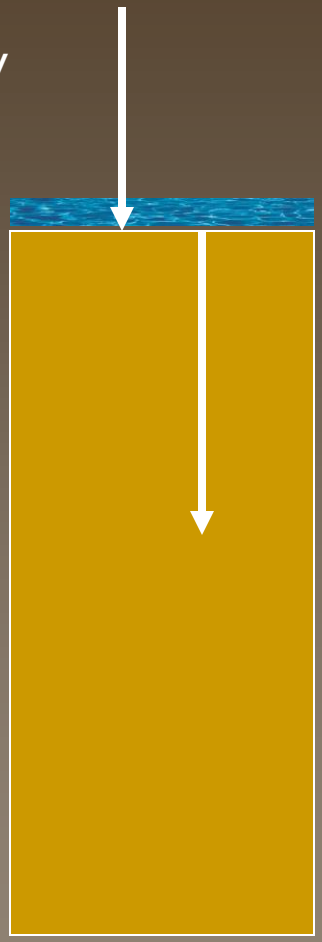
Improving Water Penetration in Vineyards

Water Penetration

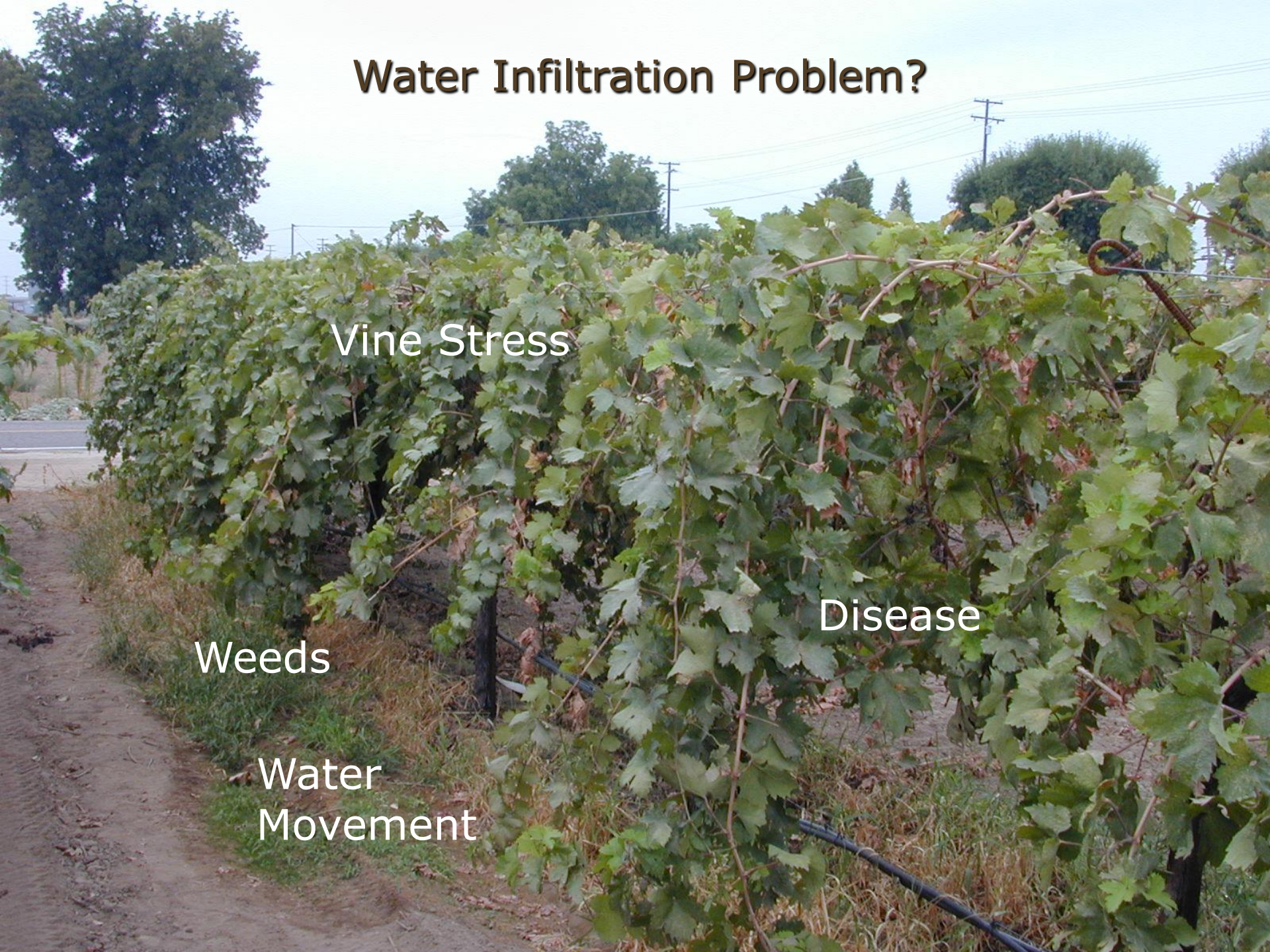
Water entry

into soil



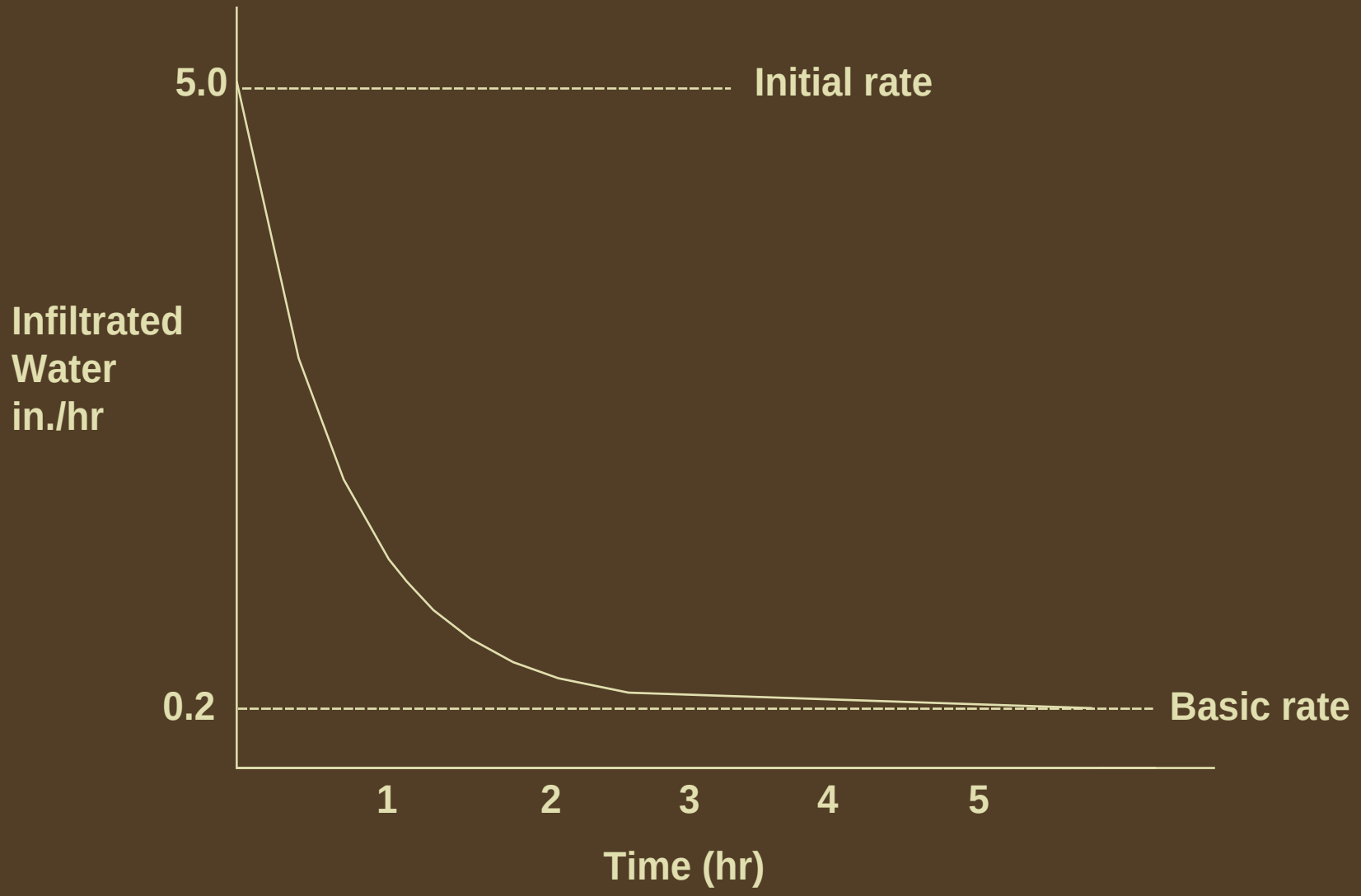
Water Infiltration

Through soil


Water Infiltration Problem?
Vine Stress
Disease
Weeds
Water
Movement

California-registered insecticides ranked by potential to move in solution or as adsorbed particles and overall pesticide runoff risk.

Insecticide active ingredient (common name)	Trade name	Chemical Class	Solution runoff potential[1]	Adsorption runoff potential[2]	Overall runoff risk[3]
chlorpyrifos	Lorsban	organophosphate	high	intermediate	very high
diazinon	Diazinon	organophosphate	high	high	very high
permethrin	Pounce	pyrethroid	low	high	High
malathion	Malathion	organophosphate	intermediate	low	Moderate
methomyl	Lannate	organophosphate	intermediate	low	Moderate
phosmet	Imidan	organophosphate	intermediate	low	moderate
fenpropathrin	Danitol	pyrethroid	low	intermediate	moderate
imidacloprid	Admire	Neonicotinoid	high	intermediate	low
spinosad	Success, Tracer	Naturalyte	intermediate	intermediate	low
dimethoate	Cygon	organophosphate	low	low	low
spirotetramat	Movento	Ketenol	intermediate	intermediate	low


5.0
Initial rate
Infiltrated
Water
in./hr
0.2
Basic rate
1
2
3
4
5
Time (hr)

Water Movement in Soil

- Downward pull of gravity
- Forces of attraction between:
  - Water to water molecules
  - Water to dry soil particles

Water Penetration: Soil / water Factors

- Dryness at start of irrigation
- Distribution/size of soil pores
- Surface access to soil pores
- Cracks
- Total salinity of irrigation / soil pore water
- Composition of irrigation / soil pore water salinity
- Non-uniformity of root zone soil, layering

Improving Infiltration

1. *Improve total pore volume*
2. *Improve individual pore size*
3. *Improve access to surface pores*

