This presentation premiered at WaterSmart Innovations

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Topsoil, Compost and Water Quality Guidelines for Landscaping Help Reduce Irrigation Demands

Von Isaman

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Premise

The most state of the art irrigation controllers, Eto based weather systems, devices and sensors will not compensate for inherent landscape deficiencies…

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Saturated Tree Roots

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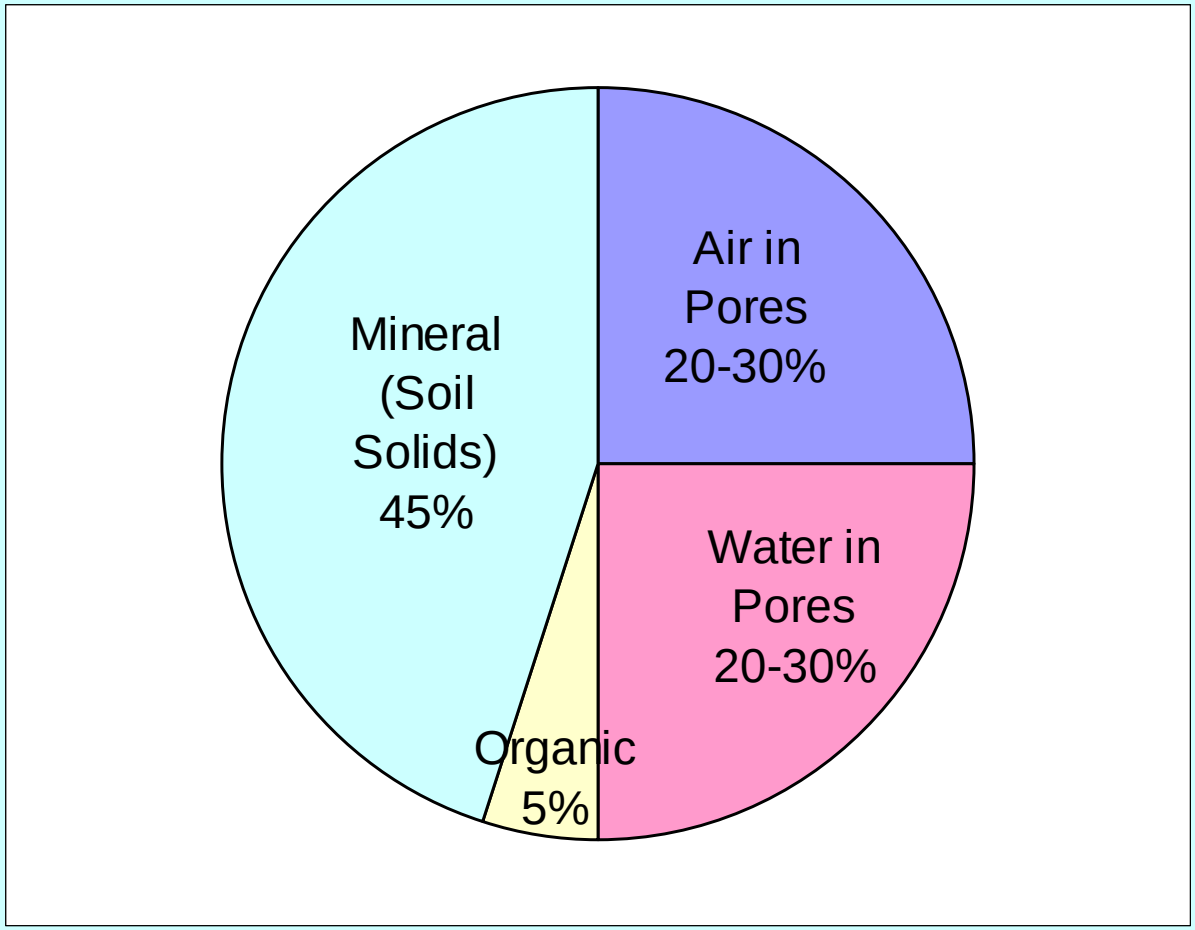
Reality

