Soil Management Techniques for Weed ~~Control~~ Management

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weeds scare me, so

The good slides are borrowed from

John Roncoroni, UCCE
Cheryl Wilen, UCCE

Images from
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Outline

1. Integrated weed management, and the role of soil
2. Soil assessment: review of soil characteristics, and how to evaluate them
3. Weed biology; weeds as indicators of soil characteristics/problems
4. Soil management techniques

Reminder: we routinely damage our soils…

DO NOT DO THESE THINGS TO YOUR SOIL

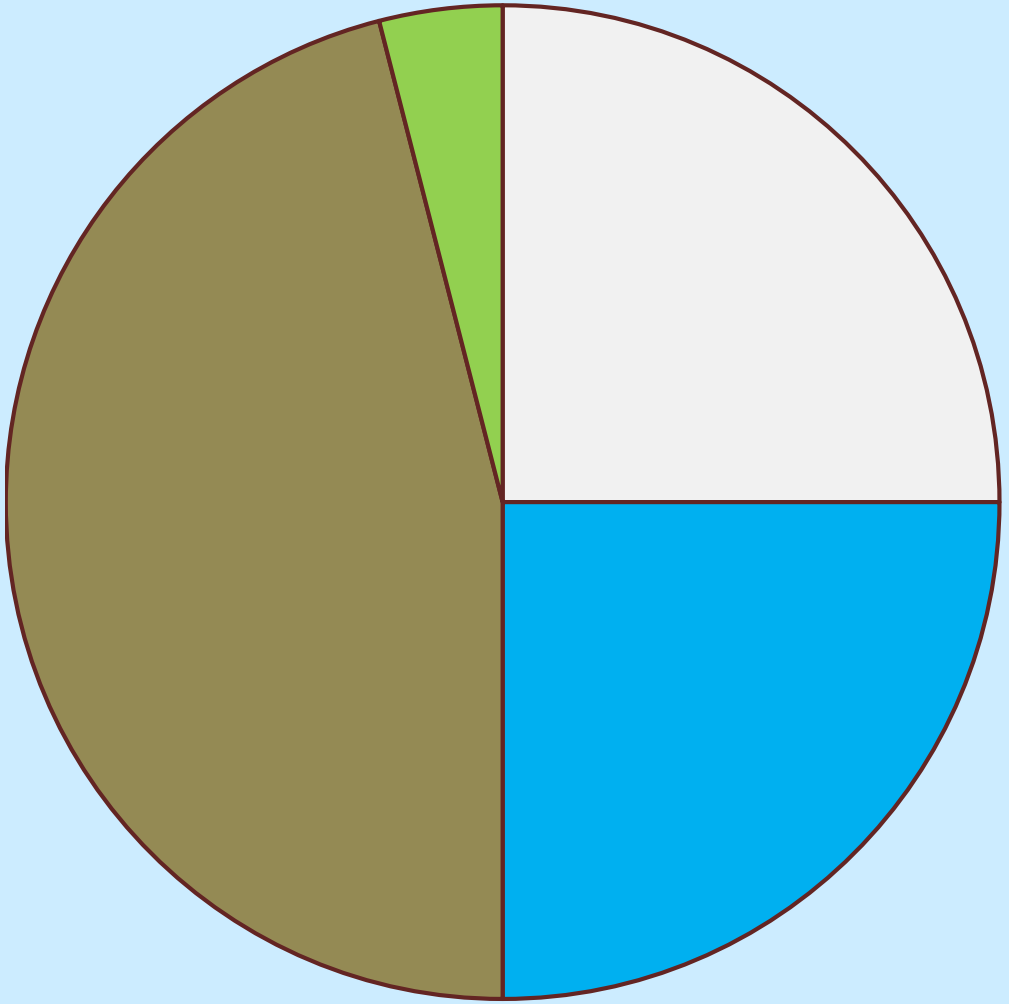
Do not:

- Drive heavy machinery over the soil, especially when it is wet.
- Allow quagmire conditions to develop on playing fields by allowing play under all conditions and refusing to install a drainage system.
- Ignore the signs of developing problems and take no remedial or preventive action.
- Destroy all microbial and small animal activity in a soil with heavy and repeated applications of chemicals.
- Carefully remove all organic materials in the interests of tidiness.
- Irrigate heavily so that the soil is frequently waterlogged.
- Irrigate with high-sodium water and don't bother about taking any precautions.
- Bash the soil about with cultivating implements, push it around wet with dozer blades, pulverise it with rollers.
- Never bother to get expert help when constructing areas for turf and think: What has been done in the past is good enough. Use what you have on hand. She'll be right.

useful (?) ideas

- weed management is about prevention!
- first manage the soil – then manage the weeds
- soil parameters: (1) water: too much (waterlogging)
  (revealed too little
  by weed un-evenly applied
  species!) (2) compaction and poor structure
  (3) nutrients
- no guarantees… but less conflict than glyphosate ☺

Soil:
stuff +
space +
time



← stuff | space →

water:

