Seminario

Manejo del riego y suelo en el cultivo del palto

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Gobierno de Chile
Ministerio de Agricultura

Instituto de Investigaciones Agropecuarias (INIA)
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Avocado Irrigation in California

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ETo: 1,000 – 2,500 mm

Rain: 250 mm S, 500 N

25,000 ha

95% ‘Hass’

>15 years age

Substantial new acreage
  w/ root rot resistant rootstocks

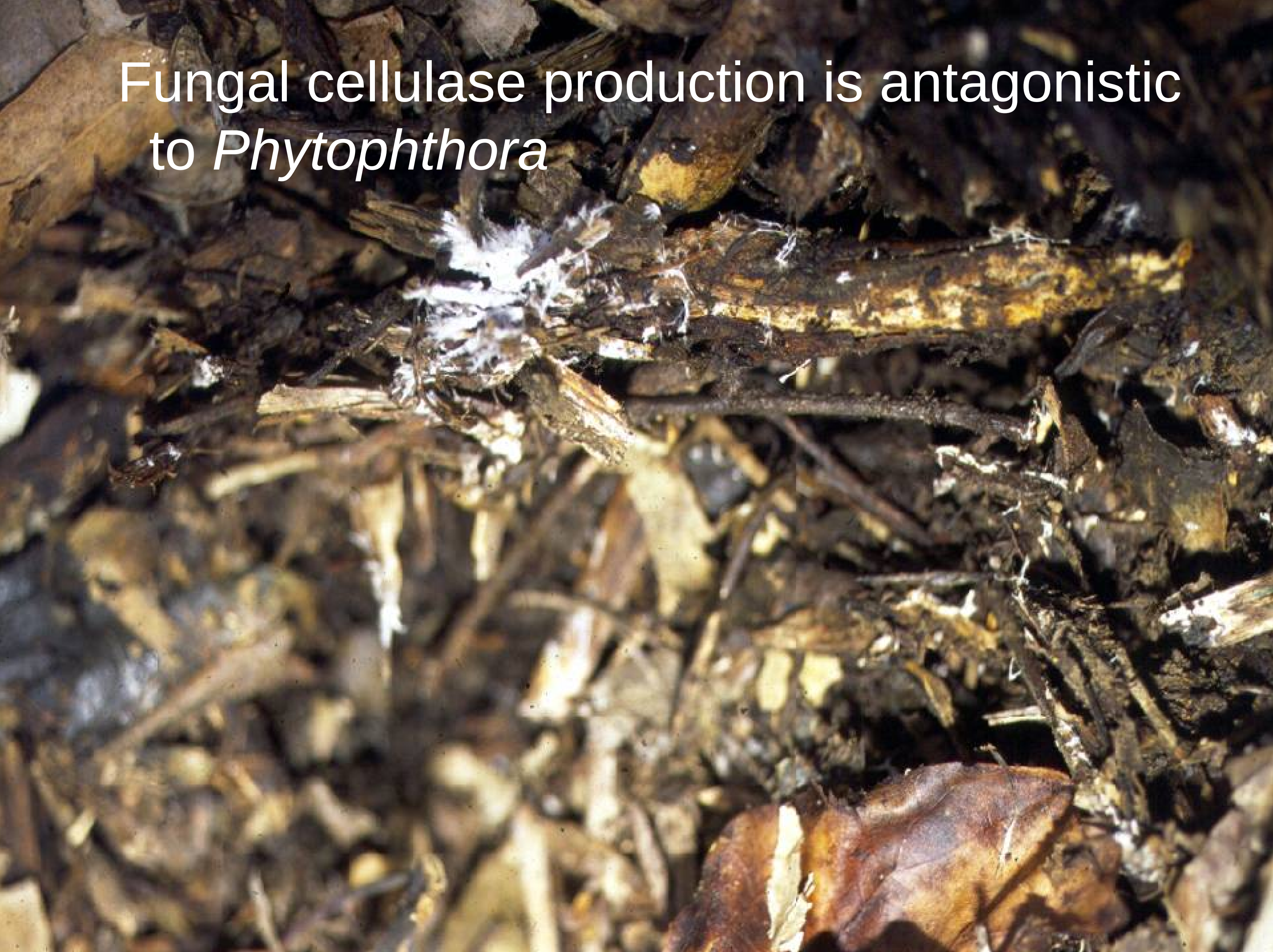
Mostly on steep slopes

Soil pH, 6-7.8

Sandy to heavy clay loams

Phytophthora cinnamomi is everywhere, so growers need to be good irrigators which is the primary defense against root rot.

