

Soil Preparation and Garden Design & Layout

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Amending Vs. Fertilizing Soil

Difference between Amendments and Fertilizers

- Amendments influence plant growth indirectly by affecting the soil's physical condition (e.g., soil tilth, water infiltration).
- Fertilizers affect plant growth by improving the supply of available nutrients in the soil to the plant. Some fertilizers can be applied directly to the plant foliage (leaves).

Fertilizers

Essential Plant Nutrients

Primary Nutrients

- Nitrogen – N
- Phosphorous –P
- Potassium – K

Micronutrients

- Boron – B
- Chlorine- Cl
- Copper – Cu
- Iron – Fe
- Manganese – Mn
- Molybdenum – Mo
- Nickel – Ni
- Zinc - Zn

Secondary Nutrients

- Calcium - Ca
- Magnesium - Mg
- Sulfur - S

Types of Fertilizers

Complete fertilizers such as 16-16-16 (sometimes referred to as 'General Purpose Fertilizers') - contain the three primary nutrients:

- Nitrogen
- Phosphorous
- Potassium



The N P K ratio is the percentage of each of these ingredients per package

Incomplete fertilizers may contain a single nutrient such as ammonia nitrate (34-0-0) or ammonia sulphate (21-0-0).



Organic Fertilizers undergo little processing and include ingredients such as compost and manure.



Inorganic Fertilizers (previous slide) are synthetic and are petroleum based
Slow release fertilizers break down slowly in the soil. An example of a slow release fertilizer is Bone Meal.

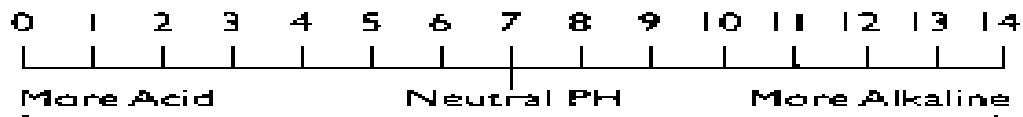


How to Fertilize

1. **Read and Follow the instructions on the package**
2. **Banding**
Apply narrow bands of fertilizer furrows 2 to 3 inches from the garden seeds and 1 to 2 inches deeper than the seeds or plants. Cover the band with soil.
3. **Side Dressing**
Scatter fertilizer on both sides of the row 6 to 8 inches from the plants. Rake it into the soil and water thoroughly.
4. **Broadcast**
Spread a recommended rate of fertilizer over the growing area and incorporated into the soil with a rototiller or spade.
5. **Foliar Feeding**
Mix fertilizer, or use ready to use liquid fertilizer, and thoroughly wet all plant surfaces.

Soil PH

- Most soils in Arizona are alkaline and have a pH of between 7 and 8.5.
- A near-neutral or slightly acidic soil is generally considered ideal for most plants.
- The major impact that pH extremes have on plant growth is the availability of plant nutrients and concentration of plant-toxic minerals.
- PH can be lowered by adding an acidifying agent such as elemental sulfur (flowers of sulfur) or aluminum sulfate.
- Caution, before attempting to lower PH, observe how your plants do without adding acidifying agents.
- Use caution when applying manures as a source of organic matter because they typically contain appreciable amounts of soluble salts and are usually somewhat high in pH as well.



Soil Solarization to Control Garden Pests and Nematodes

Some Diseases and harmful Nematodes Controlled by Soil Solarization

<u>Disease</u>	<u>Crop</u>
Verticillium wilt	Tomato, potato, eggplant, strawberry
Fusarium wilt	Tomato, melon, onion
Pink root rot	Onion
Southern stem rot (white mold)	Peanut
Rhizoctonia seedling disease (sore shin or damping off)	Potato, onion, bean
Crown Gall	Walnut
Phytophthora root rot	Ornamentals
Nematodes (lesion, root knot, reniform, cyst, sting, ring, stubby root and dagger)	Various crops

- The process uses natural heat and light to kill soil dwelling diseases.
- The solarization process will also kill most weeds, roots and seeds within the first few inches of the garden soil, up to a depth of several inches.
- Solarization means covering moist soil with clear transparent sheeting to create a hothouse effect.
- Solarization should ideally be done in the summer or whenever the temperature is high enough to make the process work effectively.
- The soil to be solarized must be worked up to seed-bed condition--that is, cultivated until it's loose and friable with no large clods or other debris on the soil surface. Remove as many weeds as possible. Smooth out and level the soil.
- Thoroughly water the soil. Let the soil drain so it is moist, not sopping wet.
- Cover the area with clear plastic.
- Eliminate air pockets in the plastic.
- To anchor the tarp, bury the edges with soil to ensure a snug fit. Use rocks, bricks or boulders to anchor the plastic if necessary.
- In summer temperatures use a heavier grade clear plastic. Black plastic does not work for solarization.
- The temperature in the covered soil should not be less than that of the air. Temps in the covered soil may exceed 140 degrees Fahrenheit. Soil temp can be tested with a soil or compost thermometer.
- Keep the plastic in place a minimum of four to six weeks.
- After that time remove the plastic and continue with your gardening. You might add compost to replace beneficial organisms. Do not add unsolarized soil from the area of the Solarized bed. Enjoy.

