

Composting: Garbage to Garden



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What is an Arizona Master Gardener?

- A University of Arizona trained volunteer who completes a Cooperative Extension semester-long specialized course in gardening/horticulture.
- A non-paid volunteer “ambassador” between the UA Extension and the community. The MG agrees to complete a specified number of volunteer hours and continuing education hours each year.

What is an Arizona Master Gardener?

- We are county-specific and local. Each county extension office has their own MG program. Maricopa and Pinal Counties focus on our conditions in the low desert.
- We may or may not be experts or “masters” at any or all horticulture topics, but we are trained to help you find science- and research-based factual information.

Arizona Master Gardener

- The internet is full of information. However, not much of it is research-based, tested, scientific and/or focused on our local area. Master Gardeners provide research-based locally-tested information
- Master Gardeners greatly expand the outreach of the County Extension's research information and knowledge, enhancing the sharing of information on gardening and horticulture to our communities.

Where it Starts - Our Desert Soils

- Primarily tiny particles of silt and clay, which results in compaction, and poor drainage or
- In some areas, so sandy that they drain quickly, resulting in poor water retention
- Very thin soil, perhaps overlaying rock or caliche
- **Minimal organic matter**



Benefits of Our Desert Soils

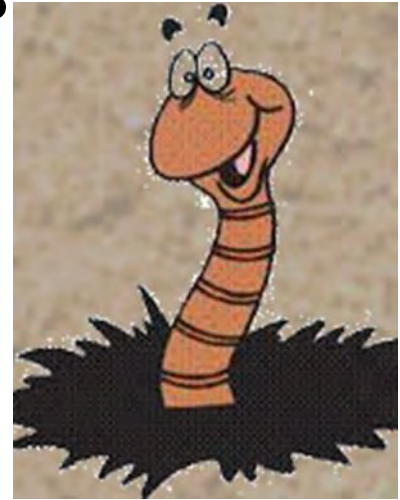
- Are good structural basis for garden soil
- Contain sufficient amounts of almost all of the 14 soil-based nutrients necessary for plant growth
- Desert soil holds an abundance of nutrients because of the minute amounts of rainfall and surface runoff

Benefits of Compost

- Incorporates organic matter into the native soil to feed micro- and macro-organisms that maintain a healthy, living soil
- Enriches soil with nutrients for plant growth
- Releases nutrients slowly so they don't leach away as some synthetic fertilizers do
- Promotes drainage and aeration in clay soil;
- Improves soil structure.

Benefits of Compost

- Aids moisture and nutrient retention
- Reduces soil compaction
- Suppresses soil-borne diseases and pests
- Inhibits erosion
- Attracts earthworms, nature's best soil builders
- Helps non-native plants to thrive



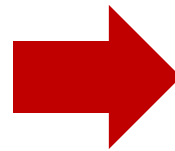
Benefits of Compost

- **Environmental**
- **Natural**
- **Scientific**
- **Economic**
- **Psychological**
- **Philosophical/Spiritual**
- **Social and fun!**



What is Compost?

- Process by which organic material decays and decomposes
- The material produced by the composting process



History of Compost

- Chemical fertilizers were not developed until around 1850
- Since animals were first domesticated, early farmers realized the benefits of composted "muck" or manure because of how well plants grew in areas with animal manure.
- For ten thousand years' of agriculture, only composted muck was used



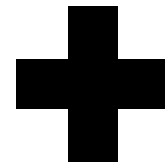
In North America

Native Americans and European settlers composted fish and “muck”

Muck (n): Moist farmyard dung; manure

New England farmers had a recipe for compost:

10 parts muck
+ 1 part fish



New “Scientific” Method of Farming

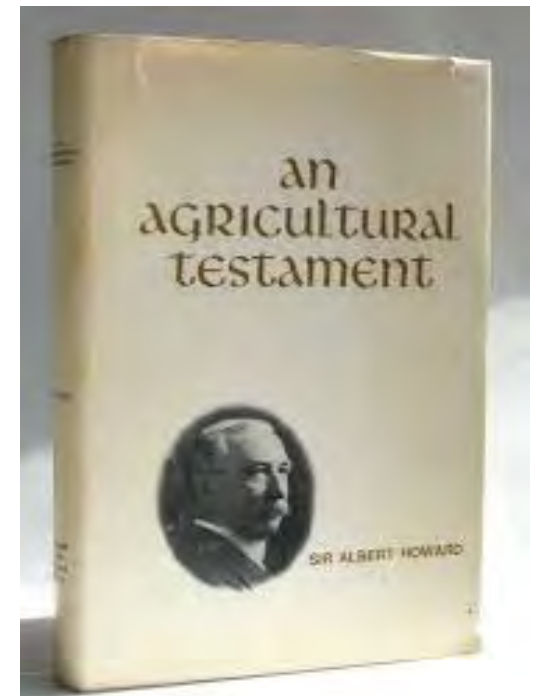
German scientist, Justus von Liebig:

- Noted that plants obtained nourishment from chemicals in a solution (1840s)
- Chemical fertilizers were found to be "easier and more effective"
- Therefore, agricultural fertilizers became increasingly more chemical



Organic Methods

- Even as chemical fertilizers were being developed there were those who continue to favor organic methods
- British Agronomist Sir Albert Howard (1873-1947), the father of "modern" organic gardening.
- Wrote "An Agriculture Testament" and generated renewed interest in organic farming/gardening



Organic vs Chemical Methods

- Organic fertilizers such as compost are slower release, as they tend to break down over time
- Some organic fertilizers can be used by the plant immediately, such as compost tea or fish/kelp liquid, applied as foliar sprays
- With a soil test, nutrient deficiencies can be determined and applied as needed, without waste or unnecessary expense

Compost – What Is It?

Carbon + **Nitrogen** +
Water + **Oxygen** =
Compost

Friendly aerobic bacteria do the work!



If you build it, they will come

Five Compost Ingredients

1. “Green” Organic Materials (nitrogenous)
2. “Brown” Organic Materials (carboniferous)
3. Oxygen
4. Water
5. Bacteria, Fungi, Insects



What happens?

Bacteria, fungi, and insects consume and digest moist organic matter and decompose the material so that it is transformed from recognizable ingredients into fluffy, sweet, earthy-smelling compost.

They do the work, we just help them succeed!

From this:



to this:



Collecting the Ingredients

- Carbon- and nitrogen-based materials will be used to set up the optimal compost recipe.
- These are often referred to as browns and greens
- Gather a ratio of about 5:1 brown to green material

“Brown” Materials Contain Mostly Carbon

Typically organic material that
is dead, dry and crunchy



Brown Materials: Outdoor Sources

- Small twigs and tree bark
- Dried leaves
- Bedding and dried manure from rabbits, chickens and grazing animals
- Grass hay and straw
- Pruning trimmings that have dried out



Brown Materials: Indoor Sources

- Shredded newspaper, paper bags and cardboard, free of tape and gloss ink or labels
- Tea bags (without the tea)
- Coffee filters, paper towels and napkins
- Sawdust
- Cotton fabric, dryer lint



“Green” Ingredients Contain Mostly Nitrogen

Usually organic material
that was recently alive

Green Materials: Outdoor Sources

- Grass clippings
- Fresh leaves, even oleander or eucalyptus
- Fresh leafy debris from pruning
- Damaged vegetables and fruits
- Spent vegetable and flower plants
- Young, not seedy, weeds



Green Materials: Indoor Sources

- Coffee grounds, tea
- Fruit, vegetable peelings, parings
- Use eggshells judiciously – we have much calcium in soil already
- Table scraps and leftovers
- Cooking liquids, old coffee or tea
- Plant-based food going bad



Mixing “Brown” and “Green”

Use about 5:1 **brown** to **green**

- Some “greens” have less nitrogen than others
- Your compost will be unique, based on what you add
- Look for clues and signs of success or inactivity and adjust

Mixing “Brown” and “Green”

C:N Ratios of Commonly Compostable Materials (From the US Environmental Protection Agency)

| | |
|-----------------|-----------|
| Chicken manure | 6-14:1 |
| Cow manure | 10-30:1 |
| Coffee grounds | 20:1 |
| Grass clippings | 17:1 |
| Alfalfa hay | 15-19:1 |
| Dry leaves | 40-80:1 |
| Newspaper | 400-850:1 |
| Sawdust | 442:1 |
| Vegetable waste | 11-19:1 |
| Fruit waste | 40:1 |
| Pine needles | 60-110:1 |

