



Fall Gardening

I. When to Start a Fall Garden in Tucson.

a. Late summer/early fall.

- i. Late August through mid-September is the start of the fall planting season. With protection, a few cool season plants can be planted at this time.
- ii. The best crops to plant during this period are those that are heat tolerant or those that require a long growing season



b. Optimum fall planting period.

- i. The period from late September through the first few weeks of November is the best time to plant cool season vegetables, all cool season vegetables can be planted during this period.
- ii. The average date of first frost for Tucson is November 15th.
- iii. Lettuce, Garlic, Peas and Spinach do best when planted in October

c. Late fall/early winter.

- i. After the winter break, the last chance to plant cool season crops is the period between New Years and mid-February.
- ii. Fast maturing crops, can be planted before the weather warms. Choose slow bolting varieties and harvest immature plants before they go to flower.

II. What to plant in your fall garden.

a. Leafy Greens

- i. Arugula, broccoli, Brussels sprouts, cabbage, cauliflower, collard greens, dandelion, kale, kohlrabi, lettuce, mizuna, mustard greens, spinach, and Swiss chard.
- ii. Asian greens such as bok choy, Chinese cabbage, and komatsuna.
- iii. Light frost improves the flavor of many greens

- iv. When choosing lettuce, avoid tight heading types such as “ice berg”, instead choose Romaine or leaf varieties. Bibb varieties also do well.

b. Root crops

- i. Beet, carrots, garlic, leek, onions, radish and turnips.
- ii. Use thinnings in salads.
- iii. Root crops are most tender when young, harvest before they reach a diameter of 3”.
- iv. Garlic takes six months to mature, so plan accordingly.



c. Cool season annual herbs

- i. Chives, cilantro, dill, fennel, parsley.
- ii. Plants in the carrot family are the best for attracting beneficial insects, plant these herbs in the center of your garden and let them go to flower for the best control.
- iii. *although not a root, green, or herb, **fava beans** and **Wheat** can also be planted now.

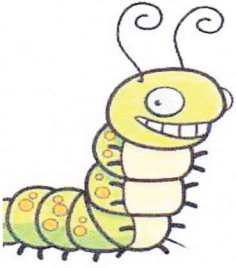
III. Protecting your fall garden.

a. Weather –If frost is in the forecast, you can take precautions to limit the damage.

- i. Light frost = 32°-28° - Plants that can withstand a light frost include arugula, beets, bok choy, carrots, lettuce, peas, and Swiss chard.
- ii. Peas and leaf lettuce show the least tolerance for frost.
- iii. Hard Frost = 28°or lower. Plants that can withstand a hard frost include Broccoli, Brussels sprouts, Cabbage, Collards, Kale, Mustard, Onions, Spinach, and Turnip.
- iv. Mulch heavily to keep roots warm on cold nights.
- v. Water garden heavily the day before an expected frost, water acts as an insulator, keeping the root zone warmer than the surrounding air temperature. Misting also works to create an “igloo” effect.
- vi. Frost cloth is a thick transparent fabric that works like a blanket, trapping warm air near the growing plants. It is most effective when allowed to cover the entire plant to ground level. In a pinch, sheets can also be used, but they must be removed promptly the next morning. Never use plastic, as it can actually exacerbate a frost.

- vii. Christmas lights, especially older types with large bulbs, draped throughout the garden are great at generating heat, combine with other methods for added effect.

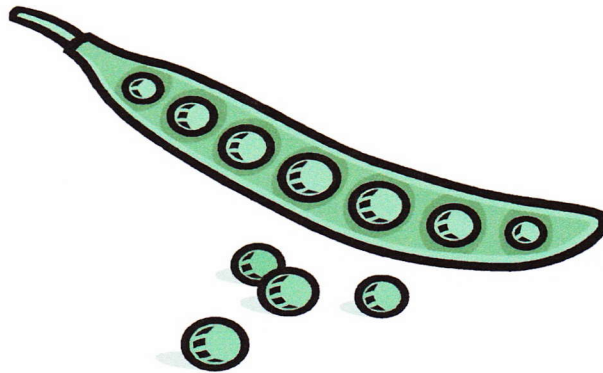
b. Insects



- i. Cabbage Looper – Very common during the early fall and winter months. Use a BT product once a week once damage appears.
- ii. Cabbage Aphid – Usually appears in early fall and then again in spring. Stressed plants are most affected. Use insecticidal soap and a jet of water for control.

c. Birds

- i. Pea and bean sprouts are a bird delicacy. Use row covers, or cloches to protect young sprouts. Once plants reach about 5", the birds do not bother them





**Tucson
Organic
Gardeners**

soiling our hands since 1971

TUCSON ORGANIC GARDENERS PLANTING GUIDE

FOR TUCSON AND THE LOW DESERT

Jan 1 – Feb 15

FROM SEED

Arugula, Broccoli, Cabbage, Chinese Cabbage, Cauliflower, Celery, Cilantro, Collards, Dill, Fennel, Kale, Lettuce, Mustard, Parsley, Bulb Onion (See Graphic), Potato

FROM SEEDLING TRANSPLANT

Artichoke, Broccoli, Cabbage, Chinese Cabbage, Cauliflower, Celery, Cilantro, Collards, Dill, Fennel, Kale, Lettuce, Mustard, Parsley, Spinach, Swiss Chard.