Increase salinity of irrigation water

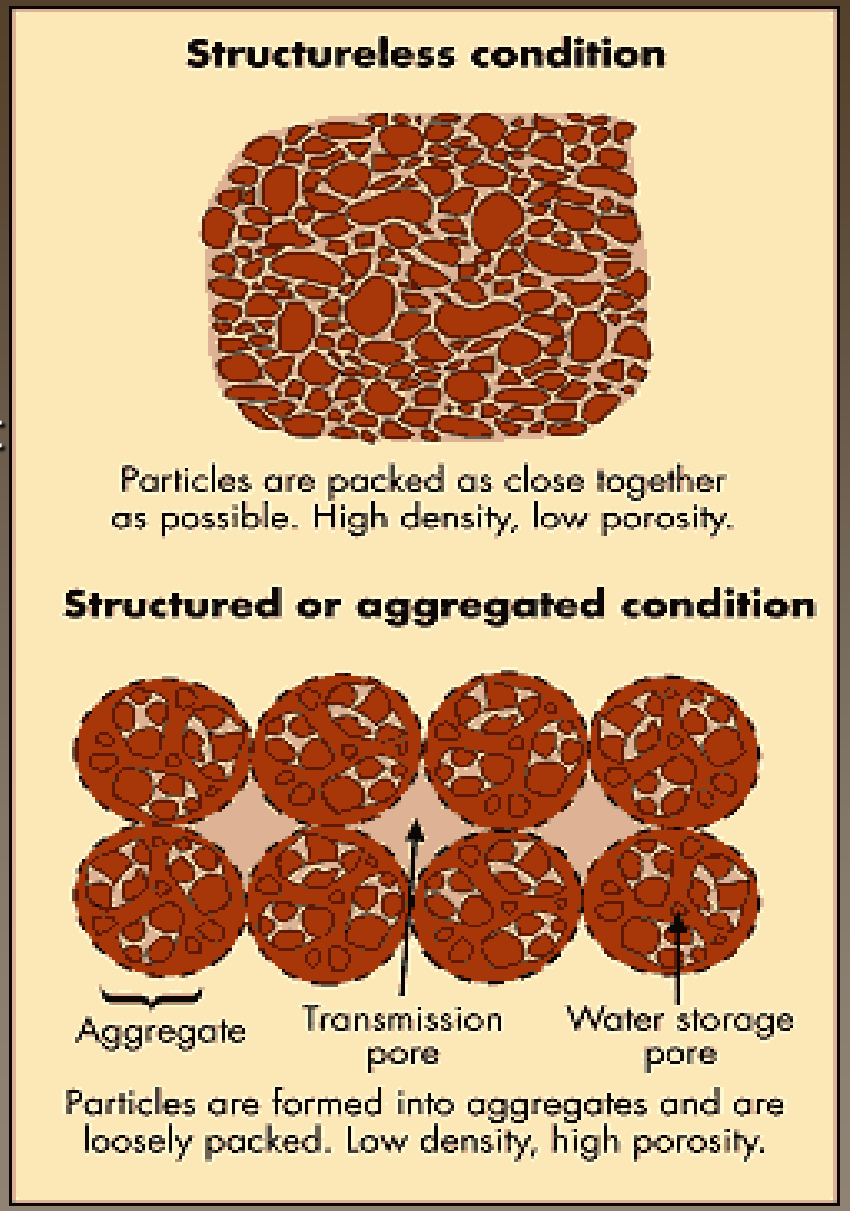
Use soluble calcium to reduce sodium effects