Fungal cellulase production is antagonistic to *Phytophthora*



The effect of mulches on the inoculum potential of *Phytophthora cinnamomi*

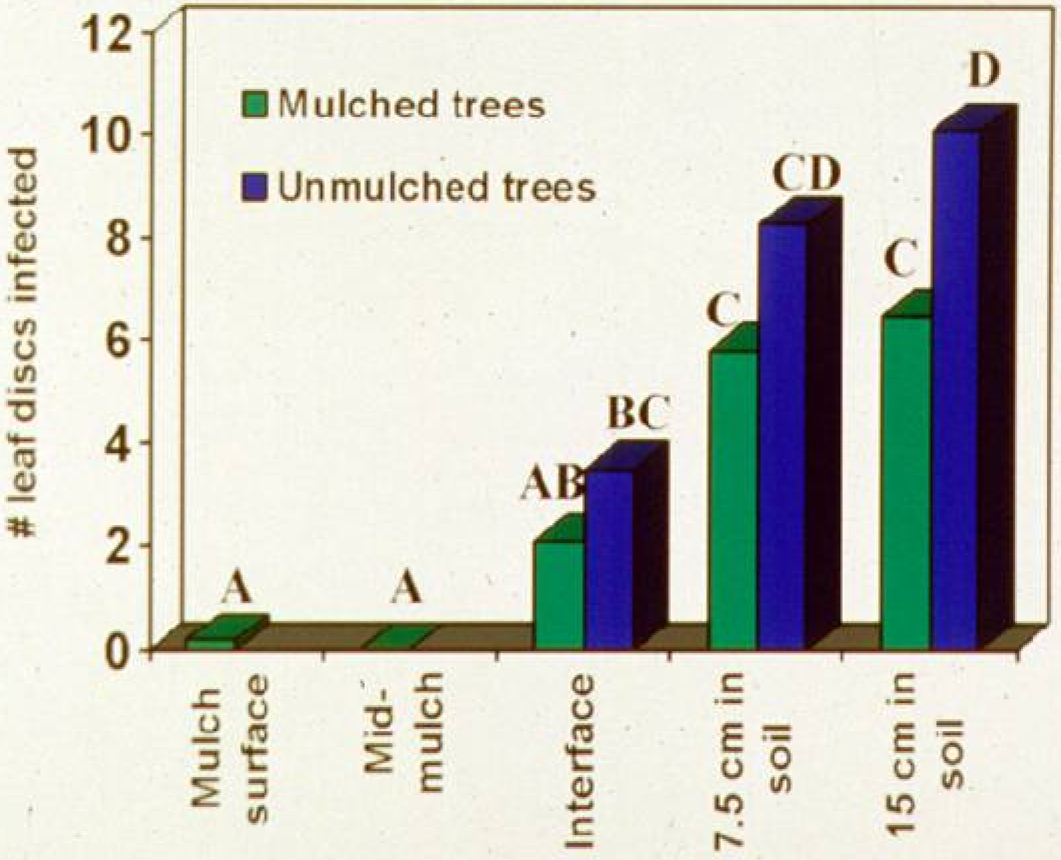
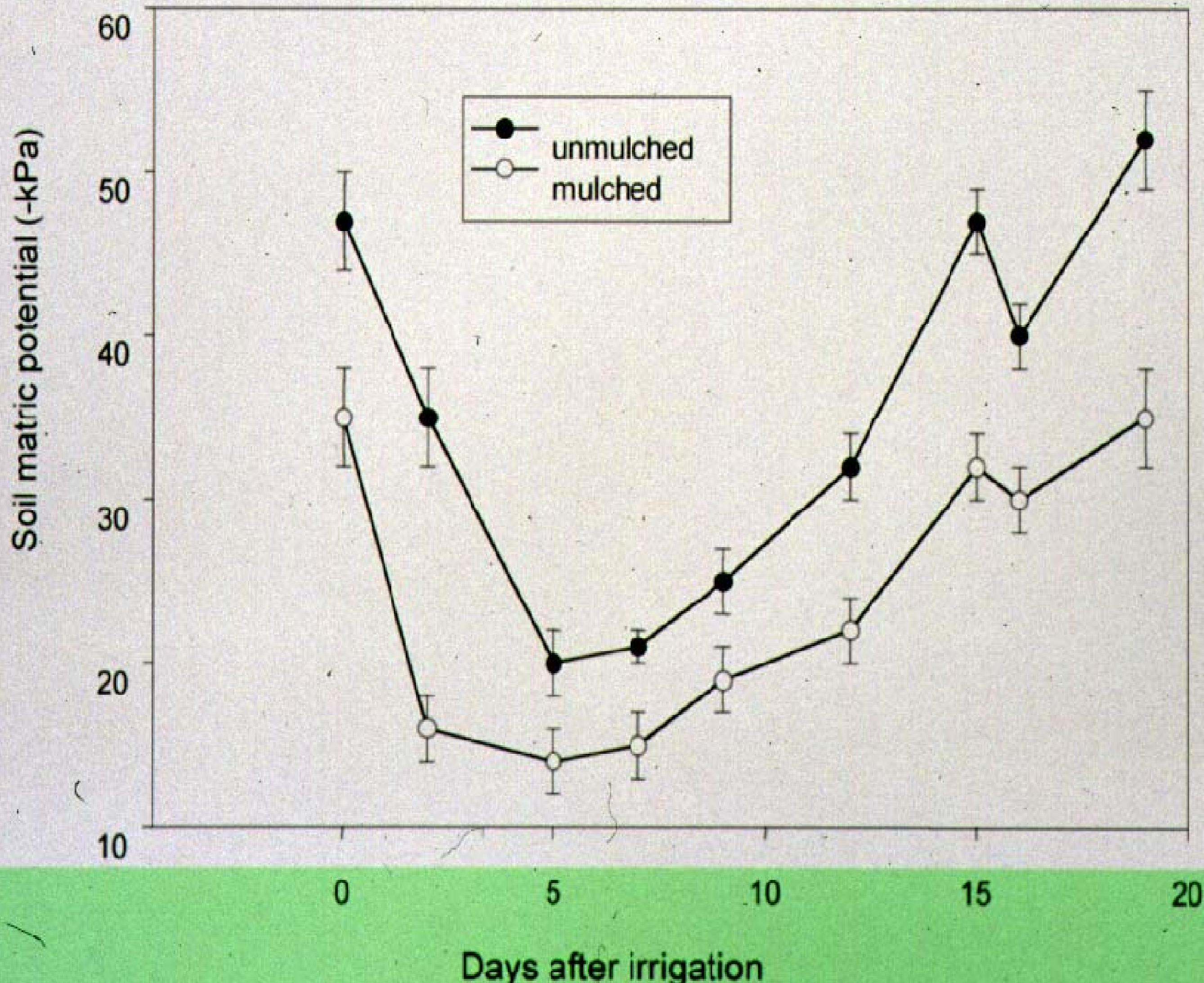


Figure 1. Soil moisture tension under mulched and unmulched trees after an irrigation at Vanoni site. Standard error bars for each sampling date are for the means of sixteen trees for each treatment.