not enough…

too much

soil texture: avoid creating interfaces

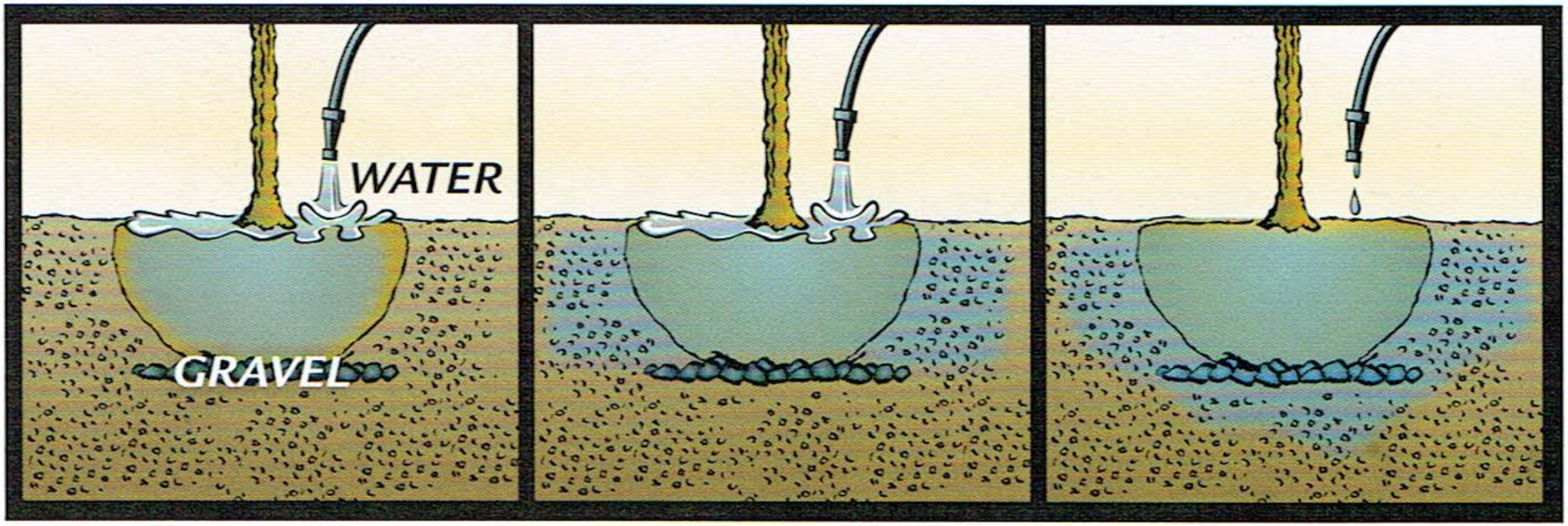


Figure 2-5 Gravel in the bottom of the planting hole can make drainage worse. Moisture will accumulate in fine textured soil above a coarse textured gravel layer until the soil is completely saturated.

gravel in the bottom of pit = waterlogged soil

soil texture: beware interfaces with potting mix

potting mix is not soil…

→ drains fast

→ can stay dry even if surrounding soil is wet

soil texture: check the drainage situation

Figure 1-17 If water does not drain readily from the planting hole, excess water may kill the roots of a tree planted in the hole.

test:
1 dig hole;
2 fill with water;
3 let drain,
4 then refill and monitor

→ Less than ¼ in/hr – potential problem
→ Over 4 in/hr – sandpit!

soil color: grey?
Think waterlogging!

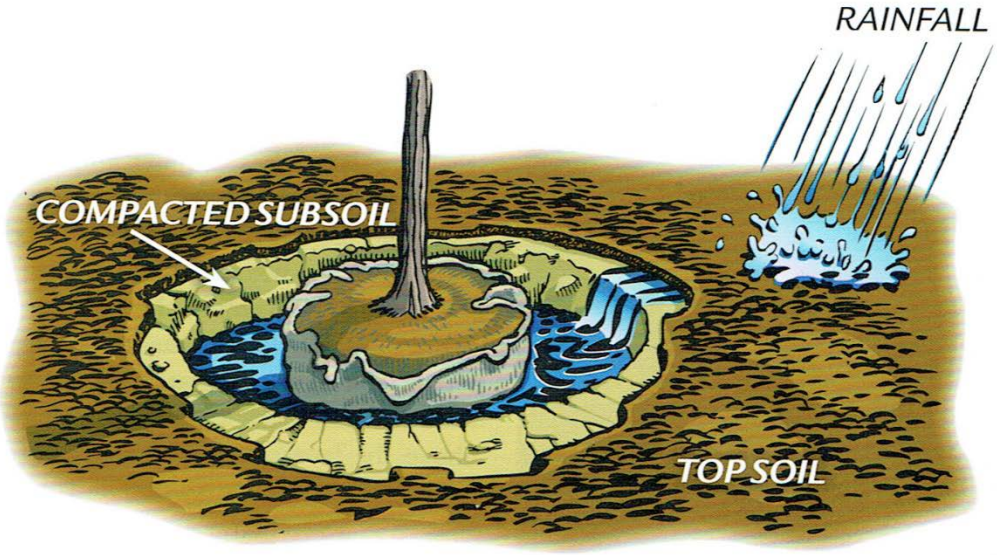


Figure 5.25. Blackened soil is an indication of anaerobic soil conditions.