Organic mater additions / management

Soil Pores

Large pores conduct water and air

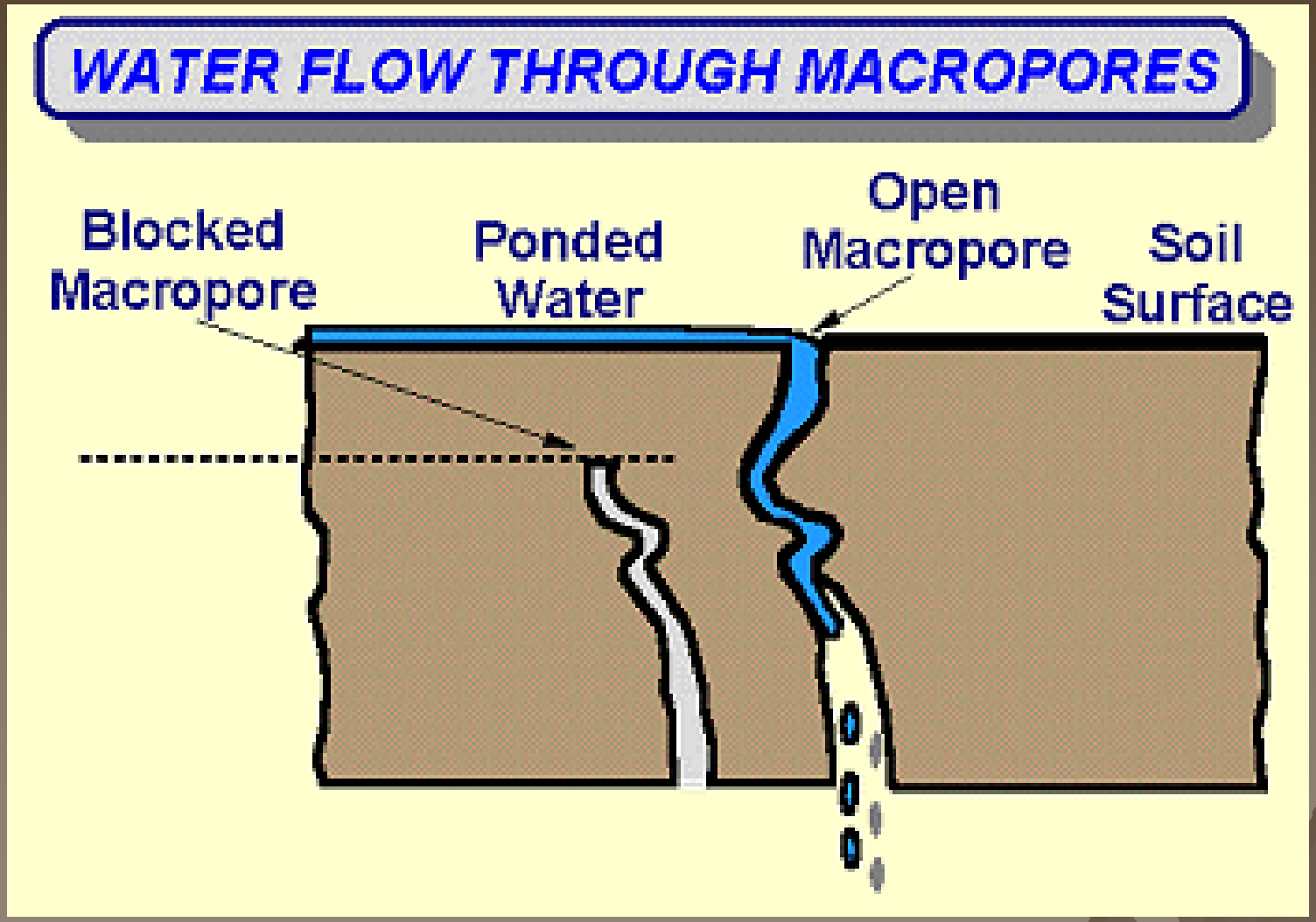
Small pores hold water



Sandy soils more large pores

Clayey soils more small pores

Soil Crusts & Access to Soil Pores



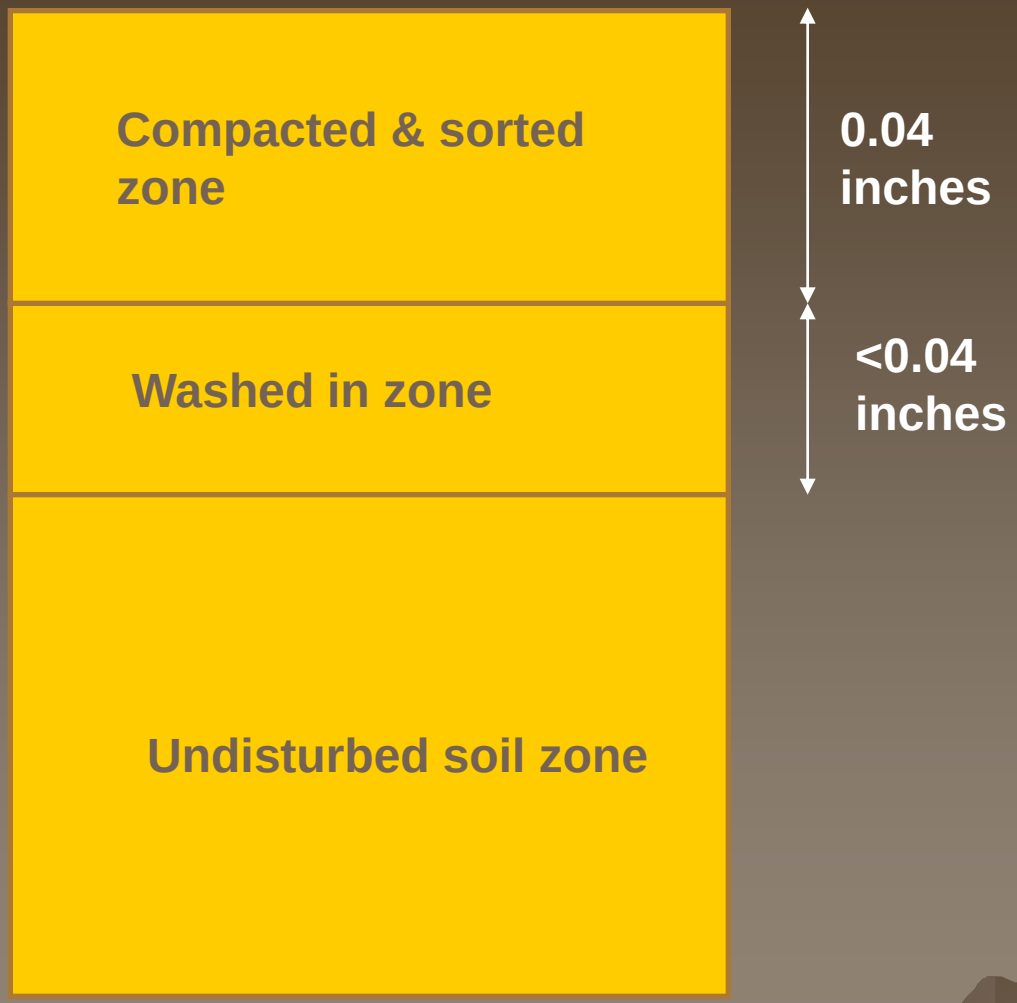

Depositional crusts
21 6'94

Depositional Crust


Structural Crusts:
Reorganization of residual
soil particles

Structural Crust: Drop Impact

Structural Crust



Soil Crusting Problems

Increase with:

- Soils with < 26% clay
- Alkaline soils
- Alkaline irrigation waters
- Compacted soils
- Large droplet sprinklers/rain
- High velocity erosive surface irrigation

Improving Water Penetration

- *Water Management*
- *Organic Matter Management*
- *Tillage*
- *Chemical Treatment of Soil and Water*

Irrigation Management

- Change will not improve infiltration characteristics
- Will take advantage of existing characteristics, lessening adverse effects to the vineyard

