The Thrivalist's Guide to Growing Food in Dry Years

"As individual gardeners and farmers, we have learned to garden and farm in the context of unusually stable times. We now need to expand our perspectives and learn, or relearn, how to garden and farm in wilder times."

~Carol Deppe~



Droughts have been an eternal part of California's climate for millennia, forcing both plant and animal populations to adapt and evolve during years of both water scarcity, and abundance; as human populations increase, global energy resources become more scarce, food prices rise, and the climate becomes more unpredictable, we can learn to adapt our food growing techniques to fit within our region's hydrological limits.

Choosing to not grow food during drought years to help reduce water consumption is only a temporary fix; one which merely shifts the problem of water use (and abuse) to other regions. In many cases, this choice places food production into the hands of industrial agriculture, which is both water and energy intensive.

The production and distribution of food by industrial agriculture is estimated to be one of the most significant drivers of global climate change. With this in mind, reducing our water footprint and our carbon footprint should be synonymous.

Resilient communities are bound to local food security. By employing adaptive strategies that utilize a variety of methods to capture, store, and conserve winter precipitation, we can strengthen our communities ability to provide low-impact food production. Through the judicious use of stored water and by utilizing many of the listed techniques below, we can play an active role in producing local sustenance, while allowing water to flow naturally to support aquatic wildlife and fisheries.

In the Veggie Garden:

Scale down and design-up: Grow and design small-scale *intensive* gardens—rather than large-scale *extensive* gardens.

Order, select, and breed drought tolerant/drought evading seeds and plants: For generations,

various food plants have been bred and selected by farmers in arid regions to tolerate and evade drought. These plants are either drought tolerant through having extensive root systems and leaves that transpire less; or they are drought evading, which means they mature quickly before excessive heat and dry conditions halt their production.

When choosing seeds or transplants, select quick-maturing varieties. Smaller fruited types of peppers, eggplants and tomatoes often require less water to produce than larger fruited varieties. Select heirloom/open-pollinated varieties, and save seeds from plants that perform well during drought years. A good place to start searching for drought tolerant and drought evading seeds is Native Seeds Search: http://www.nativeseeds.org/pdf/seedlistingcatalog.pdf

Some of the more drought tolerant/drought evasive annual crop varieties include: Amaranth sp., Tepary Beans, Garbanzo Beans, Cowpeas, Lima Beans, Armenian Cucumber, Edmonson Cucumber, Applegreen Eggplant, Ichiban Eggplant, Black Aztec Corn, Black Mexican Corn, Chapalote Corn, Persian Melon, Ashkabad Honeydew Melon, Okra, Sorghum, Dark Star Zuchini, Lebanese Light Green Zuchini, Burbank Tomato, New Zealand Paste Tomato, and Omar's Lebanese Tomato.[5]

Plant close to home: If possible, design and build your garden sites close to home. Having a garden right outside the front or back door allows one to assess the health and condition of their plants daily before disease, insects, or dry conditions affect plant health.

Start with the soil: Humus rich, living soil is the foundation of the drought resilient garden. Humus is a relatively stable source of soil carbon (and other elements) which is created through the decomposition of organic matter by soil organisms. Aside from its ability to store up to 4-6x its weight in water, humus also has a negative electrostatic charge that attracts water and most nutrients—which have a positive charge. Reducing soil disturbance and compacion, keeping the soil covered with a mulch, and cover cropping, are practices that help build and protect soil humus.

Research has shown that increasing soil organic matter from 1-2% can reduce water needs by up to 75%. One way to achieve this is by incorporating healthy amounts of compost, earthworm castings, mushroom compost, or leaf mold into the soil.

Cover cropping is also a way to build and retain organic matter in soil. Cover crops (Fava Beans, Vetch, Austrian Field Peas, Winter Rye, etc.) are best planted in the fall and then incorporated into the soil the following spring; 3-6 weeks before planting your next crop. Cover crops should be cut down and mixed into the soil while soil moisture is still present.

******Keep in mind that allowing cover crops to grow in the soil too late into the spring season can dry up the soil for crops that follow.* Getting the timing right takes practice. (See the no-till section below for more ideas on how to build soil organic matter.)

Build and protect stable soil aggregates: "Stable soil aggregates" are a fancy way of describing crumbly soil that has good tilth. Soil aggregates are formed by organisms (mostly fungi) that glue and bind soil particles together. This structure is what creates the space (surface area) to store water and paradoxically—to drain well. The increased surface area created by stable soil aggregates also increases oxygen available to roots, which promotes plant vigor.