Many different sources of water

Local streams and rivers

Long distant rivers

District wells

Private wells

With many differences in water quality

Colorado River: 600 ppm salinity, 80 ppm Na, Cl
Sacramento River: 280 ppm salinity, 80 ppm Na, Cl
Ventura City well: 1,600 ppm salinity, 120 ppm Na, Cl

Most of the salinity in well waters north of Los Angeles is derived from Ca: 400-600 ppm

With many differences in water volume from wells

50-5,000 liters per minute

As a result, usually small irrigation blocks (2-10 has)

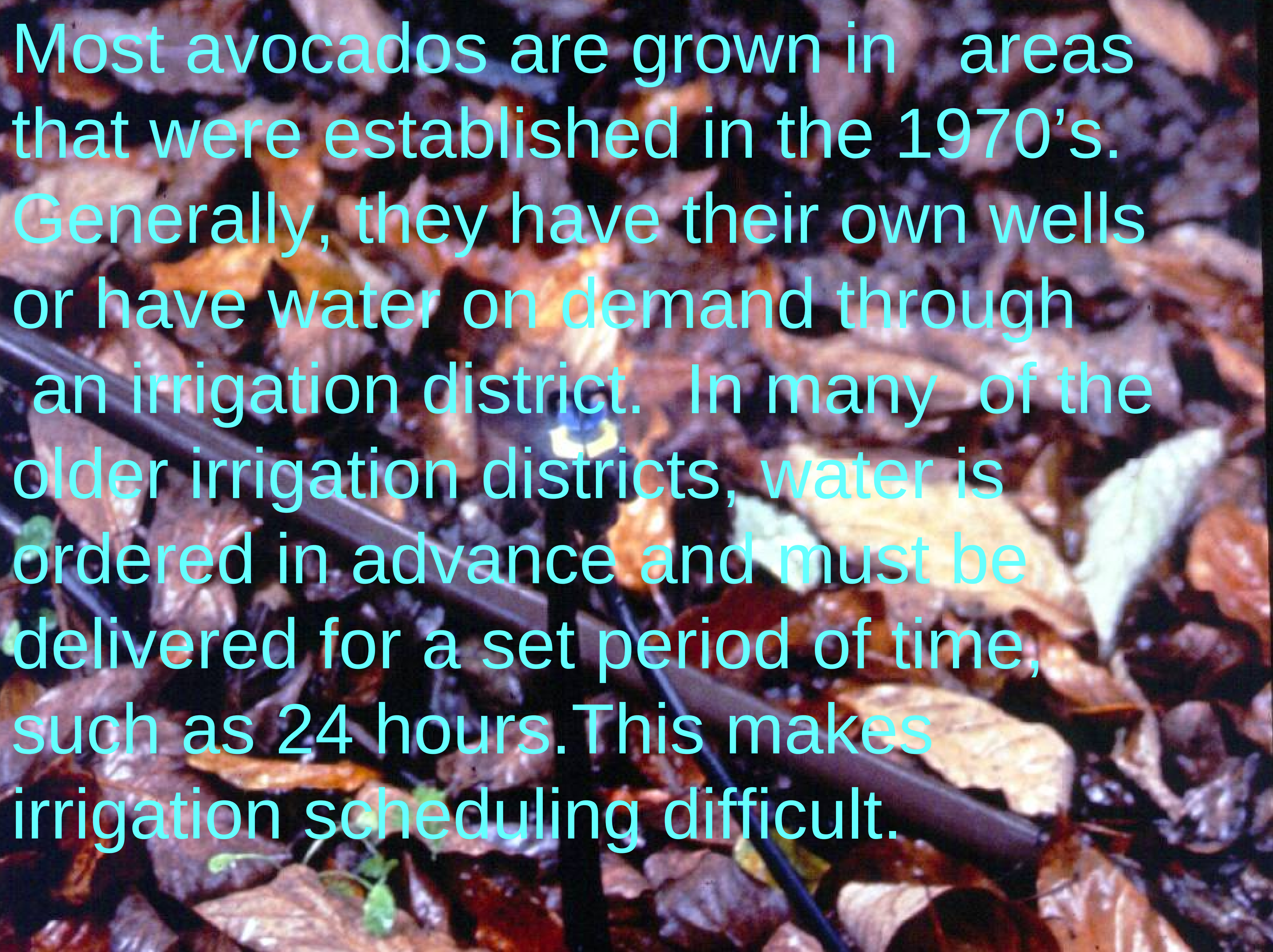
Water prices vary

$0.008 – 0.25 per m^3

And water application rates vary from 4,500 m^3 in the N to 15,000 m^3 per ha in the S.

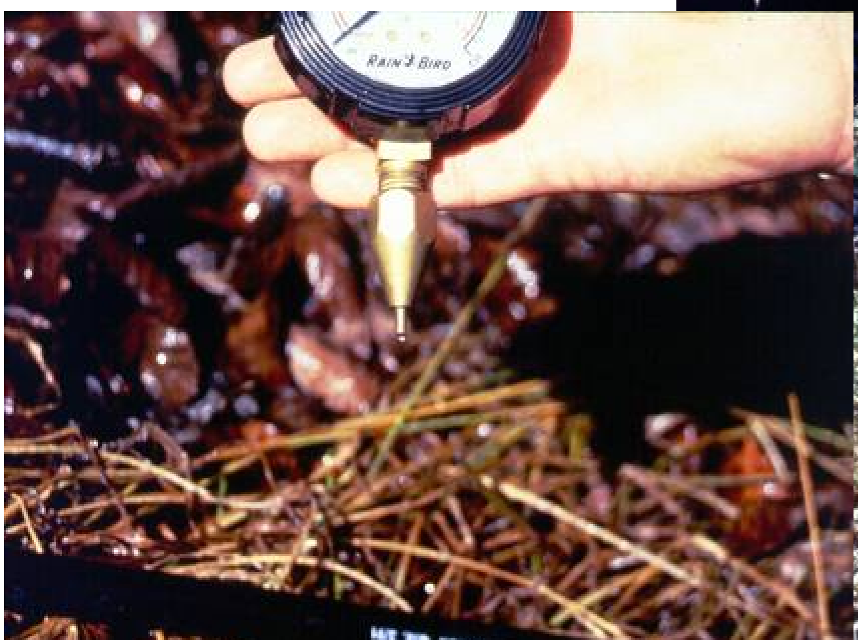
In the S, water prices can represent 2/3 of the cultural costs.