April 15 – May 31

FROM SEED

Amaranth, Basil, Cantaloupe, Cowpea, Cucumber, Malabar Spinach, Melon, Okra, Sorghum, Sweet Potato Slips, Summer Squash, Watermelon

FROM SEEDLING TRANSPLANT

Basil, Eggplant, Pepper

July 15 – August 31

FROM SEED

Bush Beans, Pole Beans, Corn (all types), Cowpea, Cucumber, Cantaloupe, I'tois Onion (See Graphic), Pumpkin, Sorghum, Summer and Winter Squash

FROM SEEDLING TRANSPLANT

Tomato (July 15 - Aug 15)

Oct 15 - Nov 15

FROM SEED

Beets, Carrots, Garlic, Greens, Lettuce, Mustard, Pea, Radish, Turnip, Wheat (December – January)

FROM SEEDLING TRANSPLANT

Broccoli, Cabbage, Chinese Cabbage, Cauliflower, Celery, Cilantro, Collards, Dill, Fennel, Kale, Lettuce, Mustard Parsley, Spinach, Swiss Chard



March 1 – April 15

FROM SEED

Amaranth, Basil, Bush Bean, Corn (Sweet), Cucumber, Jerusalem Artichoke, Malabar Spinach, Melon, Pumpkin, Sesame, Sorghum, Summer and Winter Squash, Tobacco, Watermelon

FROM SEEDLING TRANSPLANT

Basil, Eggplant, Pepper, Tomato, Tomatillo

June 1 – June 15

FROM SEED

Pole Beans, Cantaloupe, Cowpea, Melon, Sweet Potato Slips

Sep 1 – Oct 15

FROM SEED

Arugula, Beet, Bok Choy, Broccoli, Brussels Sprouts, Cabbage, Carrot, Cauliflower, Celery, Chia, Chicory, Chinese Cabbage, Cilantro, Collards, Escarole, Fava, Garbanzo, Greens, Kale, Kohlrabi, Leek, Lentils, Lettuce, Mache, Mustard, Onion (See Graphic), Parsley, Parsnip, Pea, Radish, Rape, Rutabaga, Turnip, Spinach, Swiss Chard

FROM SEEDLING TRANSPLANT

Broccoli, Brussels Sprouts, Cabbage, Chinese Cabbage, Cauliflower, Celery, Cilantro, Dill, Fennel, Kale, Lettuce, Mustard, Parsley, Spinach, Swiss Chard

ONIONS



"SHORT-DAY" BULB ONION SETS

January 1 – February 15

TOHONO O'ODHAM I'TOIS MULTIPLIER ONION

July 15 – February 1

GREEN BUNCHING/SCALLION

August 15 – February 1



Table II. Germination data for home garden vegetable seed.

| Crop | Minimum Percent Germination ^{abc} | Germination Temperature ^{bc} | | | | | | Days to Germinate Under Optimum Temperature and Moisture Conditions ^{bcd} |
|---------------------|--------------------------------------------------|---------------------------------------|----|---------|----|---------|----|------------------------------------------------------------------------------------------|
| | | Minimum | | Optimum | | Maximum | | |
| | | °F | °C | °F | °C | °F | °C | |
| Asparagus | 60 | 50 | 10 | 75 | 24 | 95 | 35 | 10 |
| Bean, Lima | 70 | 60 | 16 | 85 | 30 | 85 | 30 | 7 |
| Bean, Snap | 70 | 60 | 16 | 80 | 27 | 95 | 35 | 6 |
| Beets | 65 | 40 | 4 | 85 | 30 | 95 | 35 | 5 |
| Broccoli | 75 | 40 | 4 | 85 | 30 | 95 | 35 | 5 |
| Brussels Sprouts | 70 | | | 80 | 27 | | | 5 |
| Cabbage | 75 | 40 | 4 | 85 | 30 | 95 | 35 | 4 |
| Carrot | 55 | 40 | 4 | 80 | 27 | 95 | 35 | 5 |
| Cauliflower | 75 | 40 | 4 | 80 | 27 | 95 | 35 | 5 |
| Celeriac | 55 | | | 70 | 21 | | | 11 |
| Celery | 55 | 40 | 4 | 70 | 21 | 85 | 30 | 7 |
| Chicory | 65 | | | 80 | 27 | | | 6 |
| Chinese Cabbage | 75 | | | 80 | 27 | | | 4 |
| Cucumber | 80 | 60 | 16 | 95 | 35 | 105 | 41 | 2-5 |
| Eggplant | 60 | 60 | 16 | 85 | 30 | 95 | 35 | 6-8 |
| Endive | 70 | 32 | 0 | 75 | 24 | 75 | 24 | 6 |
| Kale | 75 | | | 80 | 27 | | | 4 |
| Kohlrabi | 75 | | | 80 | 27 | | | 4 |
| Leek | 60 | | | 70 | 21 | | | 7 |
| Lettuce | 80 | 35 | 2 | 75 | 24 | 75 | 24 | 2-3 |
| Muskmelon | 75 | 65 | 18 | 95 | 35 | 105 | 41 | 3-4 |
| New Zealand Spinach | 40 | | | 70 | 21 | | | 6 |
| Okra | 50 | 60 | 16 | 95 | 35 | 105 | 41 | 6 |
| Onion | 70 | 32 | 0 | 80 | 27 | 95 | 35 | 4-5 |
| Parsley | 60 | 40 | 4 | 75 | 24 | 90 | 32 | 13 |
| Parsnip | 60 | 35 | 2 | 65 | 18 | 85 | 30 | 14 |
| Pea | 80 | 40 | 4 | 75 | 24 | 85 | 30 | 6 |
| Pepper | 55 | 60 | 16 | 85 | 30 | 95 | 35 | 8 |
| Pumpkin | 75 | 65 | 18 | 90 | 32 | 105 | 41 | 4 |
| Radish | 75 | 40 | 4 | 80 | 27 | 95 | 35 | 4 |
| Rutabaga | 75 | | | 80 | 27 | | | 4 |
| Salsify | 75 | | | 70 | 21 | | | 6 |
| Spinach | 60 | 32 | 0 | 70 | 21 | 75 | 24 | 5 |
| Squash | 75 | 65 | 18 | 95 | 35 | 105 | 41 | 4 |
| Sweet Corn | 75 | 50 | 10 | 85 | 30 | 105 | 41 | 3 |
| Swiss Chard | 65 | 40 | 4 | 85 | 30 | 95 | 35 | 4 |
| Tomato | 75 | 50 | 10 | 80 | 27 | 95 | 35 | 6 |
| Turnip | 80 | 40 | 4 | 80 | 27 | 105 | 41 | 3 |
| Watermelon | | | | | | | | |
| Seeded | 70 | 70 | 21 | 95 | 35 | 105 | 41 | 4-5 |
| Seedless | | 85 | 30 | 95 | 35 | 105 | 41 | 5-6 |