The best way to protect and build soil aggregates is by nurturing the underground ecosystem in your garden. This can be done through minimizing tillage and compaction, cover cropping, applying compost, or compost teas, and mulching.

Time your tillage: Tilling the ground while it is too wet or too dry can seriously impact soil structure; burning up soil organic matter and reducing its capacity to receive and store water. If you are practicing farming methods that require tillage, try to find that "sweet spot" of time when the soil is neither too wet or too dry.

Keep in mind that excessive tillage also damages soil structure over time and is hard on beneficial soil organisms.

Plant in the ground: In many cases growing food in containers or raised beds uses more water than ground beds. If possible, plant directly in the ground. (The exception might be growing food in an area where surrounding tree roots compete with water, or in sandy soils.)

If you need to grow in containers, try covering the south and west sides with fabric, burlap, etc., to protect from the sun. Allowing soil in pots to dry out too much between waterings can cause soil to repel and waste water when trying to rehydrate them. One solution is to use drip irrigation and set multi-cycle timers for frequent, yet short durations, to keep soil evenly moist. (For example: 1-2 minutes 2-3x a day, depending on the size of the container, time of year, and the size of plant.) Place drip irrigation under the mulch. Trays or saucers can also be placed under pots to capture lost water.

(Pots organized to limit the sun from hitting their sides. Veggies are mulched; burlap is placed on the south side of pots.)

Keep in mind that "Smart-pots" wick moisture from their sides and are less than ideal to grow in during dry years. If necessary, smart pots can be buried part way in the ground to help reduce evaporation (only if nearby tree roots aren't a problem). Smart Pots can also be wrapped with recycled plastic, or another suitable materials to help reduce evaporation from their sides.

Experiment with spacing: Some plants such as corn and tomatoes will produce well with less water by giving them ample room. Other crops such as salad greens and squash may benefit from closer spacing to help shade soil. Experiment and see what works best.

Mulch for moisture, mulch for microbes: Mulch not only retains moisture, it also provides protection for beneficial soil organisms that are working together with your plants to help fight drought and disease. Mulch biodegrades over time, feeding the soil food-web, while increasing soil carbon. Sources of mulch can include: deciduous leaves, rotted wheat or oat straw, grass clippings, pond weeds, cattails, bracken ferns, shredded cardboard, aged wood chips, shredded egg cartons, etc.

Remember to protect your soil investment during all four seasons with mulch, growing plants, or a cover crop. *Also, by mulching paths, you can help reduce the wicking of water from surrounding garden beds.

Note: Applying too much mulch (especially fresh rice or wheat straw) can attract and create a place for rodents (voles, field mice, etc.) to hide. If this becomes a problem, try using less mulch or other types of mulch.

Calcium/Magnesium ratios count: The calcium/magnesium balance in soils can affect soil tilth and drought resistance; too much calcium can over-loosen soils, allowing soil moisture to escape; too much magnesium can over-tighten soils, reducing root penetration and water absorption.

Consider a No-Till plot:


(Before)


(After)

No-till gardening allows the symbiotic relationships between plants and soil life to take place. An healthy, intact soil ecosystem provides an indispensable array of benefits to the ecological gardener. By allowing the soil food web to flourish we can attain a multitude of yields, such as: reduced labor, reduced carbon loss, better soil structure, less plant disease, and reduced water needs.

This is our family's sixth season of experimenting with no-till practices. In most situations we have noticed up to a 50% reduction in water use in our no-till plots, and in some cases we can now dry farm areas (100% decrease in water use) through utilizing no-till methods. *No-till does not work well in areas where surrounding tree roots extend into garden beds.*

This coming rainy season, consider establishing a no-till plot by sheet-mulching. (See photos and link to directions below.) The initial sheet-mulching process requires a lot of organic matter to establish an area, but is done only once. In the seasons that follow, a cover crop is planted in the established beds each fall. In the spring, we cut the cover crop down at the soil line (leaving the roots intact) and then chop up the greens with a machete. The green material is then laid *on top* of the garden beds and gently incorporated into the top-most layer of soil, either by hand, or with a digging fork. *The cover crop is not tilled or shoveled in.*

The chopped cover crop is then covered with a carbon-rich mulch (cattails, aged straw, oak leaves, etc.) to reduce oxidation from sunlight, and to prevent weeds from sprouting. Weeds are kept from encroaching into the beds by covering surrounding paths with cardboard that is layered with crushed rock or wood chips.

For step by step directions on how to sheet-mulch check out:
http://www.patternliteracy.com/books/gaias-garden/how-to-the-ultimate-bomb-proof-sheet-mulch.