Changing Irrigation Schedule and or System

from

Infrequent → *Frequent*

Applications / Systems

Tillage for Soil Crusts

Roughing Up Surface

- spring tooth
- rolling cultivator
- sweep

Provides temporary relief

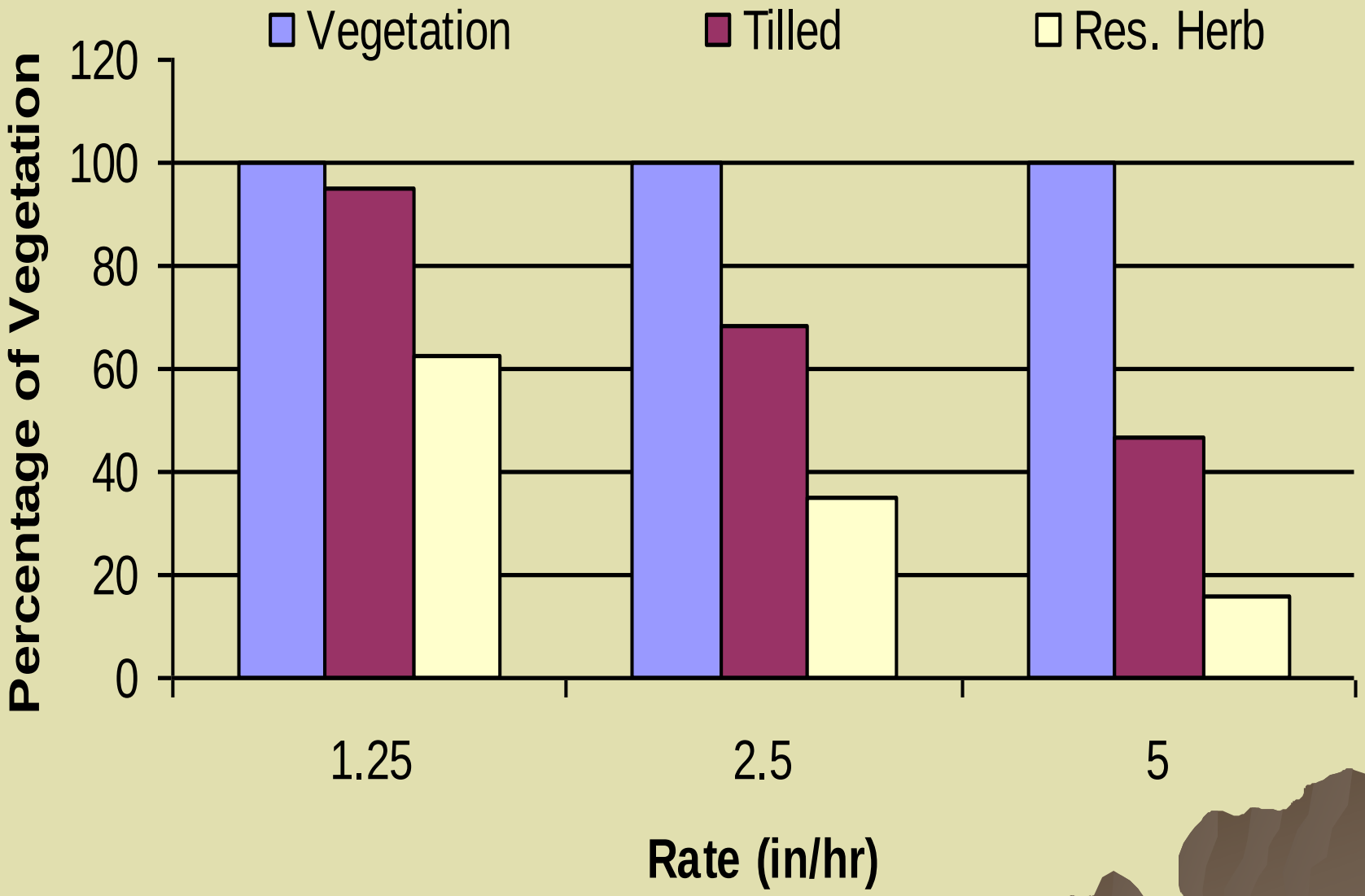
Organic Matter Management

- **Manure & composts**
- **Cover crops**

Cover Crops

- Prevent structural crusting
  - sprinklers
  - rain
- Slow water advance
  - surface gravity systems
- Increase soil pores
  - root channels
  - soil aggregation

