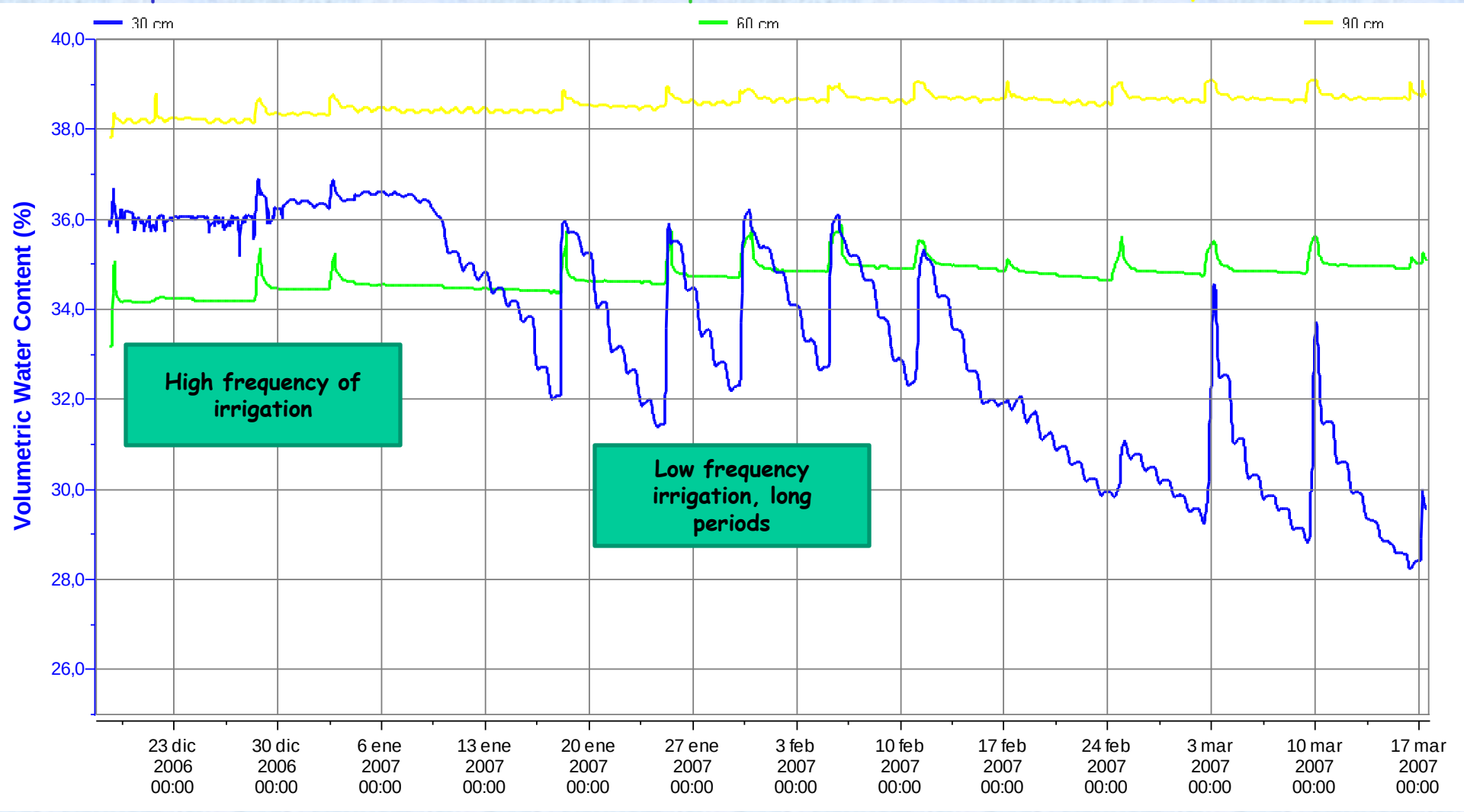
Fluctuation of water content at three depths using two different methods of irrigation