(In fall, cut grass & aerate soil) (Add rock powders, manure) (Cover w/cardboard) (More manure) (Straw, cattails, etc.) (More manure/ compost) (Cover w/ seedless mulch)

Experiment with dry farming: Dry farming is usually associated with fertile floodplains and lowland valleys; but dry farming can also be accomplished at higher elevations, and on more marginal land by timing your plantings just right, knowing your soils, and with no-till methods.

We have successfully dry-farmed sunflowers, amaranth, and tomatoes by focusing on areas of our garden where the water table is close to the soil's surface. Generally, these are low spots where

Horsetails, or Juncus sp. (wire grass) grow.

These areas are sheet-mulched in the fall, and then planted the following spring while ample soil moisture is still present, *but not too wet*. The timing has to be just right. Most years these crops require early protection from a temporary hoop frame to protect plants from cool nights. If we time it right, we are able to grow these crops without supplemental irrigation.

(Amaranth and sunflowers being dry-farmed at 1700' elevation in heavy clay soils.)

Timing counts: Getting plants established at the right time can make a big difference in their ability to withstand dry conditions. Planting in the ground early in the season while the soil is still moist from spring rains allows them to develop extensive root systems *before* hot weather arrives. Providing early season protection (remay, small hoop frames, cut plastic milk jugs, etc.,) for warm season plants like tomatoes, peppers, and squash is often necessary when following this practice.

Direct sow if possible: Seeds that are planted directly in the ground tend to establish stronger root systems than transplants. Protect newly planted seeds with remay, old milk jugs, etc., to help protect from birds and rodents while sprouting. *If purchasing or using transplants, avoid planting starts that are root-bound.*

Group plants together according to their water needs: Place plants that need extra water near each other and on separate irrigation systems than plants that need less water.

Remove the old, weak, or unintended: Be sure to promptly remove old or weak plants when they decline to provide soil moisture to plants that are still producing. Remove all weeds that may be competing for water and nutrients.

Plant in blocks: Plants perform better during droughts when planted in blocks, v.s. narrow rows.

Plant on-contour: Gardens that are planted on slopes perform best when planted on terraces, or are placed level, on-contour (perpendicular to the slope) to help slow down, and soak-in winter rains. Planting on-contour also minimizes erosion, while helping to keep nutrients on-site.

Use wind breaks: Hot summer winds can wick moisture right out of the soil. If planting in a windy site, consider erecting temporary windbreaks, or plant permanent windbreaks for longterm protection.

Cut back on nitrogen: Over-fertilizing, especially with nitrogen, leads to excessive growth of vegetation that requires more water.

Grow more perennial food crops:

(Heshiko Bunching Onion, Perennial Tree Collard, Oca, and Artichoke)

In general, perennial plants require less water (after established) than annual crops, as well as helping to stabilize and build soil. Many of the most common perennial herbs come from Mediterranean climates (Rosemary, Oregano, Sage, Thyme, etc.,) and require little or no water once established.

Here are some perennial vegetable crops that perform well for us in northern California: Asparagus, Artichoke, Cardoon, Chinese Artichoke, Tree Collards, Sylvetta Arugula, Sunchoke (Jerusalem Artichokes), Oca, Mashua, Perennial Sweet Leek, Good King Henry, Turkish Rocket, Welsh Onions, Potato Onions, Egyptian Walking Onions, Heshiko Bunching Onions, Garlic Chives, Rhubarb, and Prickly Pear Cactus (Nopales).

For a more extensive list of possibilities check out: http://perennialvegetables.org/perennial-vegetables-for-each-climate-type/cool-maritime/

Go big on winter crops: The temperate climate of northern California offers some of the best winter growing conditions in North America. Many cool season crops can be grown from fall through late spring without supplemental irrigation.

Crops such as garlic, kale, chard, cabbage, leeks, carrots, beets, and fava beans will grow or keep well in the soil, right through the winter months. Many of these crops will survive without winter protection in coastal areas, as well as some inland locations. More sensitive crops can be grown during winter inside unheated greenhouses, or poly tunnels. Potatoes and sweet peas can be started in early spring and will often provide a harvest without supplemental water.

Many of these foods can be frozen, dried, or fermented to last through the dry summer months.