texture & water movement remedies

~ avoid creating interfaces

~ break up interfaces where possible

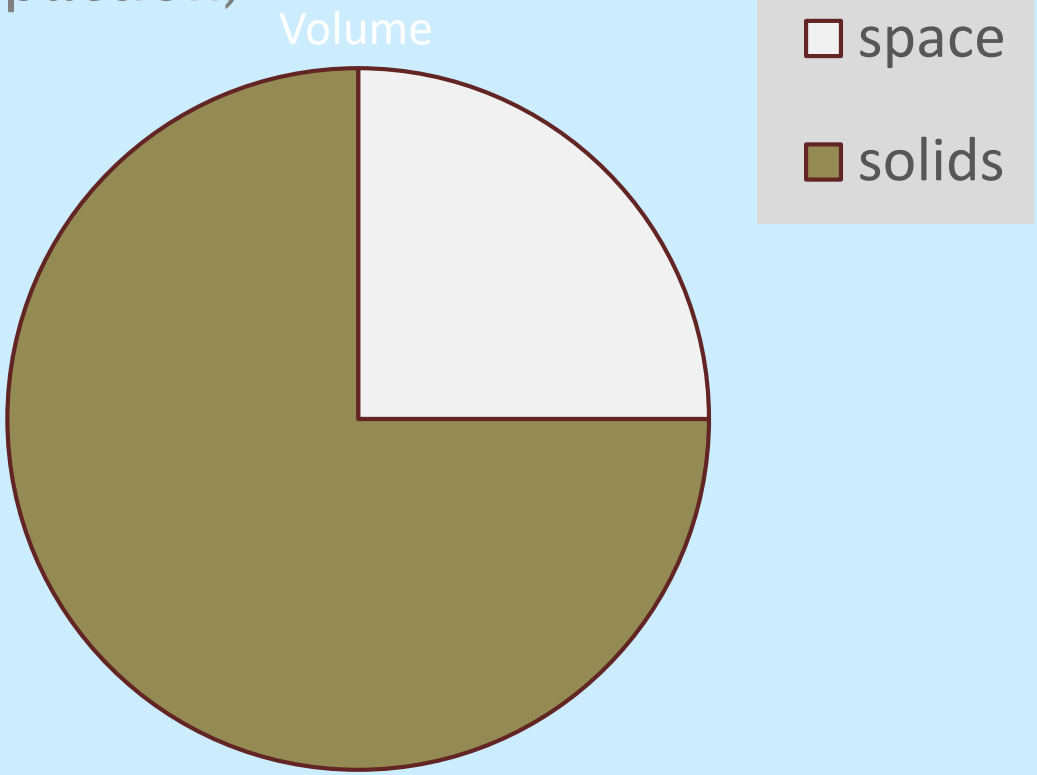
~ add organic matter (and wait…)

~ grade up (mound up) tree planting sites

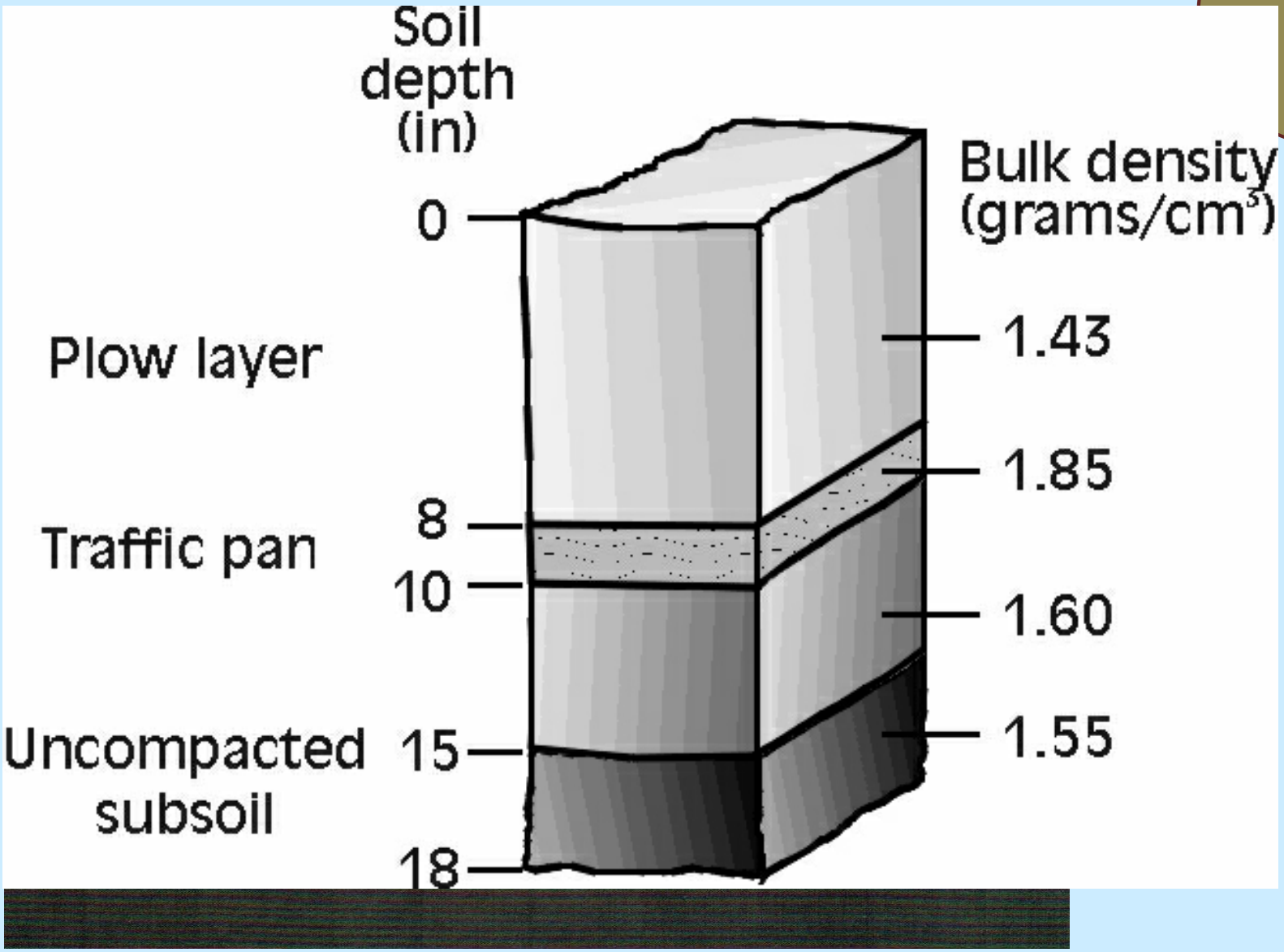
~ install under-drains

space:

not enough (compaction)