Minimum percent germination to federal standards.

^aHandbook for Vegetable Growers. 1988. Knott, J.E. John Wiley & Sons, Inc.

^bVegetable Growing Handbook. 1979. Splittstoesser, W.E. AVI Publishing, Inc.

^cSeeds, The Yearbook of Agriculture. 1961. Stefferud, A., Editor. The United States Government Printing Office

Table I. Seed weight and longevity for home garden vegetables.

| <i>Crop</i> | <i>Seeds per Ounce^a</i> | <i>Seeds per Gram^a</i> | <i>Relative Longevity under Cool, Dry Condition (Years)^{ab}</i> |
|---------------------|------------------------------------|-----------------------------------|--------------------------------------------------------------------------|
| Asparagus | 1,200 | 40 | 3 |
| Bean, Lima | 25-75 | 1-3 | 3 |
| Bean, Snap | 100-125 | 4 | 3 |
| Beets | 1,600 | 55 | 4 |
| Broccoli | 9,000 | 320 | 3 |
| Brussels Sprouts | 8,500 | 320 | 4 |
| Cabbage | 8,500 | 320 | 4 |
| Carrot | 23,000 | 820 | 3 |
| Cauliflower | 9,000 | 320 | 4 |
| Celeriac | 70,000 | 2,500 | 3 |
| Celery | 70,000 | 2,500 | 3 |
| Chicory | 26,000 | 900 | 4 |
| Chinese Cabbage | 18,000 | 650 | 3 |
| Cucumber | 1,100 | 40 | 5 |
| Eggplant | 6,000 | 200 | 4 |
| Endive | 26,000 | 900 | 5 |
| Kale | 9,000 | 320 | 4 |
| Kohlrabi | 9,000 | 320 | 3 |
| Leek | 11,000 | 400 | 6 |
| Lettuce | 25,000 | 900 | 5 |
| Muskmelon | 1,300 | 45 | 5 |
| New Zealand Spinach | 350 | 12 | 3 |
| Okra | 500 | 20 | 2 |
| Onion | 8,500 | 300 | 1 |
| Parsley | 18,500 | 660 | 1 |
| Parsnip | 12,000 | 430 | 1 |
| Pea | 90-175 | 3-6 | 3 |
| Pepper | 4,500 | 160 | 2 |
| Pumpkin | 100-300 | 4-11 | 4 |
| Radish | 2,500 | 90 | 5 |
| Rutabaga | 12,000 | 430 | 4 |
| Salsify | 1,900 | 70 | 1 |
| Spinach | 2,800 | 100 | 3 |
| Squash | 120-400 | 4-11 | 4 |
| Sweet Corn | 120-180 | 4-6 | 2 |
| Swiss Chard | 1,600 | 57 | 4 |
| Tomato | 700-1,200 | 250-430 | 3 |
| Turnip | 1,500 | 500 | 4 |
| Watermelon | 300-600 | 10-20 | 4 |

^aHandbook for Vegetable Growers. 1988. Knott, Joe. John Wiley & Sons, Inc.

^bVegetable Growing Handbook. 1979. Splittstoesser, W.E. AVI Publishing, Inc.