Shade your greens: Salad greens (especially lettuce) can be water hogs during hot summer days. Protect salad greens from mid-day sun by planting in the shade of larger plants, or by using shade cloth,

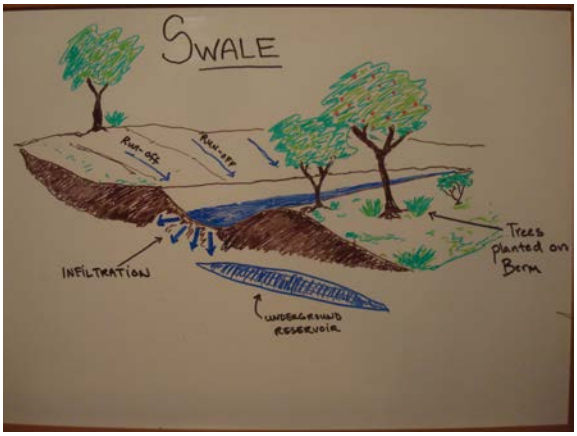
or another suitable shade structure to help slow transpiration losses.

Try growing heat tolerant varieties of greens that require less water such as: Amaranth (young leaves), New Zealand Spinach, Malabar Spinach, Louisiana Green Velvet Mustard, Southern Giant Curled Mustard, Orach, various Sorels, Swiss Chard and Kale.

Store more water in the soil: The most cost effective place to store water is in the soil. Swales, sometimes called "berms and basins," or "contour infiltration trenches," can be built above, or near garden sites to help coax winter rains into the soil. Swales can also be placed below garden plots to help keep nutrients on-site.

Water from paths, trails, roads, and the roofs of buildings or greenhouses can be directed into basins or swales near growing areas. Swales are built dead level on-contour, and can be constructed by using simple, level-seeking devices and hand tools. *Swales should not be constructed on steep or unstable slopes.* Start small, and build on what works. For a great book on earthworks for groundwater recharge, check out Brad Lancaster's book: Rainwater Harvesting for Drylands and Beyond, Volume 2.

Be sure to avoid soil compaction in or near garden beds. Keep all soil covered with mulch to protect rain from damaging soil porosity. Nurture the living sponge in your garden...



(Swales being constructed in an orchard. Also, a cross-section of a swale, and how they function.) *Drawing adapted from Toby Hemenway's excellent book: "Gaia's Garden."*

Catch and store rain: Rainwater and run-off can be collected and stored in ponds, bladders and storage tanks during the rainy season. This stored water can then be carefully used during the summer months to help allow local rivers, creeks, and springs to flow freely.

One inch of rain falling on 1,000 sq. feet of roof = approximately 600 gallons of storage potential. The roofs of greenhouses, outbuildings and houses can be used to collect rainwater. If possible, place gardens below these sites to utilize gravity to deliver stored water to gardens.

With rainwater catchment in place, the early September rains of 2013, followed by no rains in October, could have made the difference between rural residents paying top dollar for hauled water—or being self-reliant. For a great link on rainwater harvesting, check out:
http://www.harvestingrainwater.com/imagesvideoaudio/image-gallery/
Also check out this excellent resource: http://www.oaecwater.org/si-si-si-sonoma

Utilize greywater: Water from sinks, showers, and laundry can be used again to water perennial edibles. Be certain to use biocompatible soaps that biodegrade into plant nutrients. For more info, check out: http://greywateraction.org/content/about-greywater-reuse
And:

http://www.oaecwater.org/sites/oaecwater.org/files/Legal%20Graywater%20Design%20For%20Small%20Scale%20Applications.pdf

Drip irrigation: Properly installed drip irrigation can reduce water consumption by up to 50%, but not all drip irrigation is that effective; spray emitters can lose a high percentage of water to evaporation and soaker hoses can become clogged with sediment after a few seasons.

The most effective drip irrigation that we have used thus far is "in-line emitter tubing." They are currently made in 1/4" and 1/2" diameter sizes and have non-clogging emitters, especially when used with a basic sediment filter. Emitters come pre-spaced from 6" to 2' along the the length of line.

No matter what form of drip irrigation you use, remember to place drip irrigation *under* your mulch to reduce evaporation. Drip irrigation can also be placed beneath the soil to further reduce evaporation, but may cause gophers to bite the line.

Water in the early morning: Whether hand watering, or using drip irrigation, the best time to reduce evaporation losses is in the early morning hours. Watering in the evening provides similar results, but may also encourage fungal diseases.

Overhead sprinklers are highly inefficient for watering gardens during dry months. If you need to seed large areas that require overhead watering, try timing your planting to coincide with early spring, or late fall rains.

Water only when needed: A plants water needs can vary based on influences such as weather and day lengths. Try watering only when needed, v.s. on a set schedule to help conserve water.

Moisture meters can be handy to help gauge soil moisture.