Maipo Valley, Chile

30 cm depth Moisture sensor

60 cm depth Moisture sensor

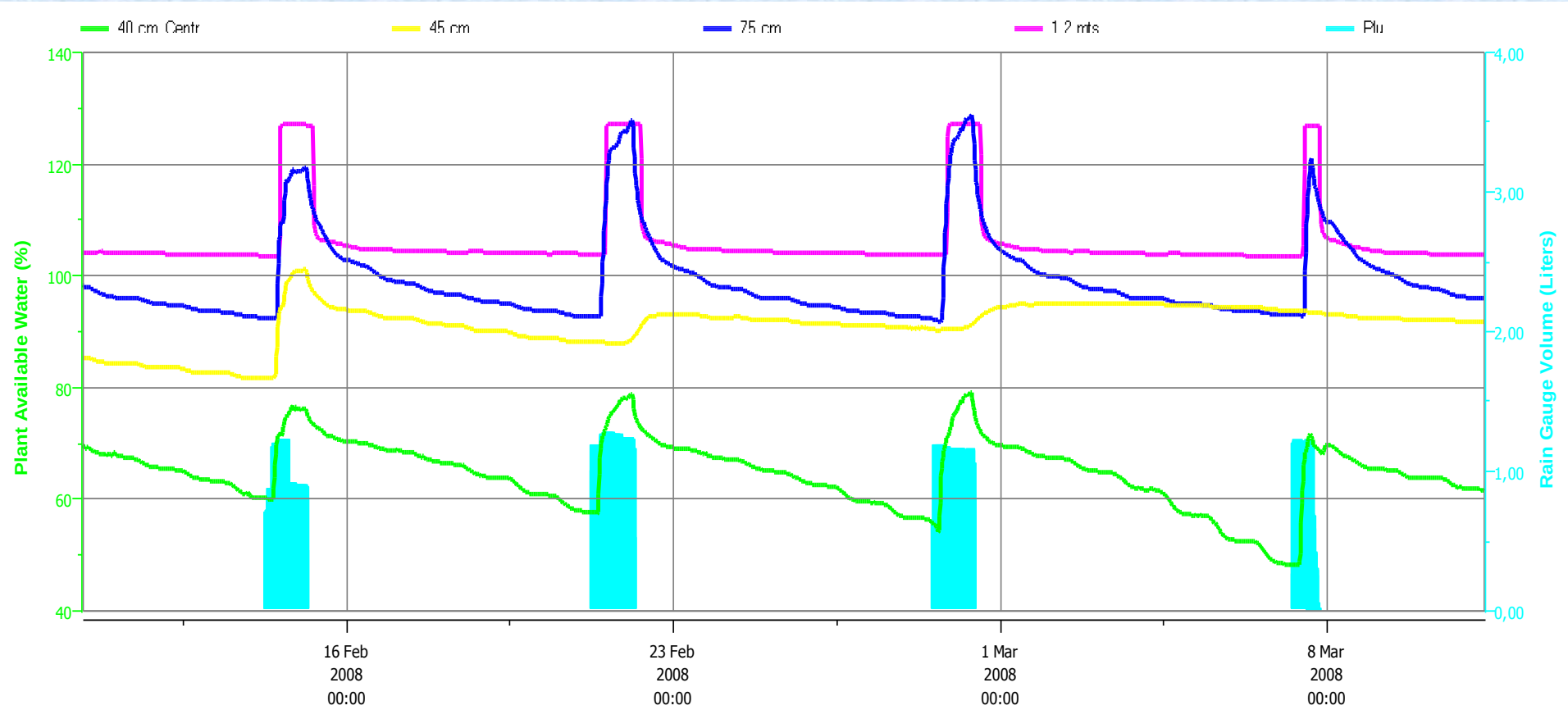
90 cm depth Moisture sensor



Fluctuation of water content at three depths using *Method for the Recuperation of Decayed Agricultural Plantations*

Maipo Valley, Chile

Perfect synchronicity between periods of irrigation



Increased porosity after calcium sulfate application


anasac


anasac


23 9:16

New roots growing in a damaged secondary root as a result of new method of irrigation

Condition of roots prior to treatment

Generation of new roots after treatment

Thank you very much!