Cool season Vegetable and Herb Varieties for Tucson

- **Artichoke** – Imperial Star Globe.
- **Bean** – Fava – Broad Windsor.
- **Beet** – Detroit Dark Red, Early Wonder Tall Top, Chioggia.
- **Broccoli** – Arcadia, Waltham 29, Sprouting varieties.
- **Brussels Sprouts** – Jade Cross, Long Island Improved.
- **Cabbage** – Copenhagen Market, Early Jersey, Red Acre, Golden Acre.
- **Carrot*** – Red Cored Chantenay, Danvers Half Long, Scarlet Nantes.
- **Cauliflower** – Snowball Early.
- **Cilantro*** – Slow Bolting Types
- **Collard Greens** – Georgia Southern.
- **Dill*** – Bouquet, Fern.
- **Garlic** – Softneck varieties.
- **Kale** – Blue Dwarf, Dwarf Siberian, Lancinato, Red Russian, Red Winter.
- **Kholrabi** – Purple or White Vienna.
- **Leek** – American Flag.
- **Lettuce** – Romaine and leaf lettuces do best. Black-Seeded Simpson, Buttercrunch, Cimarron, Nevada, Jericho, Parris Island Cos.
- **Mustard Green** – Southern Giant Curled.
- **Onion** – Bulbing – Southern Belle Red, Texas 1015Y, Texas Early White.
Bunching – Evergreen Hardy, Ishikura

Multiplying – Tohono O'odham I'toi.
- **Parsley*** – Italian Flat Leaf.
- **Pea** – Dwarf Grey Sugar, Oregon Giant Sugar Pod II, San Luis, Wando.
- **Radish*** – Cherry Belle, Champion, Daikon, French Breakfast, Icicle.
- **Spinach** – Bloomsdale Long Standing, Viroflay
- **Swiss Chard** – Rainbow, Ruby Red.
- **Turnip** – Purple Top White Globe, Seven Top

*Let some of these plants go to flower to attract beneficial insects.



Vegetable Crops for Beginning Seed Savers

| Crop | Plant Type | Number of Plants | Plant Spacing | Isolation Distance |
|---------|------------|---------------------|---------------|--------------------|
| Bean | Annual | 6 or more | 6" | N/A |
| Lettuce | Annual | N/A | 12" | 20ft. |
| Pea | Annual | N/A | 6" | 50ft. |
| Pepper | Perennial | As many as possible | 18" | 50ft. |
| Tomato | Perennial | As many as possible | 18-24" | 10-100ft. |

Vegetable Crops for Intermediate Seed Savers

| Crop | Plant Type | Number of Plants | Plant Spacing | Isolation Distance |
|----------------|------------|-----------------------|---------------|--------------------------|
| Corn | Annual | 200 | 12" | 1000ft. – 1 Mile |
| Cucumber | Annual | 6 cukes from 6 plants | 12" | ½ Mile or Hand Pollinate |
| Muskmelon | Annual | N/A | N/A | ½ Mile or Hand Pollinate |
| Okra | Annual | 12+ | 18" | 1 Mile or Bag |
| Radish | Annual | As many as possible | 6-9" | 1 mile or alt. day cage |
| Spinach | Annual | 1:2 Male/Female Ratio | 6-12" | 2-10 miles |
| Squash/Pumpkin | Annual | N/A | N/A | ½ Mile |

Vegetable Crops for Advanced Seed Savers

| Crop | Plant Type | Number of Plants | Plant Spacing | Isolation Distance |
|------------------------|------------|------------------|---------------|---------------------|
| Beets/Swiss Chard | Biennial | At least 6 | 18" | ½ - 5 Miles or Cage |
| Brassica oleracea* | Biennial | At least 6 | 24" | 1 Mile or Cage |
| Carrots | Biennial | 10 or more | 24-30" | 2 Miles or Cage |
| Chicories/Witloof | Perennial | N/A | 8-12" | ½ Mile |
| Escarole/Endive | Annual | N/A | 12" | ½ Mile |
| Onion | Biennial | At least 2 | 3-4" | ½ Mile |
| Turnip/Chinese Cabbage | Biennial | 6+ | 24" | 1 Mile or Cage |

*Broccoli, Brussels sprouts, cabbage, cauliflower, collards, kale, and kohlrabi.



Companion Planting



Companion Planting: Planting multiple crops in close proximity so that they may benefit the growth of one another. Companion planting is a form of *Polyculture*, which is a central principle of organic gardening.

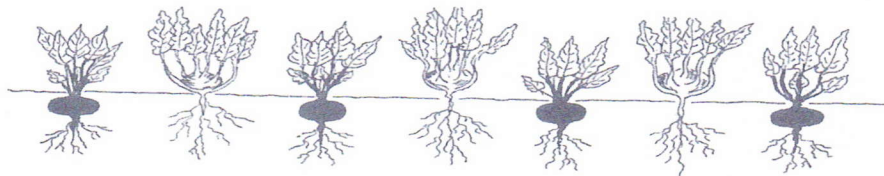
- **How can we use plant companions in our garden?**
 - **Fertilizers** – Plants in the legume family have the ability to take nitrogen from the atmosphere and fix it into the soil into a form that is useable by plants.
 - Warm season legume crops – Bush bean, pole bean, tepary bean, cowpeas, peanuts
 - Cool season legume crops – Peas, fava beans, vetches
 - **Repelling Pest Insects** – Plants with strong aromas are great at repelling garden pests. Annual and perennial herbs as well as plants in the onion (*Allium*) family work great. Plant herbs in pots and place all around the home and garden. Some of the best are:
 - Herbs – Basil, Catmint, Citronella, Lavender, Lemongrass, Rosemary, Rue (great for repelling cats), Sage, Thyme, Wormwood (*Artemisia*.)
 - Alliums – Chives, Garlic, Leeks, Onions, Shallots. Scatter plantings throughout garden or along edges of beds.
 - **Attracting Beneficial Insects** – Many annual, perennial and biennial vegetables and herbs also excell at attracting beneficial insects such as bees, lady bugs, lace wings, and predatory wasps.
 - Plants in the carrot family (*Apiaceae*) are the best. If possible, have a small section of your garden dedicated to these plants all year round. Use a bug mix such as “good bug blend” or make your own.
 - Carrots, Cilantro, Dill, Fennel, Parsley, Radish all do well. Keep fennel separate in small spaces as it is known to inhibit the growth of other plants.Not necessary in dedicated beneficial insect gardens. It is



important to have flowering plants at all time of the year.