diagnosing compaction



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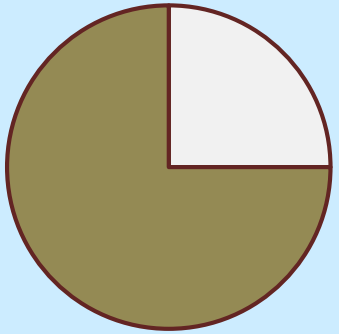
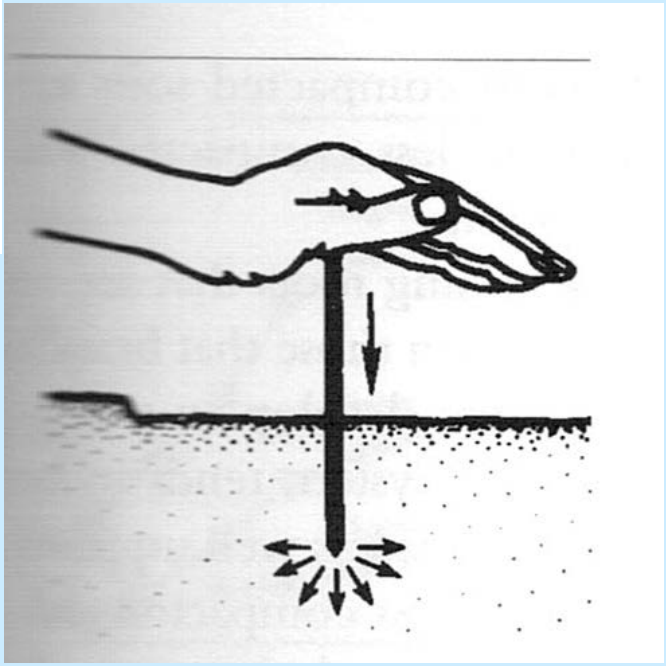
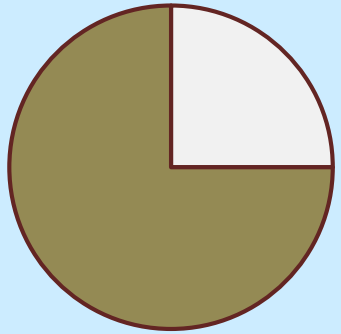


Table 1: Brief list of root growth resource requirements.

root resource	requirements minimal	maximum
soil bulk density restricting root growth (g/cc)	- -	1.4 clay 1.8 sand
penetration strength (water content dependent)	0.01kPa	3MPa



Compaction - solutions



prevention: at all costs!

equipment control, load-spreading

keep equipment off of saturated soil!

repair: focus on reducing bulk density

1) tilling/cultivation

2) de-compaction with air

3) mechanical de-compaction

4) mulch + patience

working with soil labs…

sampling: in more than one spot! (try ten!)
separately in each “suspect” area
around a happy tree, for comparison!

lab order: check the right boxes!

✓ salinity ✓ organic matter %

✓ NPK + micronutrients (if suspect)

✓ pH (if separate; usually included)

✓ SAR or ESP (if worried about sodicity)

lab results: look for things way out of range!

pH (acidity)

TABLE 5.12. pH ranges of soils and possible associated plant problems

pH scale	Soils where found	Description/problems	Common plant symptoms
12			
11			
10	Sodic soils	White crust on soil; lack of drainage; water ponding on soil surface. Possible sodium toxicity.	Marginal leaf burn, chlorosis, death.
9			
8	Calcareous soils	Soil typically light-colored, fine-textured. Iron, zinc, and manganese deficiency.	Interveinal chlorosis and bleaching of new growth.
7			
6	Humid region arable soils	Most plants tolerant.	None.
5			
4	Forest soils	At lower range, aluminum toxicity; calcium and magnesium deficiency may occur.	Reduced growth and chlorosis symptoms in sensitive plants at lower ranges.
3			
2	Acid sulfate soils	Aluminum toxicity; calcium and magnesium deficiency.	Reduced growth and chlorosis symptoms; distorted new growth with necrotic areas.
1			

Satisfactory for most plants

Source: Adapted from Brady and Weil 1996.

pH remedies

~ pH differences of <0.5 can be unimportant

~ add organic matter (& wait)

~ check for free lime in soil

~ can use sulfur to lower pH, but often simpler to use specific fertilizers (chelates or foliars)

~ don't allow accidental soil degradation (C&D debris!)

Table 11.1
Some plant genera that prefer acid soils

Abelia	*Nandina*
Camellia	*Persea*
Catalpa	*Photinia*
Citrus	*Pyracantha*
Dichondra	*Quercus*
Gardenia	Raspberry
Gladiolus	*Rhododendron*
Hibiscus	*Spirea*
Hydrangea	Strawberry
Iris	*Syringa*
Juniper	*Verbena*
Ligustrum	*Vinca*
Liquidambar	Willow
Lonicera	*Wisteria*
Magnolia	

salinity

TABLE 5.6. Guidelines for interpreting test results for salts in soil, water, and plant tissue

	Generally safe	Slight to moderate	Severe
Soil analyses			
salinity (EC_e), mmhos/cm*	0.5–2.0	2.0–4.0	>4.0
sodium adsorption ratio (SAR)	<6	7–9	>9
sodium, mg/l		>230	
boron, mg/l	0.1–0.5	1–5	>5
chloride, mg/l	<100	100–200	>250
ammonium, mg/l	0–25	>25	

salinity

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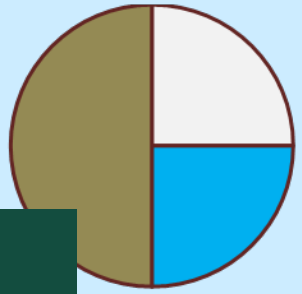
sodium, mg/l		>230	
boron, mg/l	0.1–0.5	1–5	>5
chloride, mg/l	<100	100–200	>250
ammonium, mg/l	0–25	>25	
Water analyses*			
total dissolved solids (TDS), mg/l	<450	450–2,000	>2,000
salinity (EC_w), mmhos/cm†	<0.7	0.7–3.0	>3.0
boron, mg/l	<0.5	0.5–1.0	>1.0
chloride			
surface irrigation, mg/l	<140	140–300	>350
sprinkler irrigation, mg/l	<100	>100	
sodium			
surface irrigation (SAR)	<3	3–9	>9
sprinkler irrigation, mg/l	<70	>70	

salinity remedies



~ prevent it! It doesn't happen overnight, so monitor, and take action, especially with RW

~ add organic matter (& wait)

~ flush, aka "leach" (common in production ag.)