Do Not Add

- Meat, milk, oils and salt
- Feces of cats, dogs, pigs, people
- Cactus /spiny plants
- Bermuda grass runners
- Diseased plants
- Weeds gone to seed
- Anything toxic
- Fire ash (pH)



Meat, Oils and Milk

- Meat, oils and milk are composted by anaerobic bacteria (not aerobic, as with other materials)
- Won't decompose well if pile is maintained properly with air/turning
- Smell bad when decomposing, due to the anaerobic decomposition process
- Are more likely to attract flies, mice, rats and other animals
- If you want to do it, use a separate anaerobic composting process.

Importance of Oxygen and Water

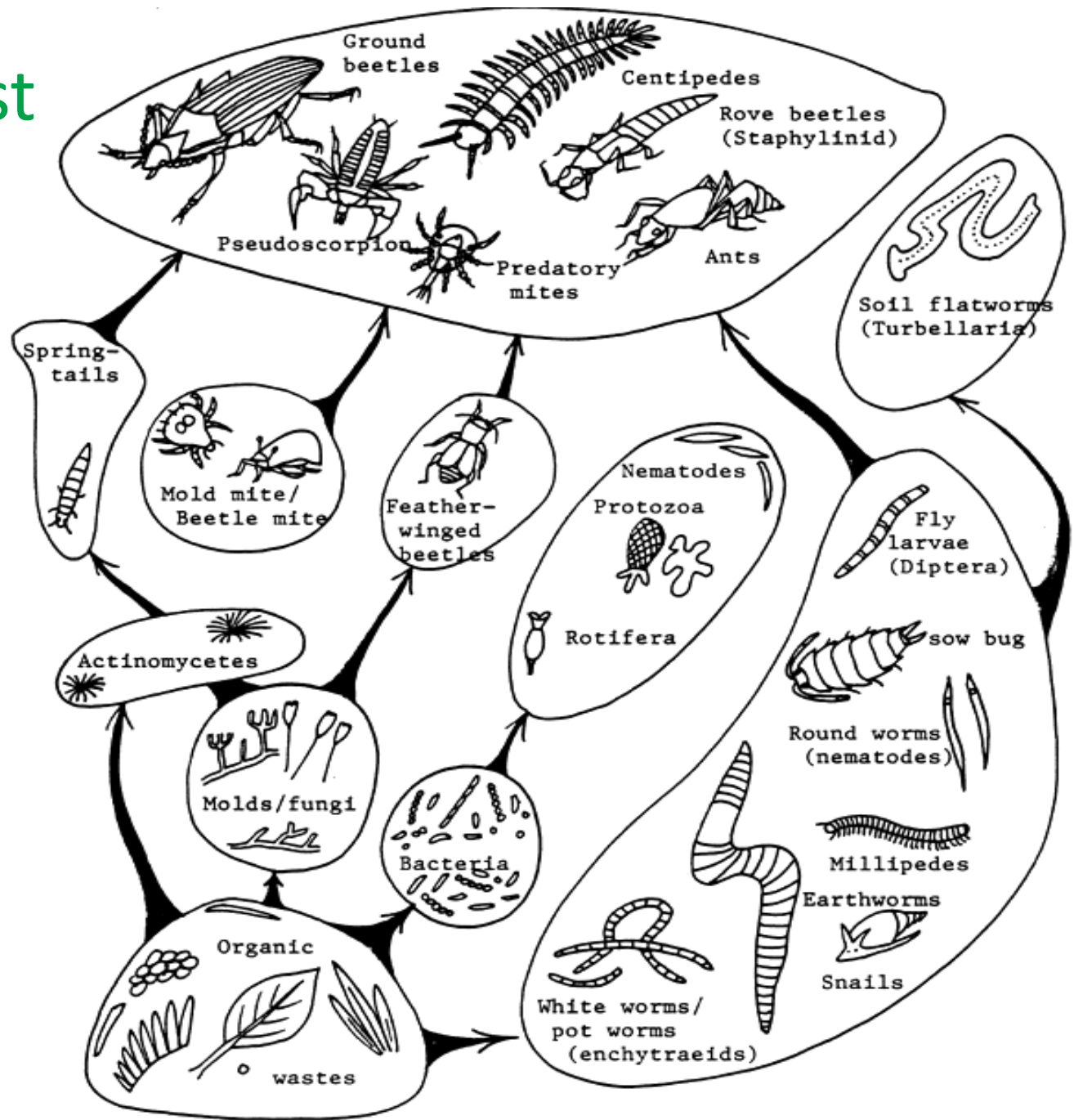
- Aerobic bacteria need oxygen and water to thrive.
- Tiny particles in compost help hold water
- Small twigs and branches help to add spaces for air
- Turning adds oxygen to the pile
- Keep damp; should be as wet as a wrung out sponge