Part of the cost of the water is to put on excess water above ET crop to leach out the high salts that are found in most of our waters

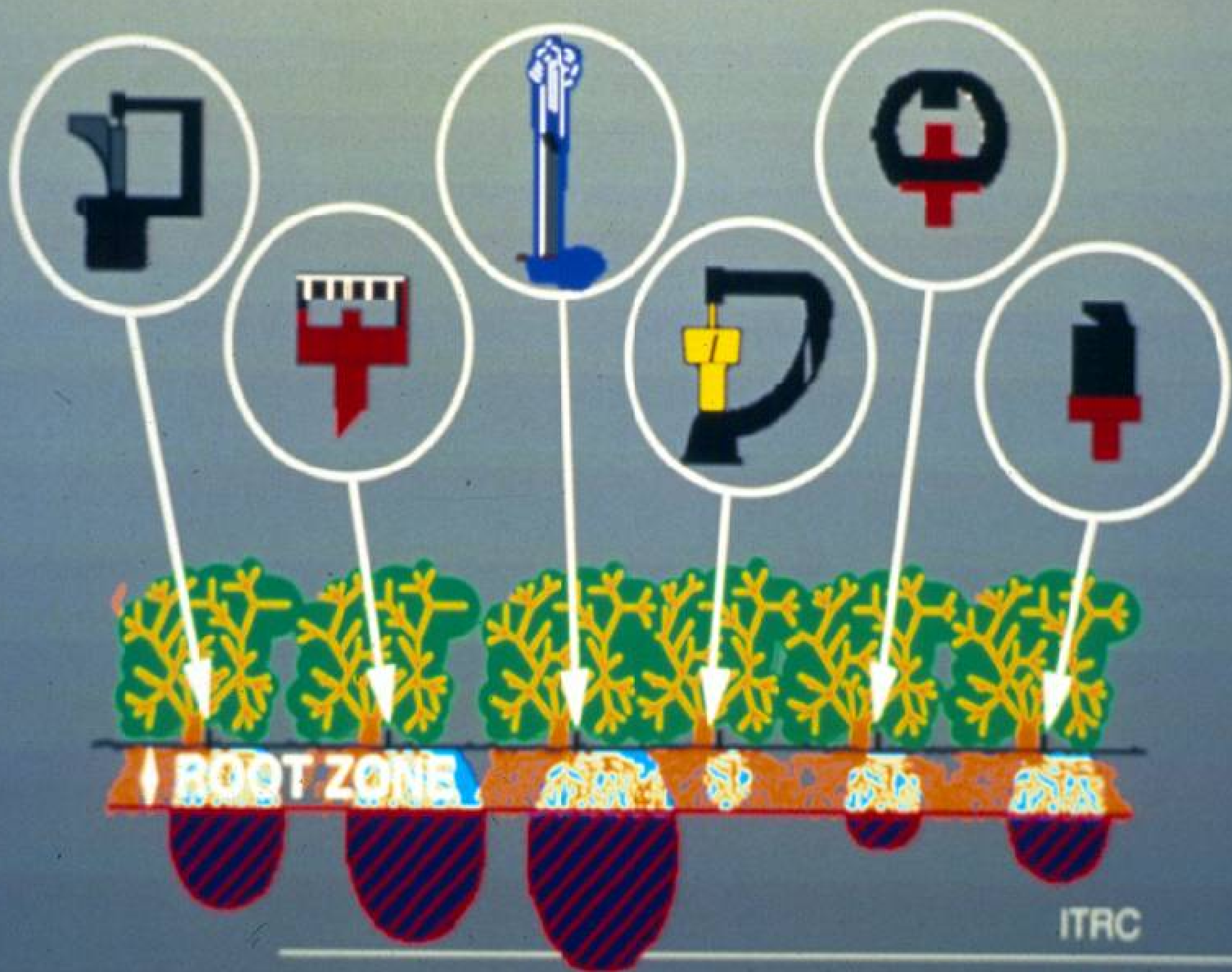


Most avocados are grown in areas that were established in the 1970's. Generally, they have their own wells or have water on demand through an irrigation district. In many of the older irrigation districts, water is ordered in advance and must be delivered for a set period of time, such as 24 hours. This makes irrigation scheduling difficult.

To schedule irrigations, growers must first measure the distribution uniformity of the irrigation system. In many areas, there are irrigation districts that provide the service for free.



Mixed and Broken Equipment



Much of the effort is aimed at improving pressure uniformity, using pressure compensating emitters and in-line pressure regulation

Other causes of poor DU

Poor filtration- poor maintenance
undersized filter

Orifice clogging from:
- Insects-walk the lines
- Precipitates-run acid
- Algae/bacteria-run acid/chlorine

In all cases flush the lines at least annually

Wear on the orifice over time
- Output increases w/ fanjets and spinners
- decreases w/pressure-compensating

Part of the maintenance is identifying potential problems in water quality

INFLUENCE OF WATER QUALITY ON THE POTENTIAL FOR CLOGGING PROBLEMS MICROIRRIGATION SYSTEMS[1]

Potential Problem	Units	Degree of Restriction on Use		
		None	Slight to Moderate	Severe
Suspended Solids	mg/l	< 50	50 – 100	> 100
Chemical				
pH		< 7.0	7.0 – 8.0	> 8.0
Dissolved Solids	mg/l	< 500	500 – 2000	> 2000
Manganese[2]	mg/l	< 0.1	0.1 – 1.5	> 1.5
Iron[3]	mg/l	< 0.1	0.1 – 1.5	> 1.5
Hydrogen Sulphide	mg/l	< 0.5	0.5 – 2.0	> 2.0
Biological				
Bacterial populations	maximum number/ml	<10 000	10 000 – 50 000	>50 000

The water report also says how much the leaching fraction needs to be

The most commonly injected material for controlling calcium carbonate precipitation is urea-sulfuric acid because of the safety issue of using sulfuric and phosphoric acids.

Chlorine gas is used for bacteria and algae, but sodium hypochlorite is more common.

These chemicals are all injected before the filter and after the valve.