Relative Time to Ponding



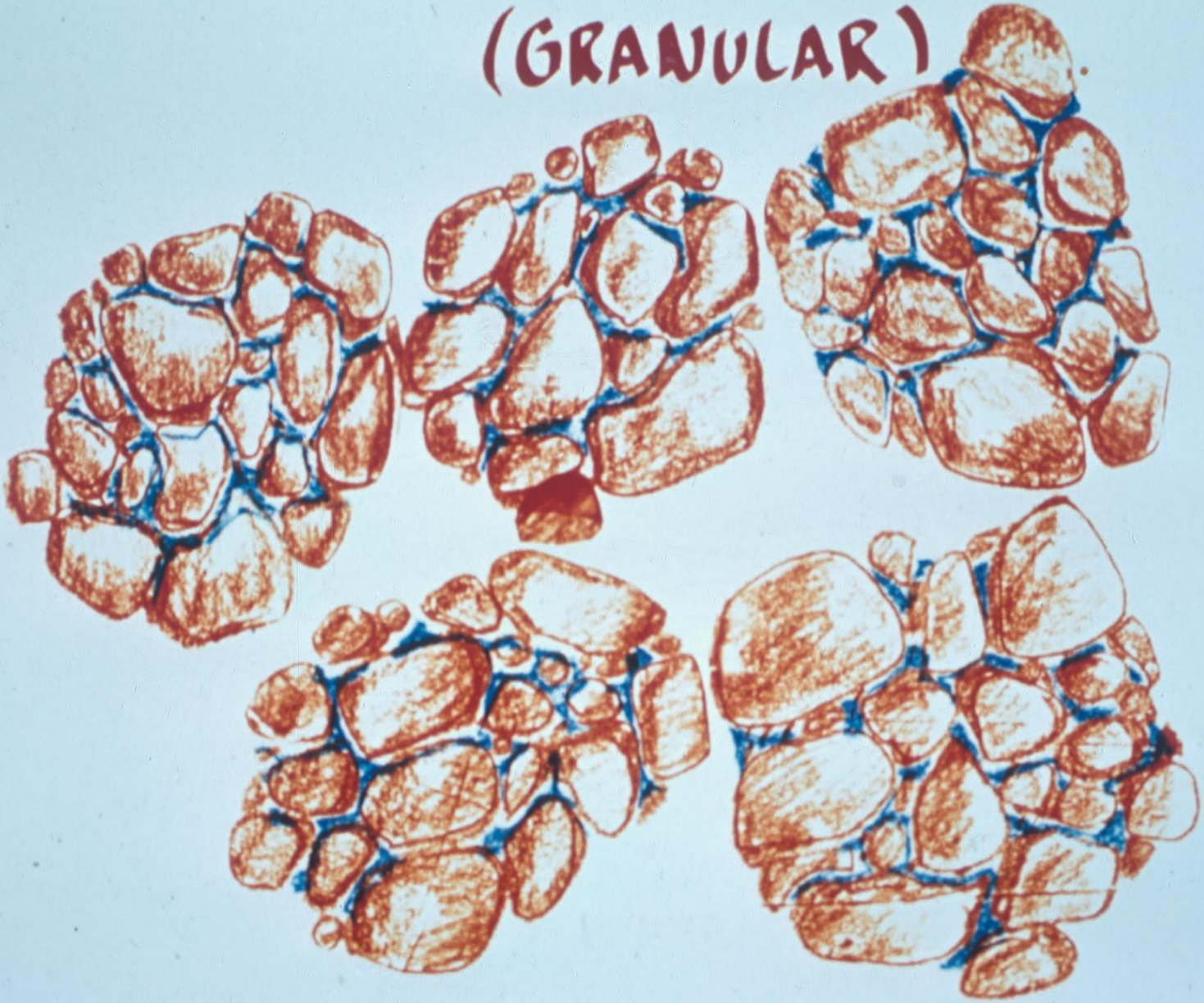
Increasing Organic Matter

Decomposition Products

- glucose
- cellulose
- hemicellulose
- ligin

GOOD SOIL STRUCTURE

(GRANULAR)



Aggregate Formation

Physical

- Wetting (shrink/soil)
- Animal activity
- Root growth

Electro-chemical

- Clay charge

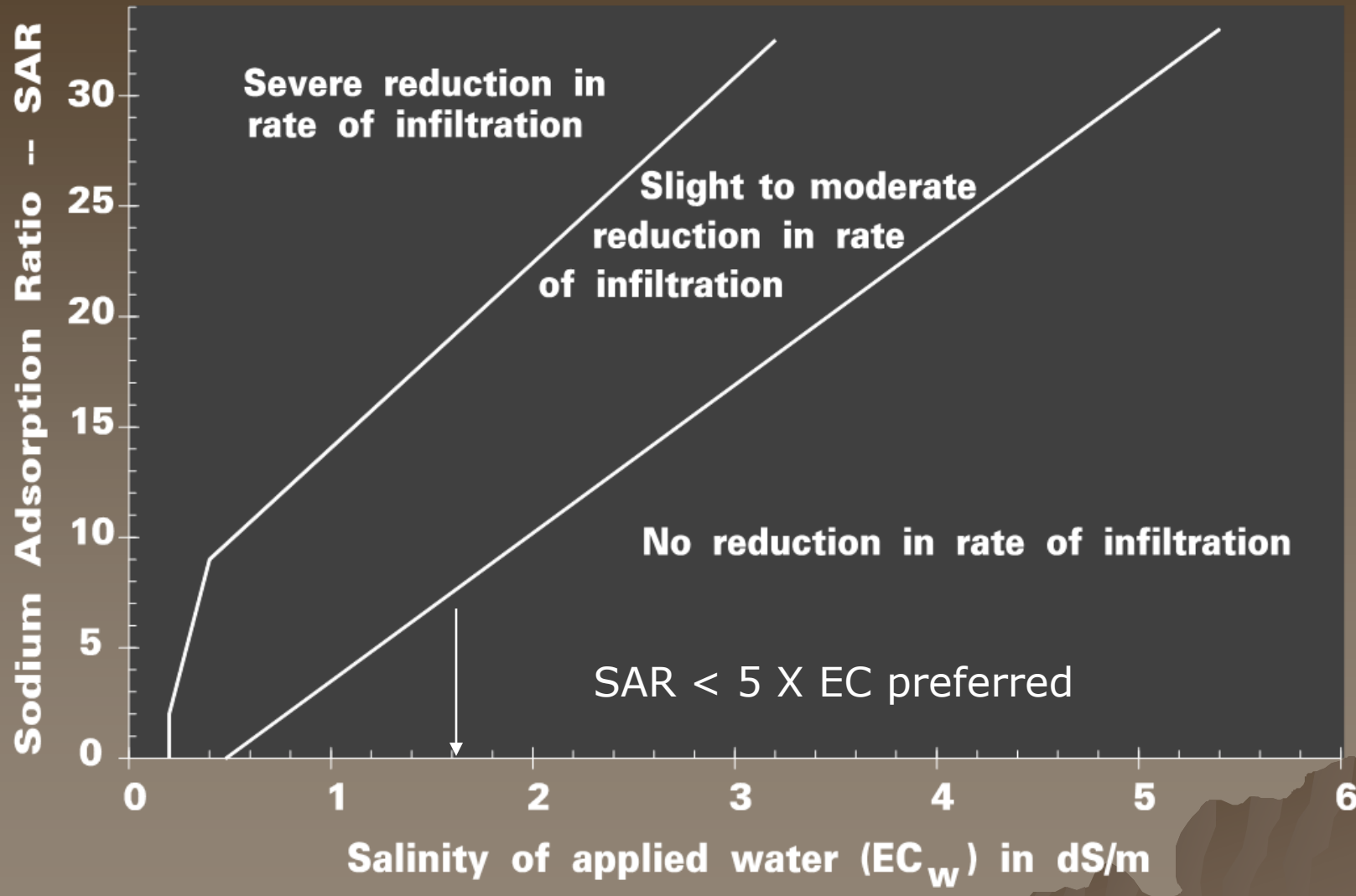
Chemical

- Soil glues

Chemical Amendments

- Increase salinity
- Increase divalent ions (Ca^{+2})
- Polymers hold particles together