~ for sodicity only: use gypsum

~ careful with imported "fill" soils

organic matter – aim for 3-5% (?)

~ in order: mulch, compost, patience

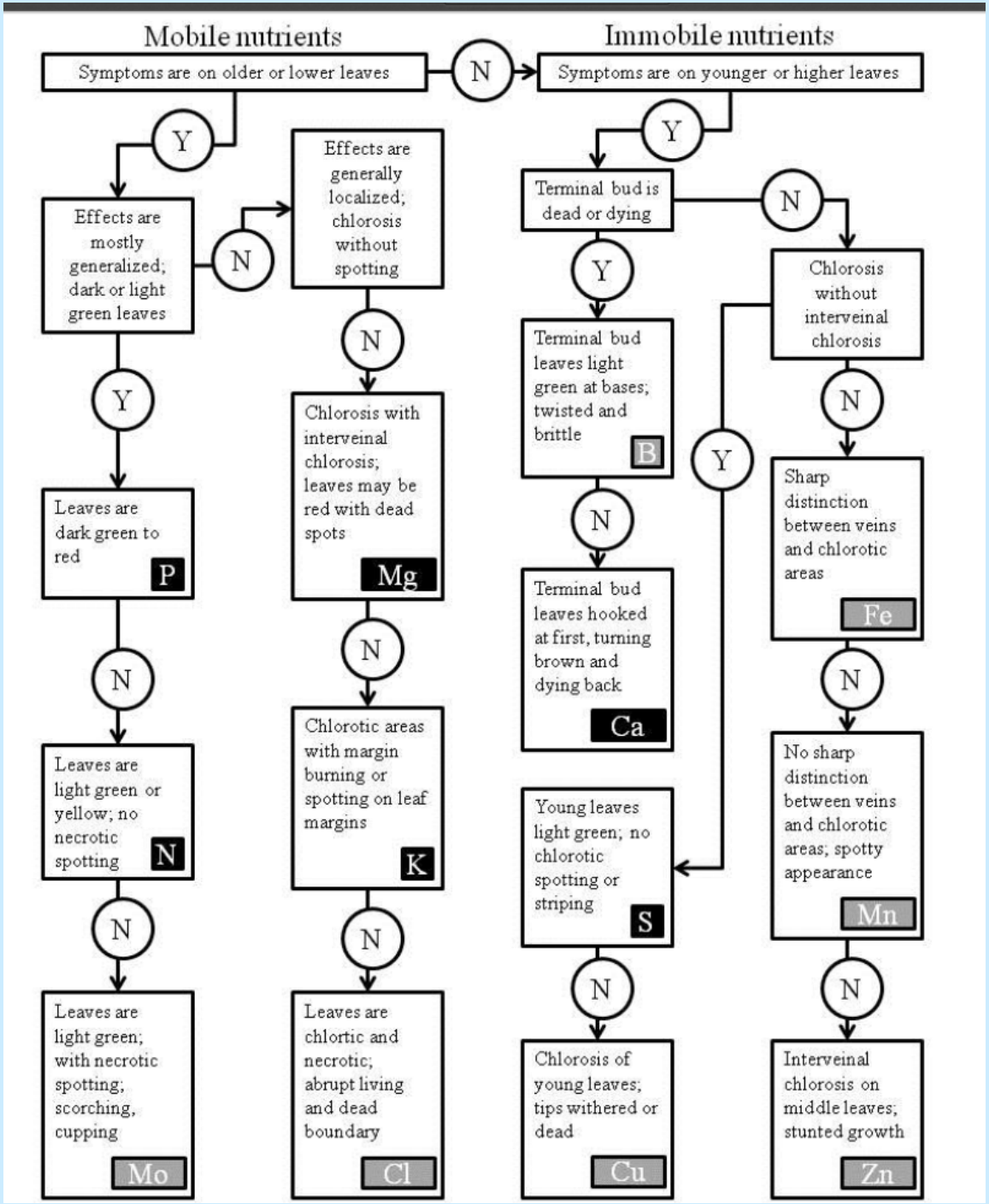
~ compost/mulch NOT the same as soil organic matter

~ don't go overboard: unusually high % of OM may cause settling, or even hydrophobicity (we are not creating a potting mix here!)

~ again: patience

Finally…
NPK

plant symptoms
vs.
nutrient mobility



Soil Wrap-up

Check on-site:

soil “size” (root A,V)

drainage

hardpan layer

texture & interfaces

compaction

Lab tests

pH

salinity (eC_e)

organic matter (%)

N, P, K, + others

Soil sampling for testing

1. Perform a comprehensive site assessment
2. List what you (now) know about the site
3. List what specifically you want the lab to tell you
4. Consider again whether something other than the "lab results" might explain the problem!