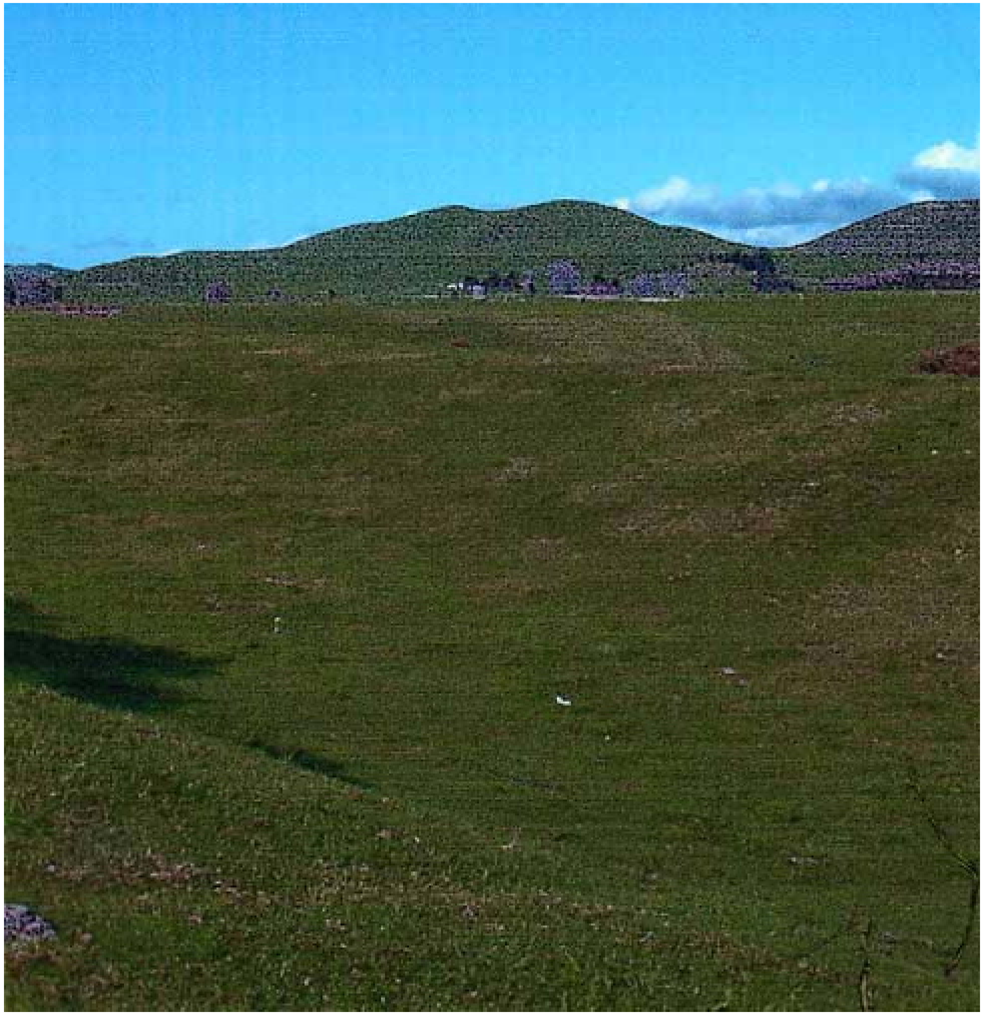
Most valves are ball or gate valves with some growers using a water meter controller for scheduling. There are some automatic valves coming in, but very few.

Once distribution uniformity is known, then the question is when and how much water to apply.

CIMIS is a network of weather stations calculating reference evapotranspiration, ETo.

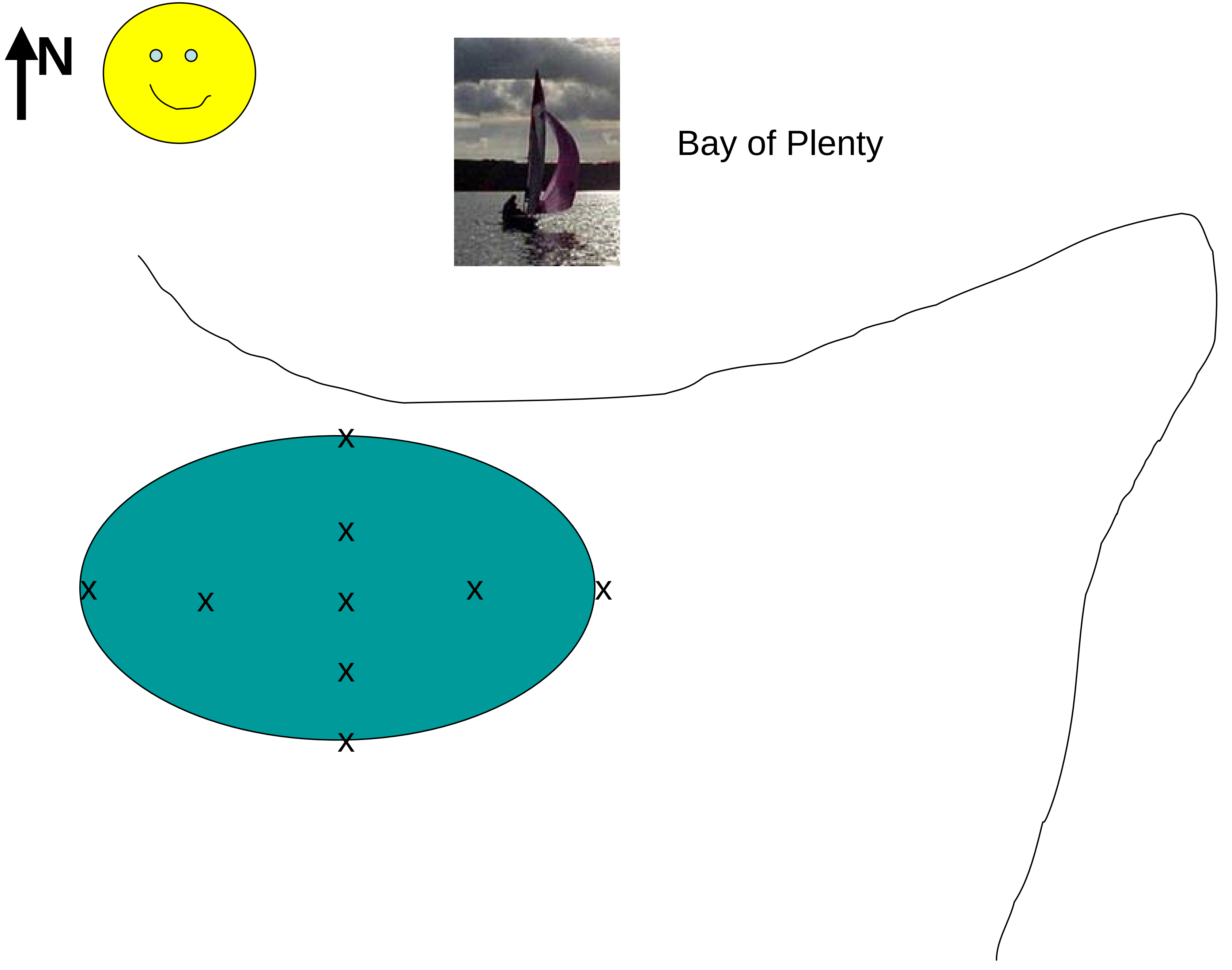
With the proper crop coefficient, scheduling works well in some areas. The problem is that there are so many slope and aspect differences in an orchard that it is difficult to know what the correlation is to the fixed-in-place weather station.