Salinity & Sodicity Effects on Infiltration



Low Salt Water
(< 0.5 EC)

Results in a surface soil with:

- Changes soil water to that of the irrigation water EC and constituents
- Reduced Calcium
  - higher Na:Ca ratio (SAR)

Increase Irrigation Water Salinity

- Soluble calcium products
- Acid
- Fertilizers
- Soil conditioning amendments

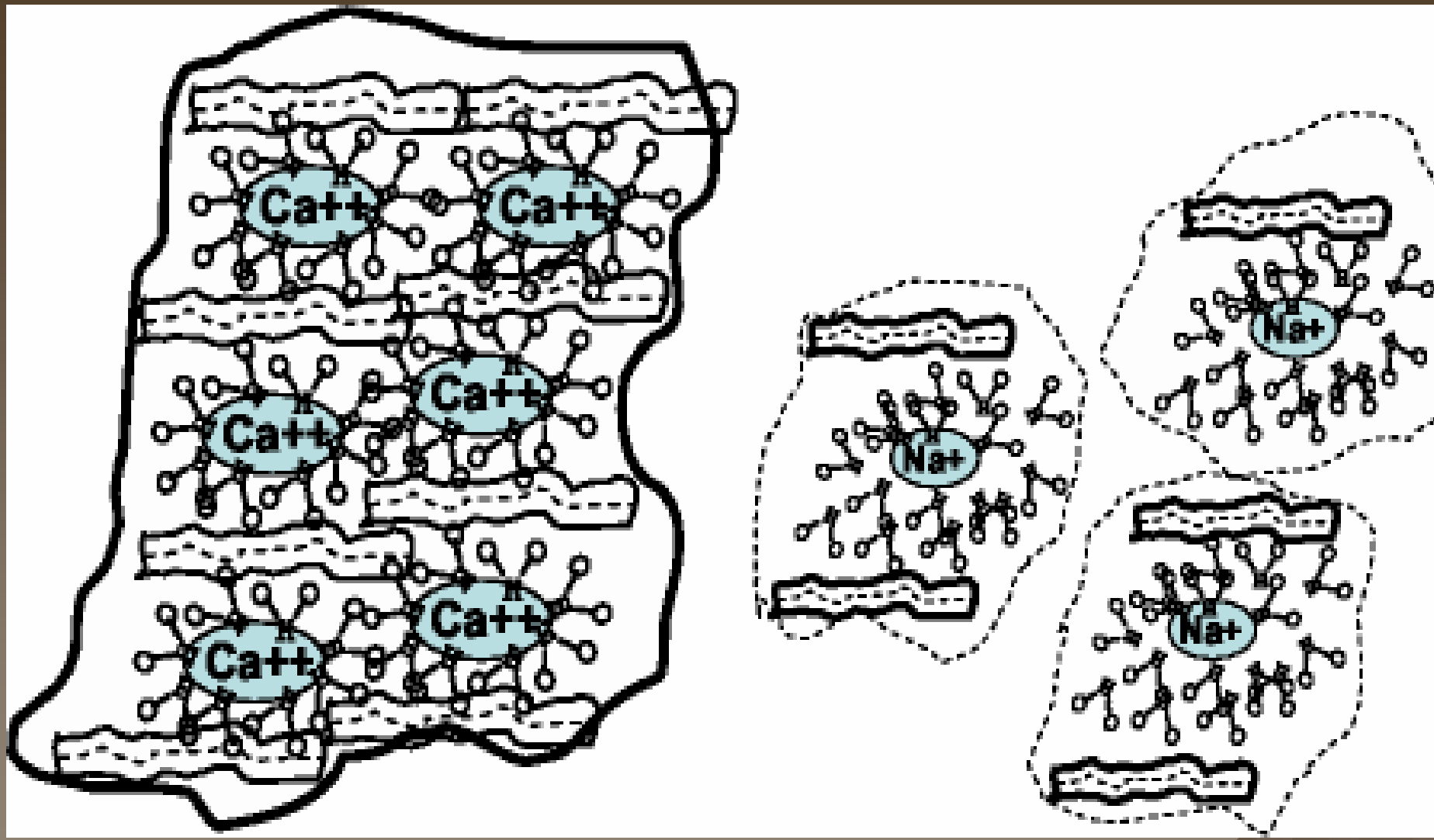
Increase Soluble Calcium

Displaces other adsorbed ions from clay particles into soil solution reducing the effect of

Sodium
Potassium
Magnesium
(in High Mg soils)

Improving Pore Size

- Calcium forces clays closer together
- Sodium forces clays apart


Ca++
Ca++
Ca++
Ca++
Ca++
Ca++
Na+
Na+
Na+

Calcium Containing Materials

Cost
Solubility
Cost

- gypsum *($CaSO_4$)*
- lime *($CaCO_3$)*
- dolomite *($CaCO_3$ + $MgCO_3$)*
- calcium chloride *($CaCl_2$)*

Gypsum Application Methods

Surface

- Incorporation
- No incorporation

Water Application

- Suspension injection
- Turbulent mixing

Soil Surface Problems

Soil application = 1-2 tons/acre

typically lasts 1.5 acre feet water

Surface gravity or sprinkler

Soil Surface Problems

Water Application

Low - Moderate Rate: 1-3 meq/L

Moderate - High Rate: 3-6 meq/L

2 meq/L = 468 lbs pure gypsum/ac ft

If Soil Contains Lime

- Acid *(H_2SO_4)*
- Acid forming compounds
  - –sulfur
  - –calcium poly sulfide
  - –ammonium sulfate