- **More Companion Planting Principles**

- **Trap Cropping** – Using certain plants that are more attractive to pest insects to lure them away is a great example of companion planting. Trap crops should be planted away from the garden and pulled from the ground and destroyed once they are infested. Either burn the plant or freeze it and dispose of it in a plastic trash bag.
- **Nurse Cropping** – In home gardening, nurse cropping is when we use the physical properties of plants to aid in the growth of other crops.
 - Planting tall growing plants, such as corn, sunflowers, or trellised vining crops on the South and West sides of the garden to create shade for other plants.
 - Planting heavily with a cover crop such as alfalfa, or buckwheat to suppress weeds.
 - Using tall growing plants such as corn, okra, and sorghum to support vining plants such as cowpeas and pole beans
 - Using sprawling vining plants like squash to shade the soil
 - Planting intensively to suppress weeds or to create a micro climate.
- **Diversity For Pest Suppression** – Simply planting two different varieties of the same crop has been shown to reduce pest insect populations. Avoid Monocultures whenever possible and instead use “Intercropping” techniques.
- **Spacing Requirements** – Certain plants make good companions because of the way that they grow. The roots of beets and kohlrabi, for example, occupy different areas of the soil and therefore do not compete for space and nutrients.



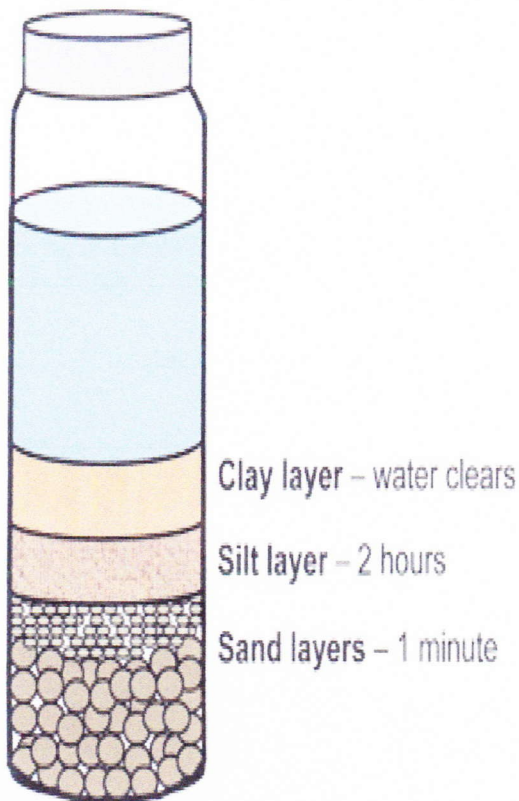
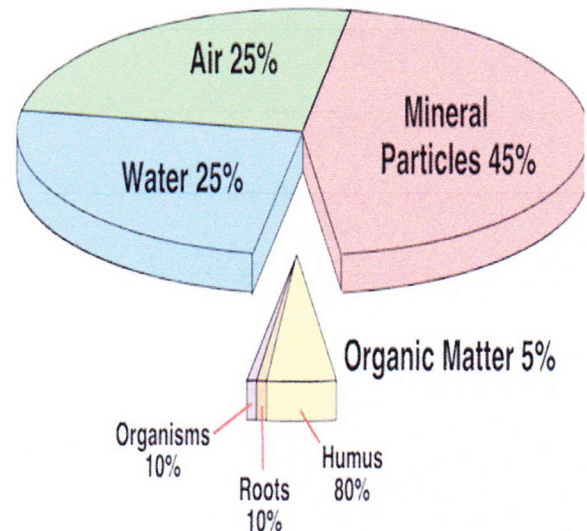


Soil Fertility and Plant Nutrition



USDA-SARE – Qualities of a Healthy Soil:

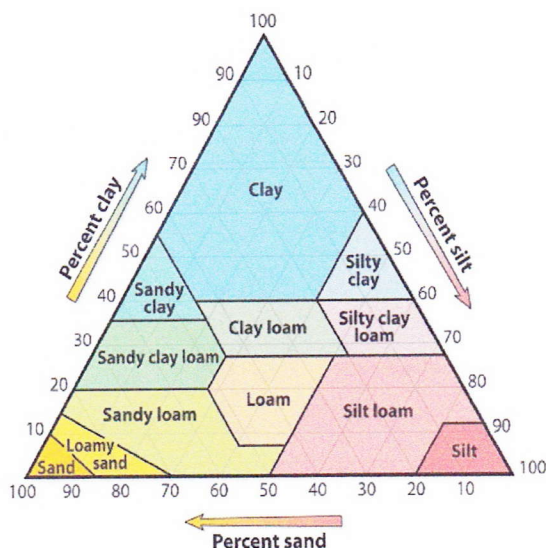
1. Accommodates active and diverse populations of beneficial organisms, with plant pest populations minimized by beneficials.
2. Contains high levels of relatively fresh residues that provide beneficials with food.
3. Includes high levels of decomposed organic matter, which help it retain both water and readily leachable nutrients.
4. Contains low levels of such toxic compounds as soluble aluminum and only low to moderate concentrations of salt.
5. Supports adequate levels of nutrients because excessive nutrients can make the crop more attractive to insect pests or can increase the threat of surface or subsurface water pollution.
6. Has a sufficiently porous surface, with many pores connected to subsoil to permit easy entry by rainfall or irrigation water.
7. Has good tilth that allows plant roots to easily penetrate large volumes of soil.