Beneficial Nematodes

What are Beneficial Nematodes?

- They are microscopic organisms that help control garden pests such as cutworms, borers, corn earworms, grubs, and other soil dwelling pests.

How do Beneficial Nematodes work?

- Beneficial Nematodes enter soil dwelling pests through body openings. Once inside, the nematode releases a toxic bacterium which kills the host larva within 24 - 48 hours.

How to Apply Beneficial Nematodes to your Garden Soil

- Follow the package instructions.
 - *Mix the nematodes with water.*
 - *First, Moisten your Garden Soil.*
 - *Either water the nematodes into the moistened soil with a hand watering can or tank sprayer- Then remoisten the soil again.*
 - *Nematodes will not harm Earthworms.*

Plan your Garden Layout

Preparing the Garden Area

RAISED BED GARDENS

- Choose a Location that is fairly level.
- Loosen the Ground level soil. Remove rocks and as many clumps as possible.
- In Arizona Soils it is often necessary to amend the soil to approximately 16 to 18 inches above ground level for proper root development.
- Most raised beds are constructed by building large boxes to hold the garden soil so that it is higher than the surrounding ground; but, it is also possible – and sometimes practical – to simply mound up the soil into raised beds without any additional support at all.
- Level out the soil in the raised bed with a steel garden rake.
- Let the soil settle.

The Process of Preparing the Garden Area

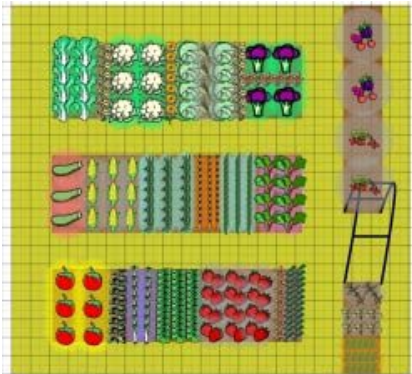
- The raised bed or growing bed is the basic unit of an intensive garden. A system of beds allows the gardener to concentrate soil preparation in small areas, resulting in effective use of soil amendments and creating an ideal environment for vegetable growth.
- Raised beds warm-up more quickly in the spring.
- Soil preparation is the key to successful intensive gardening. To grow so close together, plants must have adequate nutrients and water.
- If your soil is not deep, double-dig the beds for best results.
- Remove the top 12 inches of soil from the bed.
- Insert a spade or spading fork into the next 10 to 12 inches of soil and wiggle the handle back and forth to break up compacted layers. Do this every 6 to 8 inches in the bed.
- Mix the top soil with a generous amount of compost or manure, and return the mixture to the bed. It should be somewhat fluffy and may be raised slightly.
- To create a true raised bed, take topsoil from the neighboring pathways and mix it in as well.

Garden Row Spacing

Raised Bed Garden Row Spacing

- Individual plants are closely spaced in a raised bed or interplanted garden.
- An equidistant spacing pattern calls for plants to be the same distance from each other within the bed; that is, plant so that the center of one plant is the same distance from plants on all sides of it.

- In beds of more than two rows, this means that the rows should be staggered so that plants in every other row are between the plants in adjacent rows.



