Gardening with Metals, Mulch, and Mycorrhizae

**Heavy Metals**

**Sources of heavy metals found in residential soils**

Lead from paint and gas – no longer an additive

Old pressure-treated lumber

* CCA: copper, chromium, arsenic
* No longer sold, CCA lumber is still around
* Metals leach out of wood and into soil as wood decomposes

Rubber mulch (**see fact sheet**)

* Rubber mulches are made out of old tires
* Tires contain heavy metals, including cadmium, chromium, and zinc
* As mulch breaks down, metals are released to soil

**Action items**

Use raised beds to limit heavy metal contamination (**see fact sheet**)

* Can isolate from underlying soil using impervious membranes
* Can use clean fill if needed (though native soil is best if possible)
* Can locate in an area away from airborne contamination

Have your soil tested

* Don’t bother with kits
* Use university or government labs
* Request standard test plus organic matter:
  + Nutrients - Heavy metals - Organic matter
* Can also test compost

Avoid excessive nutrients and maintain sustainable levels

* Use certified compost
* The US Composting Council requires testing for
  + heavy metals
  + pathogens
  + pesticides

to receive their Seal of Testing Assurance (STA).

* Or make compost at home (**see fact sheet**)
* Only add clean material
  + no pesticides
  + no sprayed plant material

Don’t plant near roadways

Use tap water or rainbarrels for watering vegetable gardens (**see fact sheet**)

Use arborist wood chip mulch for weed control (**see fact sheet**)

**Arborist Wood Chip Mulch**

**An ideal mulch will…**

* Enhance water infiltration and retention Enhance gas transfer
* Moderate soil temperatures Reduce erosion and compaction
* Improve soil structure Provide mineral nutrients
* Neutralize pollutants Enhance beneficial microbes and insects
* Suppress pathogens and pests Be cheap, easy to find, and easy to apply

**Arborist wood chips are ideal, especially for weed control (see fact sheet)**

* Decrease nitrogen levels at mulch-soil interface
* Reduce light needed by photodormant seeds
* Reduce light availability to buried leaves and root crowns of weeds
* Mulch depth is critical – when depths are than 3” then weeds increase

**Myths about arborist wood chips**

“Wood chips leach nitrogen from the soil”

* Wood chip mulches have a high C:N ratio, leading to a localized nitrogen deficiency at the mulch-soil interface
* Wood chip mulches do not cause nitrogen deficiency in established plants
* High C:N ratio in wood chips prevents germination of weed seeds

“Wood chips made from diseased wood will infect plants”

# *Fungal pathogens and wood chips*

* *Armillaria*, *Cytospora*, *Thyronectria* and *Verticillium* only survive on large pieces of wood
* There is a possibility of disease transfer if wood chips are incorporated into soil
* There is no evidence that pathogens in mulch can infect roots below the soil surface

# *Fungal communities in wood chips*

* Fungal species in wood chips are generally decomposers, not pathogens
* In healthy (aerobic) soils, beneficial fungi out-compete pathogenic fungi
* Healthy plants are not susceptible to opportunistic pathogens

**Action items**

* Use fresh wood chips if possible; they have the highest nutrient content
* Begin mulch application before annual weeds are established (spring or fall)
* Prune or mow perennial weeds at root crown in spring when root resources are lowest; pulling large weeds destroys soil structure
* Remove all noxious weed materials from site to prevent rerooting
* Use thick layers (6-8” for ornamental sites, 8-12” for restoration sites and blackberry/ivy control) of coarse materials are best for weed control and water conservation
* Taper mulch to 1-2” near the trunks of trees and shrubs
* Pull any resprouting plants; the mulch layer prevents erosion and facilitates pulling
* Replace mulch as needed to maintain appropriate depth (minimum depth of 4 inches for weed control)

**Mycorrhizal fungi**

**Mycorrhizae basics (see fact sheet)**

* Primitive mutualistic associations (both parties benefit)
  + Plants receive water and nutrients
  + Microbes receive sugars and B vitamins
* Found throughout plant kingdom
* Ectomycorrhizae
  + Ecto = outside; hyphae surround and occasionally penetrate root tissues
  + Only found in a small percentage of plant families
  + Form extensive networks throughout mulch and topsoil layers
* Endomycorrhizae
  + Endo = inside; hyphae always enter the root cells
  + Widely spread through hundreds of plant families
  + Most common are arbuscular (arbuscule = small tree) species

**How mycorrhizae infect and colonize plant roots**

* There are repositories of mycorrhizal spores in coarse organic matter
* Spores germinate under moist, aerated conditions
* Roots of receptive plants release chemical cues to invite mycorrhizal growth
* Hyphae penetrate cell walls and create passageways between partners
* Hyphae create cottony sheathes around roots that extend into soil
* Most fungi have multiple hosts

**Documented benefits of mycorrhizae**

* Increases:
  + Soil organic matter content
  + Solubilization and uptake of phosphate
  + Uptake of other soil nutrients
  + Leaf, root, and shoot growth
  + Plant survival and establishment
* Improves:
  + Soil structure
  + Competition for nutrients and water
  + Resistance to many stresses

**What about packaged mycorrhizal amendments?**

* May be effective for inoculation of sterilized container media
* No significant value in landscapes
  + Soils already contain native mycorrhizal and bacterial species
  + Positive effects often due to added fertilizer in product
  + Unhealthy soils won’t support growth of native or applied microbes

**Activities, amendments and conditions that inhibit mycorrhizae**

* Soil fumigants
* Excessive fertilizer application, especially phosphate
* Excessive irrigation
* Poorly drained soil
* Any activity that destroys soil structure
* Topsoil removal
* Compaction

**Activities, amendments and conditions that encourage mycorrhizae**

* Coarse woody mulch
* Conservative additions of nitrogen fertilizer
* Warm temperatures
* Mild drought or nutrient deficiency
* Reduced pesticide use
* Reduced soil disruption
* Increased diversity of landscape plant materials
  + Living mulch
  + Strongly mycorrhizal plants (woody species)

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# URL: <http://www.theinformedgardener.com> (white papers on many of these myths)

# Blog: http//www.gardenprofessors.com

# Books: http//www.sustainablelandscapesandgardens.com

# Facebook page: <http://www.facebook.com/TheGardenProfessors>

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