Bacteria, Fungi and Insects

- Bacteria and fungi are present in the air and the soil... and find their way into compost
- Compost usually does not need an "activator," which is available for sale
- If the bin is open on the bottom, worms may find their way in
- Little helpers break down the organic materials to make nutrients available to plants

Healthy compost contains all types of life!

- Bacteria
- Microbes
- Molds
- Fungi
- Insects
- Worms



Steps to Successful Compost

Assess your Needs and Resources:

- How much space do you have?
- How much compost can you use?
- How quickly do you want your compost?
- How much can you spend?
- How nice do you need it to look?



'Hot' or 'Fast' Compost

- For best results, about 1 cubic yard mass assembled at one time
- Small pieces decompose faster
- Needs frequent turning and dampening
- Reaches internal temperatures above 140 F, which can kill some disease organisms and most weed seed.



Hot Compost

- Heat comes from the process of decomposition under the right conditions
- Decomposes quickly. If you want your compost sooner, use this method.
- Requires more work and attention to detail
- Work is done by insects and bacteria that prefer heat and produce heat.

'Cold' or 'Slow' Compost

- Less Work
- Turned infrequently
- Pieces are larger or less uniform
- Layers are added over extended period
- They can be allowed to dry out, then wetted
- “Chop and drop” with a cover crop is a slow composting method as it is green mulch that breaks down.



Slow Compost

- Will not damage weed seed
- Requires less labor
- Takes more water (if watered regularly)
- Takes months to decompose
- Work is done by insects and bacteria that prefer cooler temperatures



DIY Compost Bins

- Inexpensive
- Recycled or repurposed materials
- Design to fit your needs and space



Purchased Compost Bins

- Can be expensive
- Have useful features
- May look more attractive



\$420.00!



City of Mesa Composting Program

The City of Mesa has backyard compost containers available to Mesa residents for a \$5 non-refundable delivery fee. Once you have the container, you can keep it as long as you need it.

You must be on City of Mesa trash service (not Republic Services, or in County Islands)

To request delivery of a compost container to your home or for questions, contact Customer Service at 480-644-2221.



City of Tempe Composting Program

- Tempe is the first city in the Valley to process its own compost and return it to the community, saving money on disposal costs while conserving valuable landfill space.
- Several times per year, free compost is offered to all valley residents.
- Tempe residents: Free compost is available 24/7 just outside of Tempe's compost yard Please bring your own buckets and shovels.

City of Tempe Composting Program

The process: collect, grind, cook, test.

Tempe collects the green organic material from your curb or alley (and landscape companies) and brings it back to the compost yard where it is stockpiled.

Once there is 1400-1,500 tons of material, a grinder is brought in to break it down. This process usually takes around 2 days.



City of Tempe Composting Program

After grinding, the green waste is placed in giant piles where it cooks for 6 to 9 months.

Staff members monitor this process, watering and churning the material to stimulate decomposition and monitoring the temperature. The pile heats to over 150 degrees, which is optimal for safe and weed-free compost.

Once the material is composted, it is sent to a lab for testing. Technicians analyze the nutrient content and make sure it is free of pathogens, weeds and seeds.