- Roots begin to die after 3 hours in absence of air/oxygen
- After 2 days of saturation damage to the woody root tissue occurs
- After one week in wet soils, roots are damaged

Soil Pie



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Soil Texture and Water-Holding Capacity

Soil Texture	**Storage** *(inches water/4 inches soil depth)*
Stones & gravel	0
Sand	0.12
Loamy sand	0.4
Sandy loam	0.6
Silt loam	0.8
Peat	1.0

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Infiltration and movement

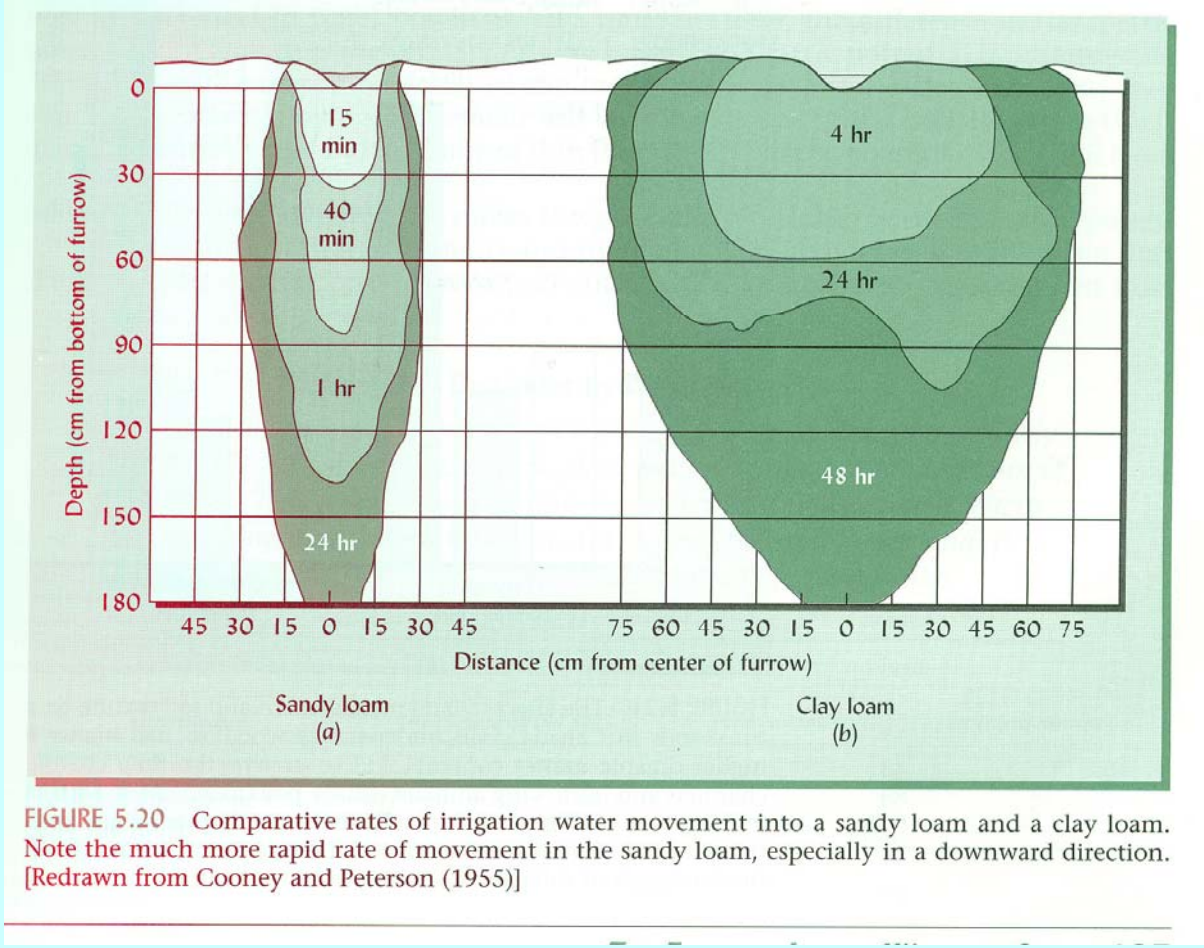

FIGURE 5.20 Comparative rates of irrigation water movement into a sandy loam and a clay loam. Note the much more rapid rate of movement in the sandy loam, especially in a downward direction. [Redrawn from Cooney and Peterson (1955)]