Polymers

Polyacrilimyde (PAM)

- Long chain polymer
- Binds soil particles together for a short period of time

Polymers

Works best

- applied to tilled soil
- application rate 4-6 lbs/ac ft
- cost: $20/lb
- applied after or before gypsum

Surfactants

Most effective in highly organic soils

- **Turf**
- **Forest soils**
- **Burned rangeland**

Mechanical Mixing/Tillage

For Soil Crusts

- Roughing Up Surface

Mechanical Mixing/Tillage

For Subsurface Problems

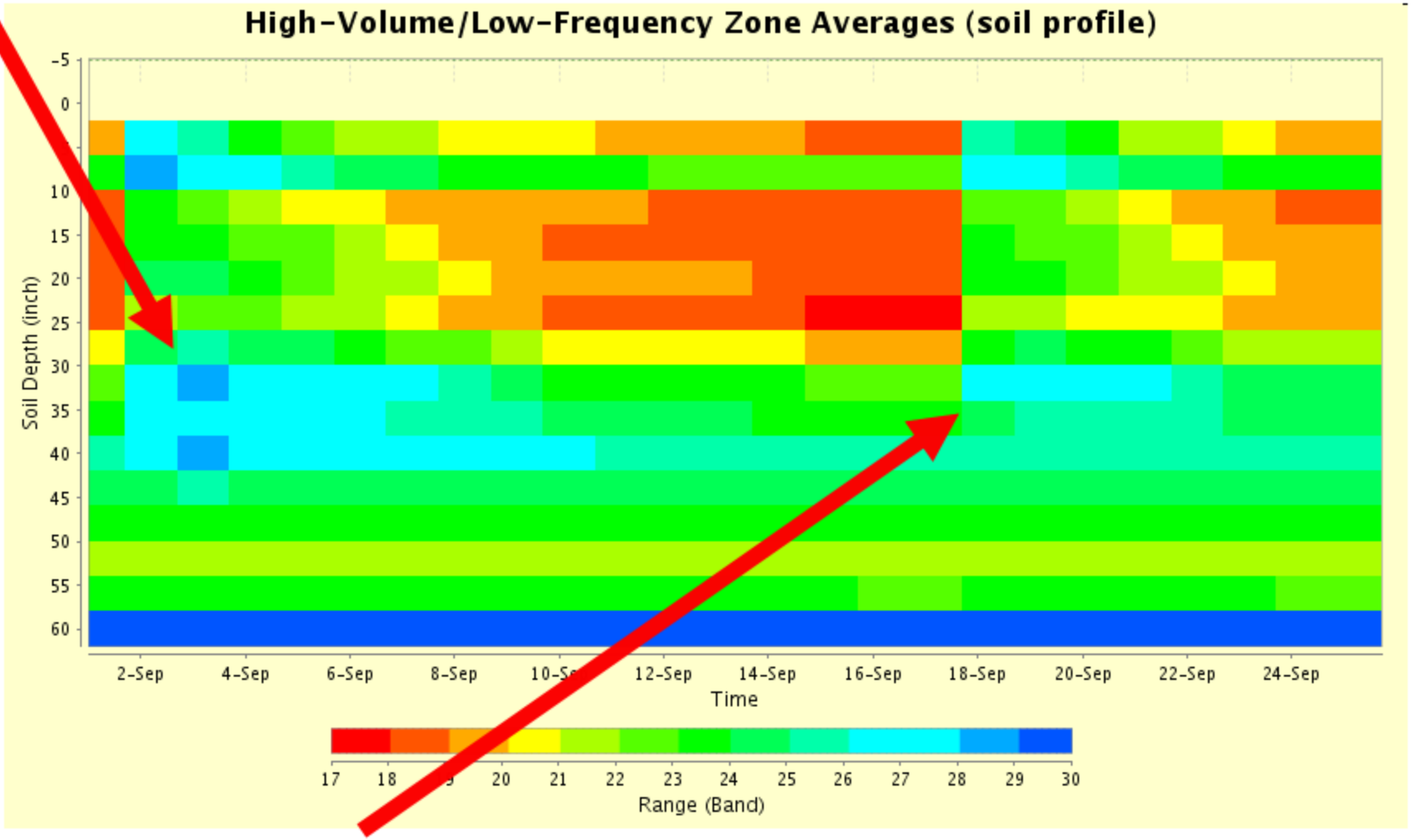
- Break up
- Mixing

Chemical Soil Modification

- Calcium
  - gypsum
  - lime
- Acidity
  - sulfur
  - lime
  - acids
- Organic matter
- Fertilizer

Chemical Name	Trade Name & Composition	Pounds/Ac-ft of Water to Get 1 meq/L Free Ca*
Sulfur	100% S	43.6
Gypsum	$CaSO_4 \cdot 2H_2O$ 100%	234
Calcium polysulfide	Lime-sulfur 23.3% S	191
Calcium chloride	Electro-Cal 13 % calcium	418
Potassium thiosulfate	KTS -- 25 % K_2O, 26 % S	256
Ammonium thiosulfate	Thio-sul 12 % N, 26 % S	110** 336***
Ammonium polysulfide	Nitro-sul 20 % N, 40 % S	69** 136***
Monocarbamide dihydrogen sulfate/ sulfuric acid	N-phuric, US-10 10 % N, 18 % S	148** 242***
Sulfuric Acid	100 % H_2SO_4	133

First Irrigation event: Water visible below root zone...



Second, Shorter Irrigation event: Minimal water below root zone