New Zealand



96 m high
2.5 km circumference
1 km of fetch
2 km from ocean
Rainfall every month
78% average R.H.
Winter 10 C
Summer 19 C
Constant clouds

9 atmometers
4 quadrants
3 positions
  toe
  mid-slope
  top

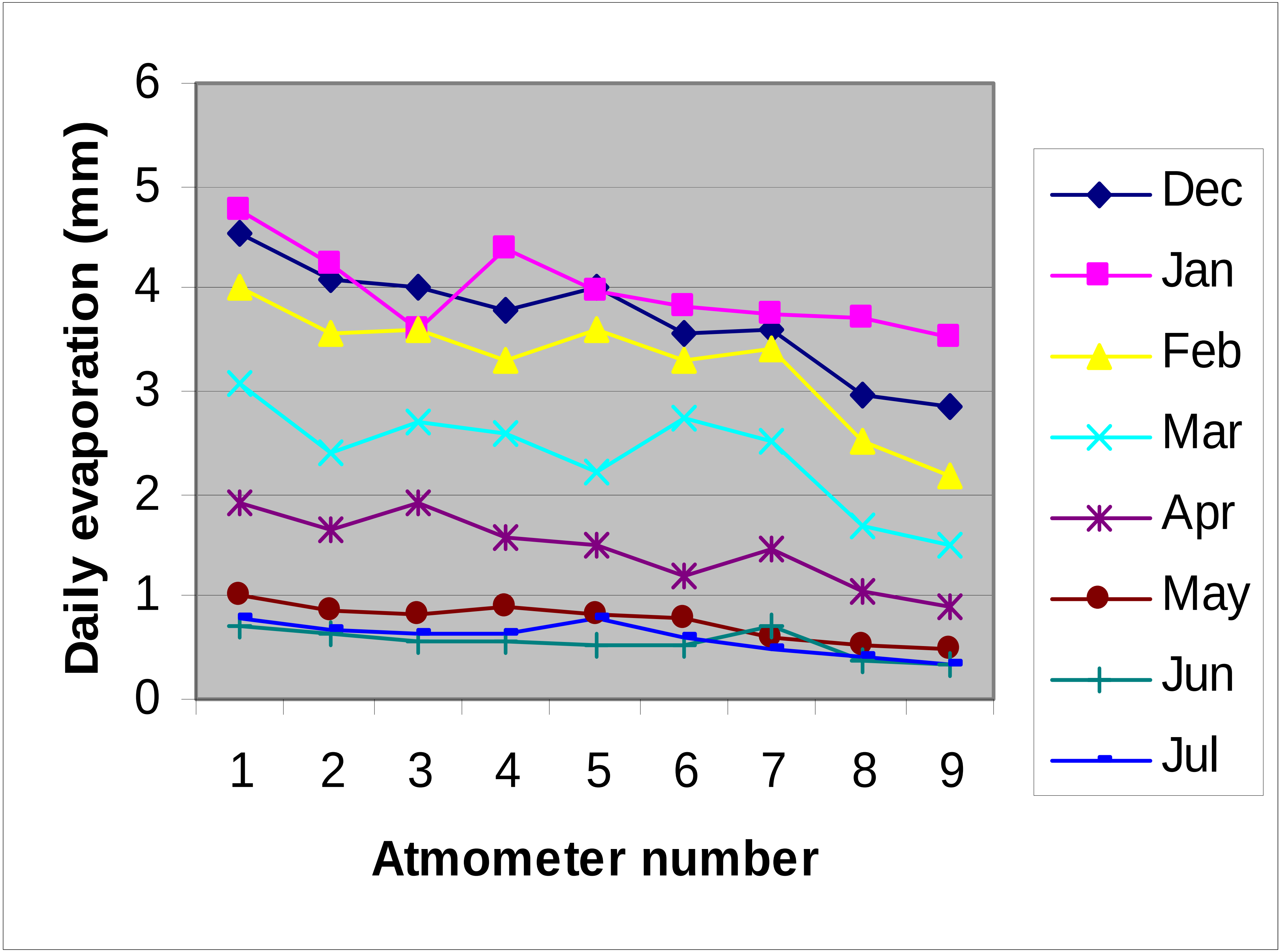

N
Bay of Plenty

Total water lost over 8 month period.

Atmometer	Loss in mm
1	614
2.	552
3.	550
4.	548
5	530
6	505
7	503
8	403
9.	369

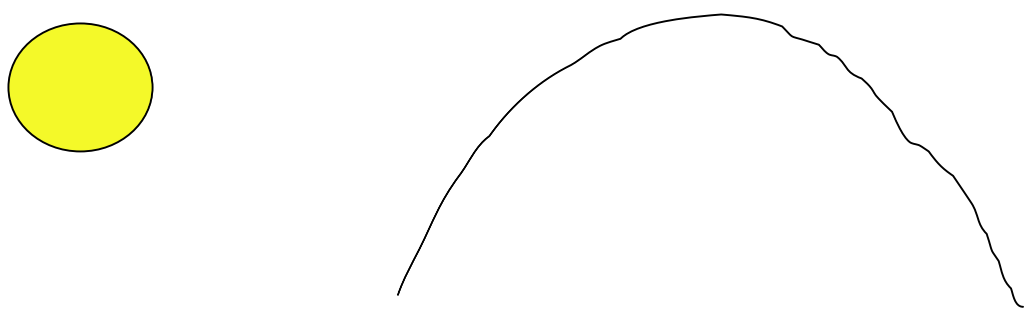
Atmometer 1 lost 60% more water than 8 & 9

1 lost about 16% more than average of 2-7


Daily evaporation (mm)
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
Atmometer number
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul

During Jan period, 1 was 32% higher than 8 & 9

During July it was 120% higher



So not only is there a difference according to position during the **year**, but also on a **monthly** basis

The solution for hillside avo growers? Break irrigation blocks into the smallest, conveniently managed size in order to give trees what they need.