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Texture	Aeration/ Porosity	Infiltration	WHC
Loam	Medium	Medium	Medium
Clay	Poor	Poor	Good
Silt	Medium	Medium	Medium
Sand	Excellent	Good	Very Poor

Topsoil and Subsoil

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Soil Layers and Compaction

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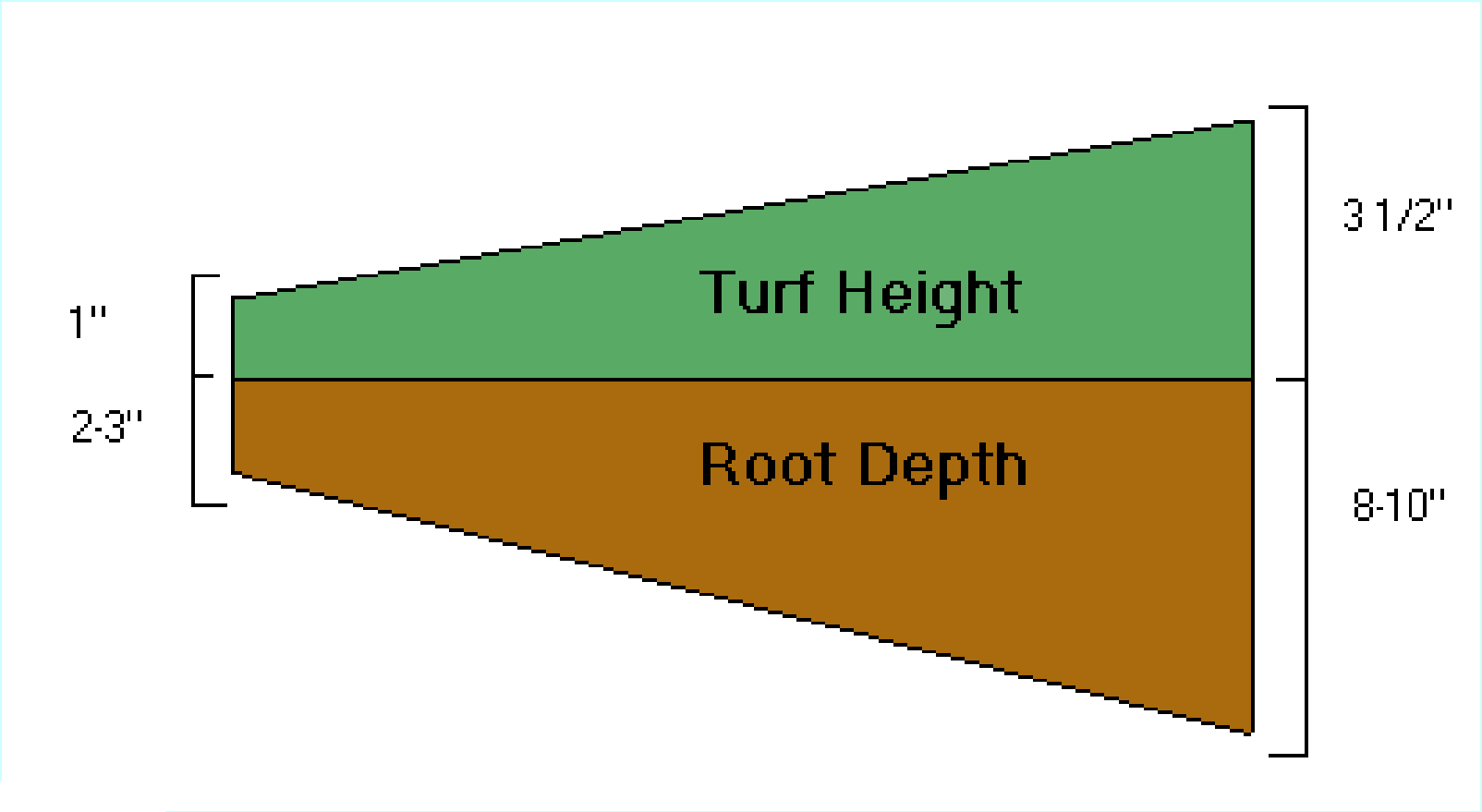
Turf Height/Root Depth