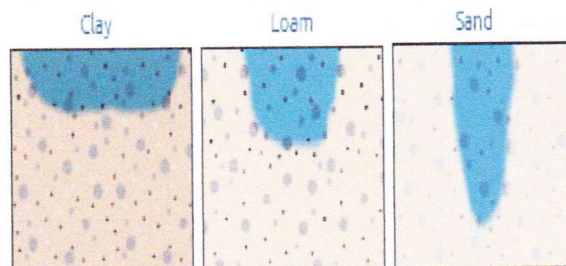
Estimating Soil Texture Using the Jar Test:

1. Spread soil on a newspaper to dry. Remove all rocks, trash, roots, etc. Crush lumps and clods.
2. Finely pulverize the soil.
3. Fill a tall, slender jar (like a quart canning jar) one-quarter full of soil.
4. Add water until the jar is three-quarters full.
5. Add a teaspoon of non-foaming dishwasher detergent.
6. Put on a tight fitting lid and shake hard for 10 to 15 minutes. This shaking breaks apart the soil aggregates and separates the soil into individual mineral particles.
7. Set the jar where it will not be disturbed for 2-3 days.
8. Soil particles will settle out according to size. After 1 minute, mark on the jar the depth of the sand.
9. After 2 hours, mark on the jar the depth of the silt.
10. When the water clears mark on the jar the clay level. This typically takes 1 to 3 days, but some soils may take weeks.
11. Measure the thickness of the sand, silt, and clay layers.
 - a. Thickness of sand deposit _____
 - b. Thickness of silt deposit _____
 - c. Thickness of clay deposit _____
 - d. Thickness of total deposit _____
12. Calculate the percentage of sand, silt, and clay.
 - a. $[\text{clay thickness}] / [\text{total thickness}] = \text{_____ percent clay}$
 - b. $[\text{silt thickness}] / [\text{total thickness}] = \text{_____ percent clay}$
 - c. $[\text{sand thickness}] / [\text{total thickness}] = \text{_____ percent sand}$
13. Turn to the soil texture triangle and look up the soil texture class.

Soil Texture Triangle:



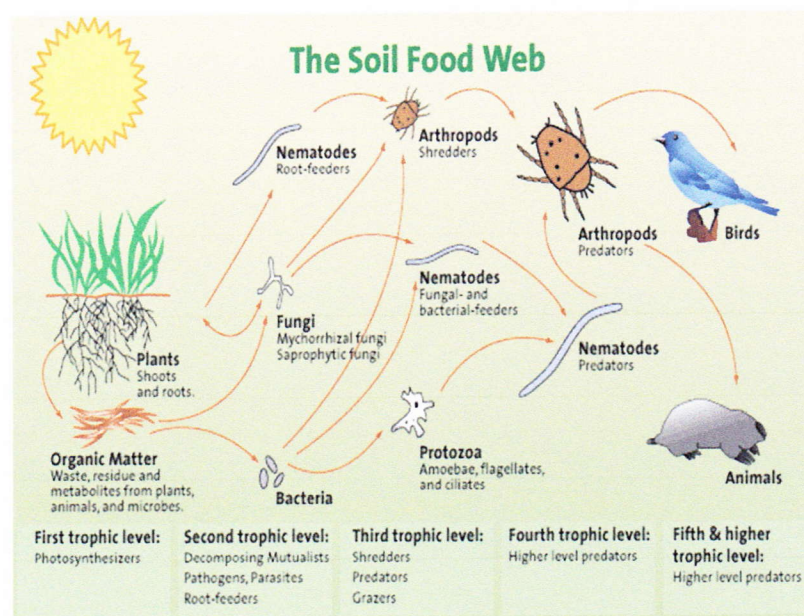
The *soil texture triangle* gives names associated with various combinations of sand, silt and clay. A *coarse-textured* or *sandy* soil is one comprised primarily of medium to coarse size sand particles. A *fine-textured* or *clayey* soil is one dominated by tiny clay particles. Due to the strong physical properties of clay, a soil with only 20% clay particles behaves as sticky, gummy clayey soil. The term *loam* refers to a soil with a combination of sand, silt, and clay sized particles. For example, a soil with 30% clay, 50% sand, and 20% silt is called a *sandy clay loam*.