5. Take a good sample! "good" = representative
6. Document your sample, and label it

Soil testing: what to do

Call the lab	if you are unsure about something!
"Standard packages" of tests	are not always useful
Use a Western-US lab	analysis methods suitable for alkaline soils
Use the same lab over time	easier to interpret changes

summary: Kim Coder's list

Table 1: Brief list of root growth resource requirements.

root resource	requirements minimal	maximum
oxygen in soil atmosphere (for root survival)	3%	21%
air pore space in soil (for root growth)	12%	60%
soil bulk density restricting root growth (g/cc)	-	1.4 clay
	-	1.8 sand
penetration strength (water content dependent)	0.01kPa	3MPa
water content in soil	12%	40%
root initiation (O2% in soil atmosphere)	12%	21%
root growth (O2% in soil atmosphere)	5%	21%
progressive loss of element absorption in roots (O2% in soil atmosphere)	10%	21%
temperature limits to root growth	40°F/4°C	94°F/34°C
pH of soil (wet test)	pH3.5	pH8.2

summary: Bryant Scharenbroch's list

Parameter	"Ideal range"
Color	Browns not grays and dry value <5 on 10YR
Smell	Organic not rotten
Texture	<50% (sand), <30% (clay), and >30% (silt)
Aggregation	Strong GR or SBK A horizon and >75% (WAS)
Density	<1.6 g/cc (sand) to <1.1 g/cc (clay)
Penetration resistance	<2.3 MPa
Tension	-10 kPa (FC) to -1500 kPa (PWP)
Moisture	25 to 40%
Infiltration	>10 cm/hr (sand) and >1 cm/hr (clay)
pH	6.0 to 7.0
Electrical conductivity	<2 dS/m
Organic matter	4 to 8% (SOM) and <25/1 (C/N)
Active SOM	0.4 to 1% (POM) and >50 ppm CO_2 day^{-1} (RES)
Earthworms	$>100/m^3$

References

~ Kim Coder – soil and tree info leaflets

~ Costello et al. 2003:

Abiotic Disorders of Landscape Plants

~ Handreck & Black 2010:

Growing Media for Ornamental Plants and Turf

~ Bryant Scharenbroch:

http://www.masslaboratory.org/

~ Jim Urban 2008: Up By Roots

~ Watson and Himelick 2013:

The Practical Science of Planting Trees

John says: consider the history of your site!

Why does it look like this…

Also: know the weed species! (their “strategy”)

…is it a “strongman?” …a “quick grifter”? … a “survivor?”

And now, weeds……

http://ipm.ucanr.edu/PMG/weeds_intro.html

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PRINT

Weed photo gallery

The UC IPM Weed Photo Gallery includes many, but not all, weed species commonly found in California farms and landscapes.

Choose a category below or skip to a **LIST OF ALL WEEDS**.

Identify your weeds

Broadleaf
Leaves are wide, veins branch out in different directions.
Identification | **Tutorial** | **Broadleaf list**

Grass
Leaves are narrow, arranged in sets of two; stems are rounded or flattened.

Weeds that indicate soil problems ("John's List")

Problem:

Soil Compaction

Weed:

Prostrate

Knotweed

Polygonum

arenastrum

Common (Prostrate) knotweed

- Summer annual (can persist). Reproduces by seed. One of the first summer annuals to germinate.
- Knotweed is easily pulled and chemicals usually are not needed.
- Compaction of soil should be corrected. Aeration will help.
  Soil amendments such as gypsum may help in clay soils

Common (Prostrate) knotweed (senescing)

Weeds that indicate soil problems ("John's List")

Problem:

Un-even

irrigation;

wet then dry

Weed:

Broadleaf

plantain

Plantago major

Broadleaf plantain

- Rosette-forming perennial. Reproduces by seed.
- Short, thick taproot. Germinates best in wet areas, but after establishment can tolerate very dry conditions. *Sign of irregular irrigation*.
- Check sprinklers for consistency. Check pipes for leaks.

Weeds that indicate soil problems ("John's List")

Problem:

Moist site

that dried out…

Weed:

Dallisgrass

Paspalum dilatatum

Dallisgrass

- Coarse textured perennial producing spreading clumps.
- Reproduces by seed; once established, the clumps expand by short rhizomes (that look like insect grubs!).
- Well adapted to close, frequent mowing. Likes moist areas, but can then persist when soil dries out (and lawn dies back)
- Once established, control by digging or chemical treatment.

Weeds that indicate soil problems ("John's List")

Problem:

low-input turf

(no nitrogen)

Weed:

White clover

Trifolium repens

White clover

- Perennial; Reproduction is by seed and stolon
- Seed coats are very hard, ensuring extended dormancy
- Grows best in areas of low Nitrogen
- Can regrow faster than turf, giving area ‘lumpy’ appearance

Weeds that indicate soil problems ("John's List")

Problem:

compacted

soil

Weed:

Goosegrass

Eleusine

indica

Goosegrass

- Annual;
- Low rosette, mat forming, stems compressed. Appears as silvery, pale green clump.
- Normally found in compacted areas or areas of heavy wear.

Weeds that indicate soil problems ("John's List")

Problem:

wet soil

Weed:

Tall flatsedge

Cyperus eragrostis

Tall flatsedge

- Erect perennial to about 1 meter tall. Short thick rhizome
- Spreads by rhizome and seed.
- Typically inhabits shallow water to moist soils- grows best on fertile soil.
- Similar to yellow nutsedge, but NO nutlets (tubers)!
- in really damp places – check your irrigation and drainage!