Some growers are using ET, and calculating irrigation schedules on the CIMIS and CAC websites

Irrigation Scheduling Calculator

Instructions for the Irrigation Scheduling Calculator

English Español

Location:	English Units Metric Units
Reference Evapotranspiration (ETo):	**in.** **Data Source**:
Crop Coefficient (Kc):	**Get Kc for a month**
Distribution Uniformity (DU):	**%**
Trees/emitters per Acre:	**Tree/emitter Spacing by ft.**
Emitter Output (Gal/Hour):	
Leaching Requirement (LR):	**%**
Water per tree per day or period:	gallons
Watering time per tree per day or period:	hours, minutes

Some growers are installing their own atmometers, to get site specific ETo. But there is still some juggling that needs to be done to use it. What is the Kc, what is the leaching fraction to remove harmful salts, and what is the distribution uniformity?

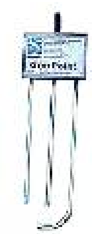
Assume Kc of 0.7, DU of 0.8 and leaching fraction of 10%, suddenly:

ETo = ET crop

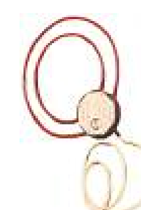
More commonly, growers are using soil moisture sensors alone or w/ ET

Common brands/models/technologies include:

Watermarks
Gypsum blocks
Tensiometers
Virrib / GroPoint
Echo2
C-Probe
EnviroSMART
EasyAG
TriSCAN
Stevens Hydra Probe II



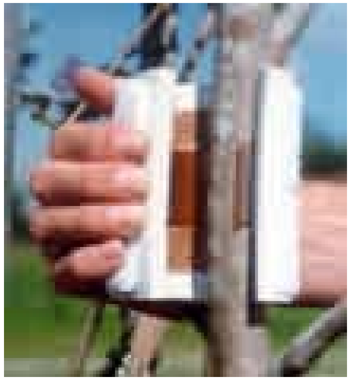




Method	Cost	Ease of Use	Accuracy	Reliability	Salt-affected	Stationary
Porous blocks	L	H	M	H	L	Yes
Tensiometer	L	M	H	M	L	Yes
Portable tensiometer	M	M	H	M	L	No
Time domain reflectometer	H	M	H	H	M	Both
Neutron probe	H	L	H	H	L	Yes
Feel (soil probe)	L	H	H	H	L	No
Gravimetric	L	M	H	H	L	No
Frequency domain reflectometer	M	H	M	H	M	Both
Time domain transmometer	M	H	H	H	M	Yes
Amplitude domain reflectometer	M	H	H	H	M	Yes
Phase domain transmomet	M	H	H	H	M	Yes

The ability to connect these wirelessly to a data logger is very attractive, but the most common devices are still tensiometers and Watermarks

Model 253 (c) 2001 Campbell Scientific (Canada) Corp.

There are no plant-based devices used commercially



Depending on the weather, age of trees, soil type and irrigation system, growers typically irrigate on a 7-10 day schedule during the summer months.

54 manufacturers of irrigation emitters

Growers will typically start the young tree off with a dripper and in some cases gradually add a dripper a year and then a second line, but that's a lot of maintenance.

But the avocado does respond to a large wetted area

In many cases growers will start the trees off with a fanjet with a hat to deflect the water down