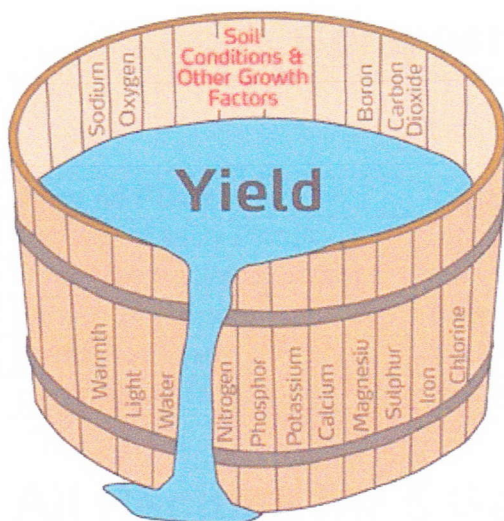


Soil Wetting Patterns

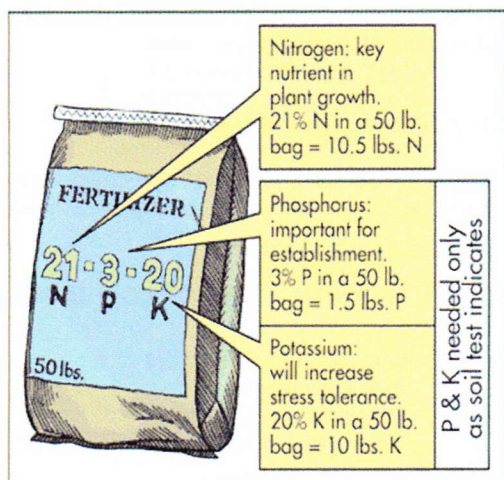
Soil Food Web Gardening Rules:

1. Some plants prefer soils dominated by fungi; others prefer soils dominated by bacteria
2. Most vegetables, annuals, and grasses prefer their nitrogen in nitrate form, and do best in bacterially dominated soils
3. Most trees, shrubs, and perennials prefer their nitrogen in ammonium form and do best in fungally dominated soils.
4. Compost can be used to inoculate beneficial microbes and life into soils around your yard and introduce, maintain, or alter the soil food web in a particular area.
5. Adding compost and its soil food web to the surface of the soil will inoculate the soil with the same soil food web.
6. Aged, brown organic materials support fungi; fresh green organic materials support bacteria.
7. Mulch laid on the surface tends to support fungi; mulch worked into the soil tends to support bacteria.
8. If you wet and grind mulch thoroughly, it speeds up bacterial colonization.
9. Coarse dryer mulches support fungal activity.
10. Sugars help bacteria multiply and grow; kelp, humic, and fulvic acids and phosphate rock dust help fungi grow.
11. By choosing the compost you begin with and what nutrients you add to it, you can make teas that are heavily fungal, bacterially dominated, or balanced.
12. Compost teas are very sensitive to chlorine and preservatives in the brewing water and ingredients.
13. Applications of synthetic fertilizers kill off most or all of the soil food web microbes.
14. Stay away from additives that have high NPK numbers.
15. Follow any chemical spraying or soil drenching with an application of compost tea.
16. Most conifers and hardwood trees (birch, oak, beech, hickory) form mycorrhizae with ectomycorrhizal fungi.
17. Most vegetables, annuals, grasses, shrubs, softwood trees, and perennials form mycorrhizae with endomycorrhizal fungi.
18. Rototilling and excessive soil disturbance destroy or severely damage the soil food web.
19. Always mix endomycorrhizal fungi with the seeds of annuals and vegetables at planting time or apply them to roots at transplanting time.





The Capacity of the Barrel represents plant yield, which is limited by the height of the shortest stave of the barrel.



| | | | |
|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|---------------------------------------------------|
| <div>7</div> <div>N</div> <div>Nitrogen</div> | <div>15</div> <div>P</div> <div>Phosphorus</div> | <div>19</div> <div>K</div> <div>Potassium</div> | |
| <div>12</div> <div>Mg</div> <div>Magnesium</div> | <div>16</div> <div>S</div> <div>Sulfur</div> | <div>20</div> <div>Ca</div> <div>Calcium</div> | |
| <div>5</div> <div>B</div> <div>Boron</div> | <div>17</div> <div>Cl</div> <div>Chlorine</div> | <div>25</div> <div>Mn</div> <div>Manganese</div> | <div>26</div> <div>Fe</div> <div>Iron</div> |
| <div>28</div> <div>Ni</div> <div>Nickel</div> | <div>29</div> <div>Cu</div> <div>Copper</div> | <div>30</div> <div>Zn</div> <div>Zinc</div> | <div>42</div> <div>Mo</div> <div>Molybdenum</div> |
| <div>1</div> <div>H</div> <div>Hydrogen</div> | <div>6</div> <div>C</div> <div>Carbon</div> | <div>8</div> <div>O</div> <div>Oxygen</div> | |