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Soil

- A dynamic natural body composed of mineral, organic and living forms in which plants grow

Lesser Soil Issues and Mitigation

- pH
  - Fertilize, select adapted plant species
- Nutrients (macro and micro)
  - Fertilize
- Organic Material
  - Add organic material

Intermediate Soil Issues

- Salinity (salts, (EC, electrical conductivity)
  - May directly cause plant death
- Sodium (SAR, sodium adsorption ratio)
  - May directly cause plant death
- Mitigation
  - Adapted species, leach with high quality water, leach with gypsum, import soil, alternative landscape

Profound Soil Issues

- Critical to plant vitality, and will directly cause plant death
- Expect secondary affects to increase the speed of mortality

Profound Soil Issue: Drainage

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Soil Drainage Factors

- Texture
  - The proportion of sand, silt and clay
    - Sand
      - Coarse soil particles that loosely holds water, i.e. drains water quickly
    - Clay
      - Fine soil particles that tightly holds water,
      - i.e. drains water slowly
    - Loam
      - Intermediate between sand and clay

COMPOST QUALITY GUIDELINES FOR LANDSCAPING*

Category	pH**	Soluble Salts** dS/m or mmho/cm	Sodium Adsorption Ratio** (SAR)	Carbon-Nitrogen Ratio*** (C:N)	% Moisture ****	≥98% Coarse Material Passing (dry wt basis)
Ideal	6 to 8	≤5	<10	≤20:1	25 to 35	3/8" (9.5 mm)
Acceptable	5-6, 8-9	≤10	≤20	21:1 to 30:1	<25, >35	3/4" (19 mm)
Suspect	<5, >9	>10	>20	<10:1, >30:1	<20, >50	<98% 3/4"

for composts with biosolid feedstocks, biosolids must meet EPA 503 Class A standards

*Von Isaman MS, President of QA Consulting and Testing LLC, Dr. Rich Koenig, USU Cooperative Extension Soils Specialist, and Dr. Teresa Cerny, USU Cooperative Extension Horticulturalist, 3 March 2003.

** 1:5 Compost:Water Slurry ON COARSE Material passing 3/8” (9.5 mm)

*** on Coarse Material passing 3/8" (9.5 mm)

**** on total sample

Acceptable level Soluble Salts and/or SAR composts then do not exceed 3 cu yds/1000 sq ft for every 3 inches of soil depth

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Compost/Organic Material

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Soil Mosaic

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Soil Mosaic

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Composting Operation

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Compost:

- The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- Compost bears little physical resemblance to the feedstock's from which it originated.

Final Compost Product

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Remedy

DO NOT ADD MORE SAND OR CLAY TO YOUR CLAYEY OR SANDY SOIL-

ADD ORGANIC MATERIAL

(the universal soil miracle worker)

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Benefits of adding compost to soil are to:

- Improve soil structure resulting in increased water infiltration rates
- Increase water-holding capacity
- Increase nutrient holding capacity
- Improve the micro-organism environment

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Benefits of adding compost to soil are to: (cont.)