Weeds that indicate soil problems ("John's List")

Problem:

compacted soil + close mowing

Weed:

Annual bluegrass

Poa annua

Annual bluegrass

- Winter Annual to Perennial
- Grows best in cool, moist weather
- Adapted to close mowing
- Adapted to Compacted soil – low oxygen
- Does Well in High Nitrogen
- Produces lots of seed throughout

Weeds that indicate soil problems ("John's List")

Problem:

dry site +

low mowing

Weed:

Bermudagrass

Cynodon

dacytlon

Bermudagrass

- Perennial. Reproduces by stolon or rhizome, less by seed.
- Does whatever it wants
- Outcompetes everything else when you mow it low
- Drought-tolerant; dormant in low temperatures.
- Cultural control.
  Clean mower
  before moving
  into uncontaminated area.
  Mow cool-season turf
  at 2-3 inches high

Weeds that indicate soil problems ("John's List")

Problem:

Wet soil

+

neglected

Weed:

Buttercup

Ranunculus

muricatus

Roughseed buttercup

- Winter or summer annual, biennial or short-lived perennial.
- Reproduces by seed in fall or spring
- Often inhabits moist or seasonally wet places
- Shallow roots, needs moisture to establish
- No taproot – cluster of slender fibrous roots from a short stem base
- Mechanical control

Weeds that indicate soil problems ("John's List")

Problem:

over-fertilization

Weed:

Common chickweed

Stellaria media

Common chickweed

- Winter annual; may become perennial in cool moist areas
- 1 or 2 generations can be produced each year
- Germination is usually early spring and late summer; in shady moist areas germination can be continuous
- Does well under close, frequent mowing regime

Weeds that indicate soil problems ("John's List")

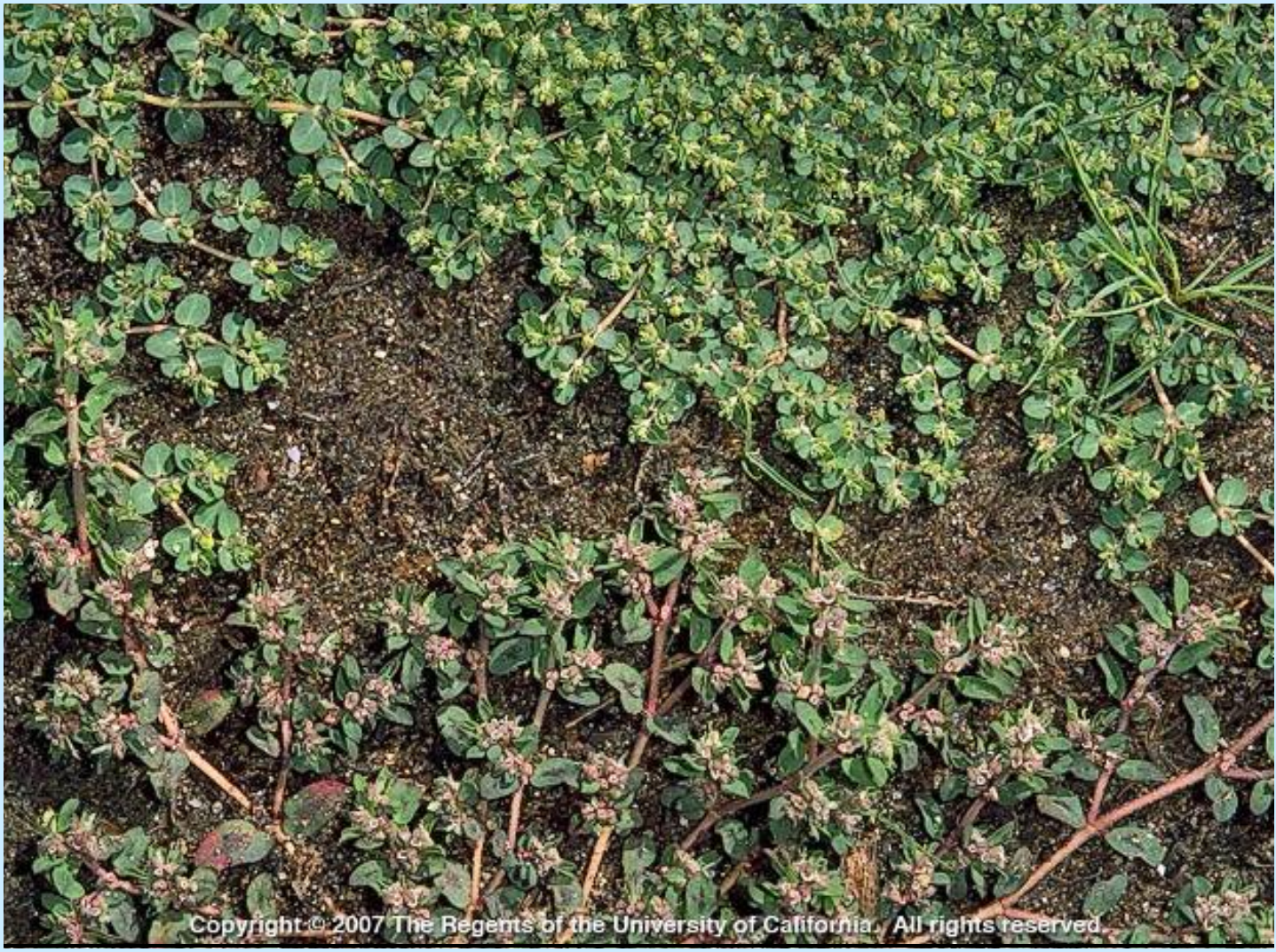
Problem:

compacted, dry soil

Weed:

Spotted spurge

Euphorbia maculata



Spotted spurge

- Prostrate mat-forming summer annual
- Seeds can be produced in as little as 4 weeks; can produce 1000's of seeds – can remain dormant, but NEED LIGHT to germinate
- Can grow in drought prone or compacted soils
- Control: mulch!

Recap

1. Many weeds are indicative of soil moisture status…

2. …or soil compaction…

3. …or soil nitrogen or pH level

→ Review John's lists!

4. Soil management techniques

Soil management for weeds

1. Correct soil problems (compaction, drought, flooding, over/under fertilization)
2. Don't bring in new weeds! (free dirt!)