- Macronutrients
- Secondary Nutrients
- Micronutrients
- Non-Fertilizer Elements

| Fertilizer | N-P-K | Cost Per Pound/Location | Yearly Application Rate 10 ft ² |
|-----------------------------|---------|---------------------------|--------------------------------------------|
| Alfalfa Meal | 2-1-3 | \$.40 at OK Feed | 2.5/lbs |
| Bat Guano | 10-10-1 | \$4.67 at Mesquite Valley | 0.5/lbs |
| Bat Guano | 0-5-0 | \$3.25 at EcoGro | --- |
| Blood Meal | 12-0-0 | \$2.33 at Mesquite Valley | 0.40/lbs |
| Bone Meal | 3-15-0 | \$1.35 at Mesquite Valley | 1.66/lbs |
| Cotton Seed Meal | 6-4-1.5 | \$.40 at OK Feed | .85/lbs |
| Fish Emulsion | 2-4-1 | \$5.00 at ARBICO Organics | 2.5/lbs |
| Fish Meal | 10-6-2 | \$.83 at OK Feed | 0.5/lbs |
| Kelp Meal | 1-0-4 | \$1.60 at OK Feed | 5/lbs |
| Dr. Earth Home Grown | 5-7-3 | \$2.08 at EcoGro | 1/lb |
| Dr. Earth Natural Wonder | 7-4-2 | \$2.08 at EcoGro | .70/lbs |
| Happy Frog All Purpose | 5-5-5 | \$2.25 at Eco Gro | 1/lb |
| Happy Frog Fruit and Flower | 5-8-4 | \$3.00 at Mesquite Valley | 1/lb |



Creating Pollinator Habitat in Sonoran Landscapes

Plants for Attracting Pollinators in Sonoran Landscapes:

From Tucson Audubon Society Guide to Food Rich Landscapes for Birds and People:

These plants support hummingbirds, butterflies, native solitary bees and other pollinators. Some provide food for the larval stage of butterflies and moths.

Insect pollinated:

Small to Medium Shrubs

White-ball acacia *Acacia angustissima*

Sweet bush *Bebbia juncea*

Twin dropseed *Dicliptera resupinata*

Palmer mallow *Abutilon palmeri*

Fairy duster *Calliandra eriophylla*

Butterfly mist *Eupatorium greggii*

Fragrant bee brush *Aloysia gratissima*

Coursetia *Coursetia glandulosa*

Goodding's verbena
Glandularia gooddingii
(*Verbena gooddingii*)

Desert milkweed *Asclepias subulata*

Feather dalea *Dalea formosa*

Velvetpod mimosa *Mimosa dysocarpa*

Desert broom *Baccharis sarothroides*

Brush dalea *Dalea pulchra*

Desert senna *Senna covesii*

Vines

Queen's wreath *Antigonon leptopus*

Virgin's bower *Clematis drummondii*

Arizona passion flower
Passiflora arizonica

Southwest pipevine
Aristolochia watsonii

Hummingbird pollinated:

Trees

Desert willow *Chilopsis linearis*

Large Shrubs

Wolfberries *Lycium* spp.

Small to Medium Shrubs

Desert honeysuckle
Anisacanthus thurberi

Flame anisacanthus
Anisacanthus quadrifidus
var. *wrightii*

Smooth bouvardia *Bouvardia*
glaberrima

Fairy duster *Calliandra*
eriophylla

Chuparosa *Justicia*
californica

Red justicia *Justicia*
candicans

Mexican honeysuckle
Justicia spicigera

Parry penstemon *Penstemon*
parryi

Firecracker penstemon
Penstemon eatonii

Hummingbird trumpet
Zauschneria latifolia (*Z.*
californica)

Cacti, Succulents, Yuccas, Other Accent Plants

Ocotillo *Fouquieria splendens*

Vines

Snapdragon vine *Maurandya antirrhiniflora*

Night pollinated:

Small to Medium Shrubs

Sundrops *Calylophus*
hartwegii (sphinx moth larval
source)

Sacred datura *Datura wrightii*
(sphinx moth)

Tufted evening primrose
Oenothera caespitosa
(sphinx moth)

Cacti, Succulents, Yuccas, Other Accent Plants

Palmer agave *Agave palmeri*
(bat)

Shin dagger *Agave schottii*
(bat)

Saguaro *Carnegiea gigantea*
(bat and bird)

Night-blooming cereus
Peniocereus greggii (sphinx
moth)



Resources: Water Harvesting and Irrigation

Books and Publications and Websites:

- Introduction to Permaculture – Bill Mollison
- Rainwater Harvesting for Drylands and Beyond Volumes 1 & 2 – Brad Lancaster
 - <http://www.harvestingrainwater.com/>
- The Sonoran Permaculture Guild
 - <http://www.sonoranpermaculture.org/>
- Harvesting Rain Water for Landscape Use
 - <https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1344.pdf>
- City of Tucson Rain Water Harvesting Guide
 - https://www.tucsonaz.gov/files/water/docs/Rainwater_Harvesting_Guide.pdf
- Landscape Watering by the Numbers
 - http://www.chandleraz.gov/Content/WC_LandscapingWateringbyNumbers.pdf
- Watering Trees and Shrubs
 - <https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1298.pdf>
- Irrigating Citrus Trees
 - <https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1151.pdf>
- Tucson Audubon Society Guide to Food Rich Landscapes for Birds and People
 - http://www.tucsonaudubon.org/images/stories/urban_habitat/TAS-Landscaping-Guide-130728-web.pdf
- City of Tucson Recommended Irrigation Tips
 - <https://www.tucsonaz.gov/water/irrigation-schedule-tips>
- Guidelines for Landscape Drip Irrigation Systems
 - http://www.amwua.org/pdfs/drip_irrigation_guide.pdf

Low Water Use Landscaping Plant Lists:

- <http://www.amwua.org/plants/>
- <http://www.azwater.gov/azdwr/WaterManagement/AMAs/LowWaterUsePlantList.htm>