Compost Pile Considerations

- Where do you want to put your compost container? (water, shade, convenience, appearance)
- How do you want to collect your kitchen waste?
- Will you want/need to join forces with your friends or neighbors or local businesses? (Starbucks offers free coffee grounds)



Building the Pile

1. Collect materials
2. Cut/shred/mash/chop (using food processor, paper shredder, coffee grinder, etc)
3. Soak
4. Combine, alternating materials, to about 1 yard square
5. Covering helps to keep out pests, pets, birds, and helps keep moisture in.

Maintaining the Pile

- Turn the pile weekly to mix well and add oxygen
- Add water to level of a wrung out sponge.
- If hot composting, check temperature close to center.
- When the pile is almost ready, start another container / new batch.
- Ideally, if you have space, multiple containers allows batches in different stages of the process



Is It Done Yet?

- 25-40% of original pile size
- Can't identify the original materials
- Dark and rich looking
- Smells earthy
- Crumbles in your fingers



Harvest The Compost

- Remove the compost from container
- Set aside anything that doesn't look done
- Sift to remove larger chunks
- Mix the compost into the soil, or use it to start seeds
- Start a new pile with the partially decomposed material



What Could Go Wrong?

My pile has bugs

- ✓ Great! They are part of the process

My pile is not **HOT**

- ✓ Needs nitrogen or “**GREEN**” stuff or water
- ✓ Turn more frequently
- ✓ Not enough mass



What Could Go Wrong?

My pile smells like ammonia

- ✓ Too much nitrogen
- ✓ Needs carbon--- “**BROWN**” material
- ✓ Not enough oxygen—turn it!

My pile has a putrid odor

- ✓ May be too wet
- ✓ Needs aeration (turning)
- ✓ Needs more “**BROWNS**”



Not Composting Fast Enough

- Turn it more frequently
- Turn inside out
- Irrigate if pile is too dry
- Add nitrogen source
- Add additional materials to achieve mass
- Check temperature



Rolling compost bin on caster base with compost tea bin

Untended Pile
Cold, Dry, Inactive



Three days later: Water
+ Cut Grass + Turning!



More Problems

My pile has no bugs

- ✓ Water it
- ✓ Stop watering it
- ✓ Turn it

I have flies

- ✓ Add a layer of **brown** after each layer of **green**
- ✓ Cover a newly turned pile with a thin layer of brown
- ✓ Bury fly attracting materials

Benefits of Compost in the Garden

- Incorporates organic matter to feed microorganisms and macroorganisms that maintain a healthy soil food web
- Enriches soil with nutrients for plant growth
- Releases nutrients slowly so they don't leach away as some synthetic fertilizers do
- Improves soil structure
- Promotes drainage and aeration in clay soil

Compost Tea

- Produced through steeping compost in water, like a bag of tea.
- Produces an organic-rich, high-nutrient liquid.
- Commercial products may be labeled as compost extract/leachate, organic tea, or manure tea. These are the same watery end-product of circulating water through compost

Compost Tea

- Compost tea applied to plants has been shown to suppress phytopathogens on a variety of edible crops, including tomatoes.
- Acts faster than compost, because the plants can take up the liquid immediately
- Can be applied to soil or sprayed on the plant as a foliar spray.

Making Compost Tea

- Steep finished compost in water for several hours or several days, stirring occasionally.
- Filter through a cheesecloth or other material
- There are more complex setups to speed the process or produce larger amounts.



However, For Food Safety...

- When compost teas are used on edible portions of crops, it is suggested that they be applied to the soil above plant roots, rather than directly to the foliage.
- Ensure that compost used for the tea has been hot-composted to over 140 F for 5+ days to kill pathogens
- If pathogens are present, bacterial food poisoning may occur. (E-coli, Salmonella)

Results with Compost Tea

Left: two weeks of water with no compost tea.
Right: water and compost tea added



Vermicompost

- Composting with worms (also called vermicomposting) is usually done with the common red wiggler worm.
- The worm's specialized digestive system converts food waste and other organic materials to a nutrient-rich compost called vermicast or worm castings.
- Worms can be purchased online, at worm farms, and (sometimes) at nurseries

Vermicompost

- Worms thrive in an aerobic (with air) environment. They are able to process large amounts of food waste and rapidly reproduce in a confined space.
- Vermicomposting is considered “cold” composting. There is no noticeable heat generated during decomposition
- No onions, garlic and citrus. These can be harmful to worms.