2. Solarize
http://ipm.ucanr.edu/TOOLS/TURF/SITEPREP/soilsolar.html

3. Mulch (weed seeds need light!)
http://ipm.ucanr.edu/PMG/GARDEN/ENVIRON/mulches.html

4. Water/Germinate → Flame/scuffle → Plant

Weeds PestNote

http://ipm.ucanr.edu/PMG/PESTNOTES/pn7441.html

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How to Manage Pests
Pests in Gardens and Landscapes

Weed Management in Landscapes

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Quick Tip
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Revised 9/18

In this Guideline:

- Weed management before planting
- Weed management in established plantings
- About Pest Notes
- Publication
- Glossary

Related videos
Weed control using landscape fabric and mulch
How to remove dandelions (2:30)

Weed management in landscaped areas is made difficult by the complexity of many plantings. Landscapes can include turfgrass, bedding plants, herbaceous perennials, shrubs, and trees. Usually more than one species is planted in the landscaped area, and there is often a mix of annual and perennial ornamentals. The great variety of ornamental species, soil types, irrigation systems, slopes, and use of mulches creates the need for a variety of weed management options. There is also public concern about the use of chemicals to control weeds and their effect on water quality, public health, and non-target species if the herbicide moves offsite through runoff, drift, or other means of exposure.

The choice of specific weed management tactics depends on the weeds present and the types of turf or ornamentals planted in the area. Because of the many variables, weeds in landscape plantings are usually controlled by a combination of nonchemical and chemical methods.

Use this publication as a practical review and guide to weed management options suited to planting beds and areas around trees and shrubs.

Information on weed control methods that are more directed towards turfgrass can be found in *Pest Notes: Weed Management in Lawns*.


Mallow and other weeds in an unmulched landscaped area.

WEED MANAGEMENT BEFORE PLANTING

An integrated approach using several methods is the most economical and effective means of controlling weeds. Develop a weed management plan for landscapes before planting by following these five basic steps:

1. **Site assessment.**
   Before soil preparation and when weeds are visible, evaluate the soil and slope of the site so problems can be corrected or future problems anticipated before planting. Site characteristics to look for include drainage, soil compaction, shading, and water infiltration rate.

   Identify the weed species in the site, focusing on perennial weeds (see REFERENCES). The best time to look for winter annual weeds is mid- to late winter; perennials and summer annuals are easiest to identify in mid- to late summer.

2. **Site preparation.**
   The most frequently overlooked aspect of a landscape maintenance program is site preparation. Control existing weeds, especially perennials, before any grading and development are started. Non-selective translocated herbicides (ones that move from the site of application to other parts of the plant) containing the active ingredient glyphosate (e.g., Roundup or glufosinate (e.g., Leopard or Finale) can be used to kill existing annual grasses and many types of perennial weeds. Non-selective contact herbicides, including synthetic active ingredients (e.g., diquat-dibromide) or organic ingredients (e.g., acetic acid and clove oil) are effective for controlling young annual plants as long as there is good spray coverage.

   Soil solarization can be used but the soil must be covered with clear plastic for 4 to 6 weeks. Solarization is most effective when done during the time of highest solar radiation—from June to August for much of California although later in some parts of the state (see REFERENCES).

   The number of annual weeds can be reduced by irrigating the area after final grading, allowing the weeds to emerge. While the weeds are still small, remove them through shallow


Mowing strips can prevent weeds from moving into other areas.

Cheryl says: beware common turf problems

- Too much traffic – soil compaction
- Improper lawn species selection
- Too much shade
- Unfavorable soil conditions – moisture, pH
- Poor lawn management techniques
  - mowing too high or low

Reduced competitiveness

John’s lists…

Weeds Growing in Drought Prone or Dry Sites

- Prostrate Spurge
- Black Medic
- Yellow Woodsorrel (Oxalis)
- Goosegrass
- Prostrate Knotweed
- Birdsfoot Trefoil
- Bermudagrass
- Cinquefoil
- Yarrow
- Red sorrel
- Speedwell
- Mustard
- Sandbur
- Nettle
- Pigweed

Weeds Growing on Wet Sites

- Annual Sedge
- Annual Bluegrass
- Pearlwort
- Liverwort
- Rushes
- Horsetail
- Lady's-thumb
- Silvery cinquefoil
- Curly dock
- Sheep sorrel
- Plantain
- Common chickweed
- Crabgrass
- Goosegrass
- Ground ivy
- Mouse-ear chickweed
- Violets
- Yellow nutsedge
- Spotted spurge
- Chickweed
- Creeping buttercup
- Mosses

Weeds Growing on compacted Soils

- Mustard
- Cress
- Nettle
- Wild garlic *(Allium vineale)*
- Creeping buttercup
- Mouse-ear chickweed
- Annual Bluegrass
- Annual Sedge
- Broadleaf Plantain
- Prostrate Knotweed
- Prostrate Spurge
- Goosegrass
- Chickweed
- dandelion
- broadleaf dock

Weeds and Fertility Level – in Ag or Turf Settings
High fertility (Nitrogen)
Luxuriant users

- Annual Bluegrass
- Chickweed
- Ryegrass
- Chicory
- Pigweeds
- Purslane
- Dandelion
- Lamb'squarters
- Velvetleaf
- **Queen Anne's lace**
- Bentgrass
- Henblt
- Yellow woodsorrel (oxalis) – high P!
- Crabgrass – high P!
- Mallow

Weeds and Fertility Level
Low fertility

- Birdsfoot Trefoil
- Black Medic
- Common yarrow
- **Queen Anne's lace**
- Mullein

- White clover
- Fennel
- Thistle
- Dandelion
- Plantains
- Red sorrel

Weeds Associated with Soil pH Problems

Acid soil

- Sorrel
- Sow thistle
- Prostrate knotweed
- Lady's-thumb
- Wild strawberries
- Plantain
- Rough cinquefoil
- Silvery cinquefoil
- Knapweeds
- Bentgrasses

Alkaline Soil

- Field peppergrass
- Goosefoot
- True chamomile
- Queen Anne's lace
- Chickweed
- Spotted spurge
- Chicory


Thank you!
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