- Improve root growth through reducing compaction
- Improve tilth (the ‘workability’ of the soil; clays don’t stick, sands don’t fall apart)
- And reducing erosion (by increasing soil infiltration and water holding)

Water Quality

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Water Quality Guidelines

Category	pH	Soluble Salts dS/m or mmho/cm	Sodium Adsorption Ratio (SAR)	Sodium meq/L	Bicarbonate meq/L	Chloride meq/L	Nitrates mg/L (ppm)	Sulfates mg/L (ppm)	Boron mg/L (ppm)	TDS mg/L (ppm)
None*	6.5 - 8.4 (normal)	0 - 0.7	By formula	<3 by SAR	<1.5	<4	<5	0 – 250	<0.7	<450
Slight to Moderate*	6.5 – 8.4 (normal)	0.7 - 3.0	By formula	3 - 9 by SAR	1.5 - 7.5	4 - 10	5 – 30	250 – 400	0.7 - 3.0	450 - 2000
Severe*	<6.5, >8.4	>3	By formula	>9	>7.5	>10	>30	>400	>3.0	>2000

From “Guidelines for Interpretation of Water Quality for Irrigation”, Oregon State University, “Irrigation Water Quality Criteria”, Colorado State University, and “Irrigation Water Quality”, University of Minnesota. Complied by Von Isaman, QA Consulting and Testing, LLC

* degree of restriction on use, TDS total dissolved solids

SAR formula:

If SAR is	None	Slight to Moderate	Severe
0 - 3 and EC =	>0.7	0.7 - 0.2	<0.2
3 - 6 and EC =	>1.2	1.2 - 0.3	<0.3
6 -12 and EC =	>1.9	1.9 - 0.5	<0.5
12 - 20 and EC =	>2.9	2.9 - 1.3	<1.3
20 - 40 and EC =	>5.0	5.0 - 2.9	<2.9

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pH, Soluble Salts, SAR, Sodium

Category	pH	Soluble Salts dS/m or mmho/cm	Sodium Adsorption Ratio (SAR)	Sodium meq/L
None*	6.5 - 8.4 (normal)	0 - 0.7	By formula	<3 by SAR
Slight to Moderate*	6.5 – 8.4 (normal)	0.7 - 3.0	By formula	3 - 9 by SAR
Severe*	<6.5, >8.4	>3	By formula	>9

SAR Formula

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0 - 3 and EC =	>0.7	0.7 - 0.2	<0.2
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6 -12 and EC =	>1.9	1.9 - 0.5	<0.5
12 - 20 and EC =	>2.9	2.9 - 1.3	<1.3
20 - 40 and EC =	>5.0	5.0 - 2.9	<2.9

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Bicarbonate, Chloride, Nitrates

Category	Bicarbonate meq/L	Chloride meq/L	Nitrates mg/L (ppm)
None*	<1.5	<4	<5
Slight to Moderate*	1.5 - 7.5	4 - 10	5 – 30
Severe*	>7.5	>10	>30

* degree of restriction on use

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Sulfates, Boron, TDS

Category	Sulfates mg/L (ppm)	Boron mg/L (ppm)	TDS mg/L (ppm)
None*	0 – 250	<0.7	<450
Slight to Moderate*	250 – 400	0.7 - 3.0	450 - 2000
Severe*	>400	>3.0	>2000

* degree of restriction on use TDS total dissolved solids

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Potential yield reduction from saline water for selected irrigated crops.

	% yield reduction			
Crop	**0%**	**10%**	**25%**	**50%**
	EC_w [2]			
Barley	5.3	6.7	8.7	12
Wheat	4.0	4.9	6.4	8.7
Sugarbeet	4.7	5.8	7.5	10
Alfalfa	1.3	2.2	3.6	5.9
Potato	1.1	1.7	2.5	3.9
Corn (grain)	1.1	1.7	2.5	3.9
Corn (silage)	1.2	2.1	3.5	5.7
Onion	0.8	1.2	1.8	2.9
Beans	0.7	1.0	1.5	2.4

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Plant, Soil, Water Relations Rule!

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