Keeping a Worm Bin

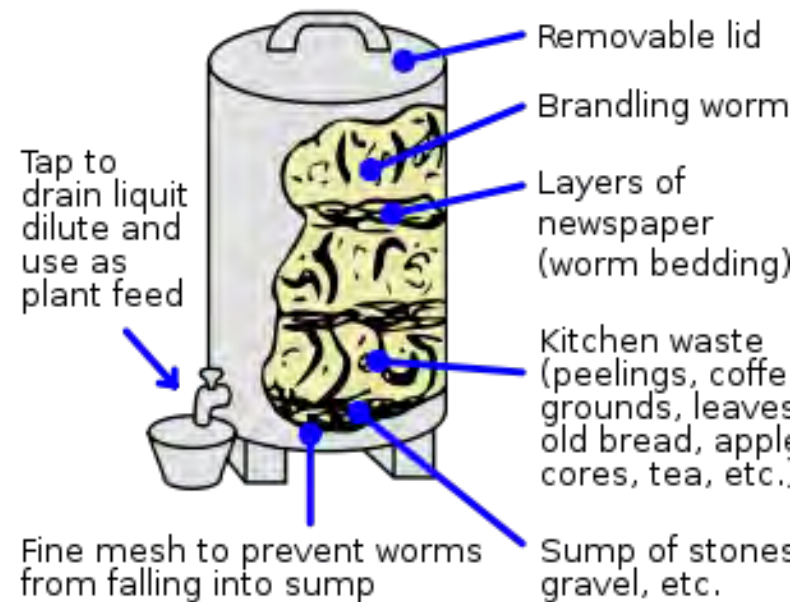
- You can keep a worm bin indoors. A well-tended worm bin is odorless. You can keep it in a pantry, utility room, or under the kitchen sink.
- You can keep a bin outdoors for part of the year. Worms thrive in temperatures between 55 and 77°F. So, if you keep your bin outside, you'll need to protect it from extreme temperatures (i.e. summer in AZ).

Vermicomposting - Materials

- Worm bin
- Worms (Red Wiggler is the best)
- Biodegradable bedding (e.g. newspaper)
- Some form of grit (crushed oyster shell, non-medicated chick starter, pulverized egg shells
 - Use an old coffee grinder, blender or spice grinder to pulverize
- Food Scraps

Vermicompost

- Vermicomposting ingredients are lower in the brown to green ratio than “hot” compost. More greens, less browns.
- 1 cubic foot of bin space and 1 pound of food waste for each pound of worms you maintain. (There are about 1,000 worms per pound.)



Cover Crops

Cover crops are plants grown to:

- Add nitrogen to the soil
- Suppress pest populations
- Mitigate soil erosion and hold rainwater
- Reduce nutrient leaching
- Build up and maintain soil organic matter (when used to become mulch or compost)

Cover Crops

- Cover crops can also be used as “chop and drop,” cut down and left in the garden to compost in place, OR...
- harvested and added to your compost as greens when fresh, or browns if dried out
- Legumes are excellent cover crops, as they fix nitrogen in the soil
- The seed can be harvested first, or the plant turned into the soil before it goes to seed.

Cover Crops

- Cowpea (black eyed pea), is one of the best, for edible beans and a terrific nitrogen fixer.
- Legumes benefit from inoculants to help them fix nitrogen.
- Any plant with heavy green growth can be used for chop and drop or for harvesting directly to the compost pile.
- Some suggestions... Spring: Cowpea; Summer: other beans; fall and winter: peas and fava beans.

References

- *UA Extension Publications <https://extension.arizona.edu/pubs>*
 - *AZ1632: Small Scale Composting in the Low Desert of Arizona*
 - *AZ1739: Compost Tea 101: What Every Organic Gardener Should Know*
- *Utah State Extension on Vermicomposting
https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1789&context=envs_facpub*
- *University of Nebraska-Lincoln Extension on Vermicomposting:
<https://lancaster.unl.edu/pest/resources/vermicompost107.shtml>*
- *For a copy of this presentation, email Laura at lajward@gmail.com*