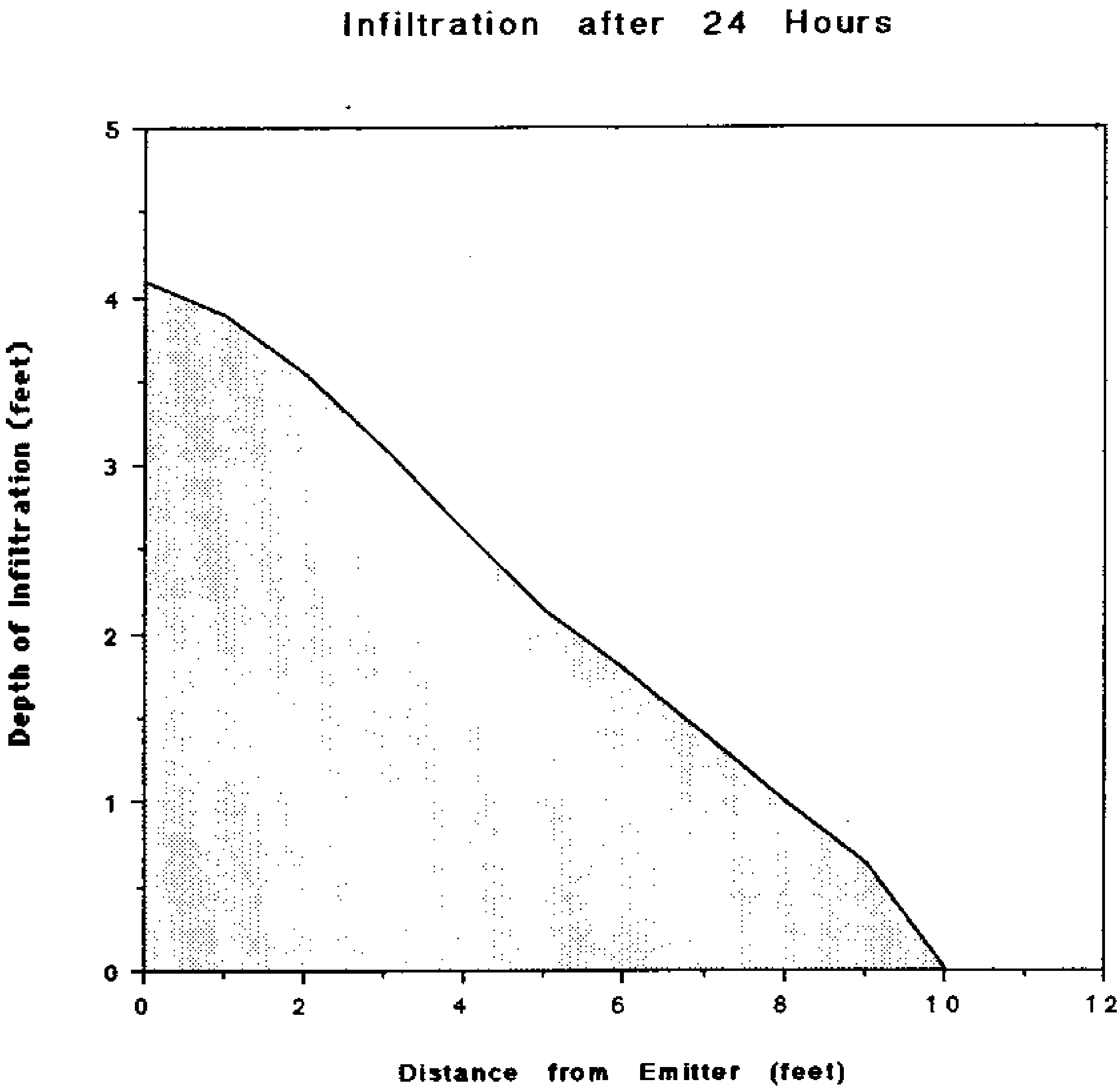
Invert the sprayer

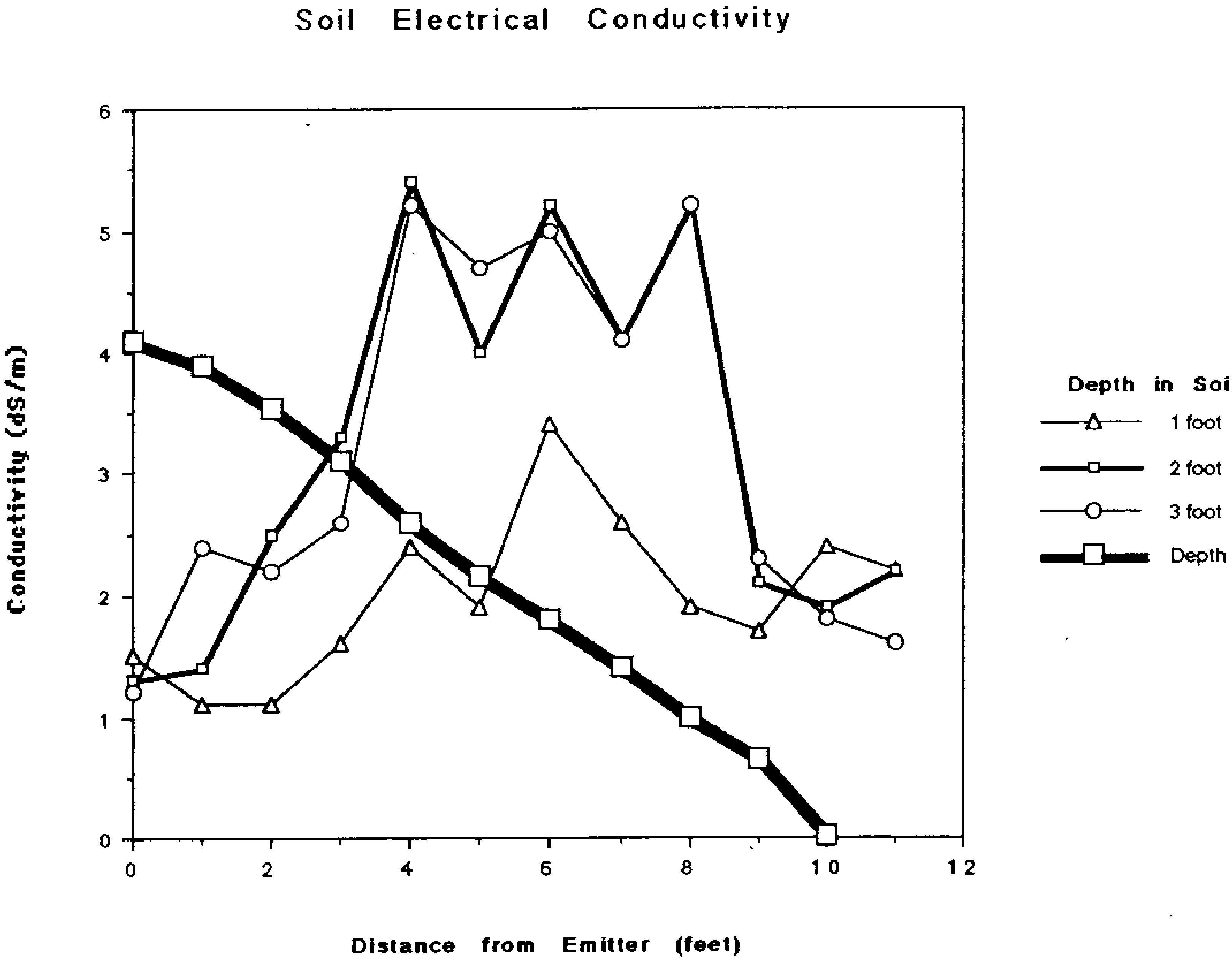
Or remove the the spinner

One of the problems with all these methods is that a large volume of water is being delivered and it takes 20-30 minutes for it to get to the very end of the line. That means trees closest to the water source may get too much water.

Another problem with the use of microsprinklers is an uneven application uniformity, some w/ patterns of more water near the center or more to the edge of the wetted pattern.

In a catch can test we measured emission with distance and soil salinity at 3 depths


Infiltration after 24 Hours
Depth of Infiltration (feet)
5
4
3
2
1
0
0
2
4
6
8
10
12
Distance from Emitter (feet)



Soil Electrical Conductivity
Conductivity (dS/m)
Distance from Emitter (feet)
Depth in Soil
1 foot
2 foot
3 foot
Depth
0
1
2
3
4
5
6
8
10
12

Another cause of poor application uniformity is not operating at the proper pressure rated for the emitter.

The size of the spaghetti tubing on the emitter stake assembly can cause a pressure reduction of 15-20% if it is too small.

Poor application uniformity affects not just water use, but also with chemigation nutrient and pesticide management. California growers are increasingly being required to prevent environmental contamination. Very strict laws are being enforced to prevent ground and surface water contamination.

A cover crop on young orchard slopes to prevent erosion and improve infiltration. And make sure emitters do not exceed the soil's uptake rate.

Gracias por invitarme

¿Hay preguntas?

U.C. del norte