Recommendations for Row and Plant Spacing in a more traditional Home Garden

Vegetable	Seed or Plants for each 10 ft of Row	Inches between Plants	Inches between Rows
Asparagus	7 crowns	18–24	36–48
Beans, bush	1½ oz.	2–3	24
Beans, lima	1½ oz.	4–6	24
Beans, Pole	1 oz.	4-6	24
Beets	½ packet	2-3	12-18
Broccoli	5-7 plants	18-24	20-28
Cabbage	7-10 plants	18-24	20-28
Carrots	½ packet	2-3	12-18
Cauliflower	5-10 plants	18-24	24-30
Celery	20 plants	6	20-24
Corn, sweet	1 packet	8-12	30-36
Cucumbers	½ packet	15-18	48-60
Eggplant	6-8 plants	18	24-30
Endive	1 packet	6	12
Kale	1 packet	4	12-18
Kohlrabi	½ packet	4-6	15-24
Lettuce (leaf)	1 packet	2-3	12
Muskmelon	1 packet	18-24	48-60
Mustard	1 packet	4	12-18
Okra	¼ oz.	18-24	24-36
Onion seed	1 packet	2-3	12-15
Onion Sets	60 sets	2-3	12-15
Parsley	1 packet	4	12-18
Parsnips	1 packet	3	18-24
Peas	1 ½ oz.	2-3	6-12
Peppers	5-7 plants	18-24	24-30
Potatoes (Irish)	10 pieces	12	24-36
Pumpkins (winter squash)	1-2 hills	4	60-72
Radishes	1 packet	1-2	6-12
Rhubarb	3 crowns	36-72	36-60
Spinach	1 packet	3	12-18
Squash (summer)	½ packet	4	24-30
Swiss chard	8 plants	6-8	15-18
Tomatoes	2-5 plants	24-36	24-48
Turnips	½ packet	2-3	18-24
Watermelons	½ packet	18-24	60-84

- The distance recommended for plants within the row on a seed packet is the distance from the center of one plant to the center of the next. This results in an efficient use of space and leaves less area to weed and mulch.
- The close spacing tends to create a nearly solid leaf canopy, acting as a living mulch, decreasing water loss, and keeping weed problems down.
- However, plants should not be crowded to the point at which disease problems arise or competition causes stunting.

Cover Crops

- Cover Crops:
 - Add organic matter and nutrients to the soil.
 - Help Protect from wind damage.
- When – Fall is the Best time to plant a cool season cover crop.
- Cover Crop plants can be a single species or a variety of species.
- Legume Cover Crops can add 300 lb per acre of nitrogen.

Mulch, Mulch, Mulch

- Mulching can be an alternative to weeding if you have a reliable source of mulching materials.
- Thick layers of organic mulch will not allow most annual weeds to poke through, and those that do are usually easily pulled.
- Mulch can also be used to modify soil temperatures. Inorganic mulches (plastic sheeting, weed mats, etc.) warm up the soil, while organic mulches (sawdust, compost, straw, newspaper, grass clippings, etc.) cool the soil.
- After your soil has settled, you should mulch the top layer. Mulching can be used to control weeds, and also conserves soil moisture.
- Mulch at least 2 to 4 inches above the ground. Straw, lawn clippings, dried bark, weathered sawdust or other materials can be used.
- Sawdust is not recommended for use right around plants because of its tendency to crust.
- These materials can be turned into the soil periodically to improve the condition of the soil.
- Some gardeners prefer not to use weed cloth, or weed block underneath the mulch because some have observed that plants are not as healthy with it as without.

Water Crystals - Myths of Reducing water usage

Water Crystals or Polyacrylamide Hydrogels are sometimes used by the home gardener as a means of reducing water usage in the home garden.

Myths

- These hydrogels, sometimes referred to as root watering crystals or water retention granules, swell like sponges to several times their original size when hydrated. Water is then released slowly to the surrounding soil, reducing the need for irrigation.

Reality

- When hydrogels break down, they release potassium acrylate and acrylamide. Acrylamide is a lethal neurotoxin and has been found to cause cancer in laboratory animals. It readily passes through the skin and can be inhaled as dust.
- Neither PAM, acrylamide, nor any other degradation product appears to be taken up by plant roots.
- Hydrogels are organic compounds that will degrade after 2-5 years; they are not a long-lasting solution to droughty conditions.

To Till or Not to Till

Whether to till your garden soil or not till is an individual decision, but before you begin, consider this.

Some issues with tilling:

- The more soil that gets turned upside down, the larger the number of dormant weed seeds that rise to the surface where they germinate and grow.
- Deep tilling can spread pathogens and pests.
- Roto-tiller engines are notorious air and noise polluters.
- Tilling can destroy soil structure.

Worms

Beneficial effects of Earthworms

Earthworms and soil productivity: Numerous investigators have pointed out the beneficial effects of earthworms. Some of these are as follows:

- They aid in the degradation of organic residues in the soil with the release of elements such as carbon, nitrogen, sulfur, and other nutrients.
- The action of the digestive fluids and increased microbial activity in the casts (droppings) tends to solubilize inorganic plant nutrient elements present in inorganic soil minerals.
- The structural stability of ingested soil is improved through increased microbial activity while the soil is within the worm and after it has been deposited as casts.
- The extensive burrowing of the earthworm improves soil aeration and may increase water penetration into soils.
- Under natural conditions the earthworm will feed on surface organic litter and deposit its casts in the plant root zone. After further microbial decomposition of the partially digested residues, plant nutrient elements are released.