Try buried pitcher irrigation: Buried pitcher irrigation is reputed to be one of the most effective ways of conveying moisture to root zones (up to 95% efficiency) in small-scale intensive gardens. Buried pitcher irrigation has been utilized for over 2,000 years and is presently being used by traditional desert farmers worldwide, including here in California. (Nabhan)

Buried pitcher irrigation is accomplished by using unglazed clay pots that are sometimes referred to as "ollas." (Pronounced "Oy-yah.") Ollas usually hold between 1/4 to 2 gallons of water. They are buried in the soil before planting, with their top a few inches above the soil's surface. Compost, or another suitable fertilizer can be placed in the planting hole around the container. *Do not*

place fertilizers inside the olla. It can clog the pores of the container.

Often, a small dish or piece of tile is placed under the olla to increase efficiency. Seeds are planted right next to the sunken container and are watered by hand until they germinate. A small dish, rock, or other suitable lid is placed on top of the container to reduce evaporation. Fill the olla as needed.

It is reported that not all plants work well with this method. Plants with fibrous root systems like peppers, squash, tomatoes, and melons supposedly work well. Ollas do not work well in heavy clay soils. (We'll be experimenting with buried pitcher irrigation this season.)

For more info:
http://www.academia.edu/3804322/2006_Buried_clay_pot_irrigation_booklet

Experiment with Hugelkultur: Hugelkultur, pronounced (HOO-gul-cool-Toor), or mound culture, is a technique for building soil that was developed in central Europe. This method uses brush, dead wood, and other organic materials to be piled and then covered with soil to form a large mound. This mound is then planted. As the wood and other organic matter in the soil decays, it provides a sponge-like structure that holds water, as well as providing nutrients. Potatoes, squash, melons, and other vines reportedly do well with this method, as well as many perennial edibles. For more info check out:http://www.richsoil.com/hugelkultur/

**The burying of large pieces of organic materials (wood, brush, etc.) may encourage an environment that favors symphylans.* (See more on symphylans below.)

Apply actively aerated compost teas: Actively aerated compost teas (AACT's) are an effective way to increase populations of beneficial soil organisms in food gardens—beneficial soil organisms that may help plants to withstand drought and disease. To learn more on the topic, check out:
http://www.treehugger.com/lawn-garden/how-to-make-compost-tea-why-you-should.html

A word on symphylans: Symphylans can severely limit a plant's ability to withstand dry conditions by consuming their roots. Symphylans are small, pale colored, soft-bodied, centipede-like arthropods that are roughly about the size of of this capital "I." They can be found in various soil types, but are most often found in higher numbers in forest soils, or soils that are high in organic matter. Symphylans can cause serious challenges for gardeners and often go undetected due to their secretive nature and small size.

Signs of symphylan damage are: plants that stay stunted, often in groups, or in a particular area of the garden; and/or plants that wilt, regardless of soil moisture. To see if you have symphylans, try placing slices of beet or potato on the soil's surface, near the suspected area. Cover the slices with a small wooden board, or something similar. In the morning, quickly lift up the slices and either look closely underneath them to find the symphylans, or place the slices in a bucket of water and look for the floating critters. One can also place suspect soil in a bucket of water and see if they float to the surface.

There is quite a bit of contradictory information out there on the internet on how to deal with symphylans. Here is what we have learned from direct experience:

Keep large pieces of undigested organic matter (manure, wood chips, rough compost, etc.) out of the soil profile. Only use sifted compost if incorporating it into the soil layers. Mulching, or placing compost on the soil surface seems to not cause problems.

Thus far, our no-till plots do not have symphylan issues. We believe that this is due to the high number of soil predators present (various centipedes, predaceous ground beetle larvae, etc.,) as well as a healthy, undisturbed soil ecosystem that offers symphylans their preferred food—fungi.

We speculate that excess tillage damages soil predator populations, as well as creating expansive new territories for the symphylans to colonize. (Symphylans are not able to create their own burrows and rely on using the burrows of other subterranean creatures to travel.) We currently feel that excess tillage creates an environment that does not allow for predators to keep up with symphylan populations.

Other ways of obtaining a yield without symphylan damage are by growing in tightly woven "smart pots," or by growing in containers that are placed on pallets, cement blocks, or recycled soil bags. Getting transplants off to a good start before planting can also help. (Seedlings are often stunted or killed if symphylan populations are high.) Perennial edibles seem more resistant to symphylan attack than annual plants.

Also, symphylans seem to not like potato plants. In areas where symphylans have been a problem, we have been able to plant potatoes in that area, and then we replace them with other crops that are more susceptible after the potato harvest. Reportedly, a plant called “Mighty Mustard” may also deter symphylans.

Experiment with biochar: Biochar is a stable from of carbon (charcoal) created through pyrolysis (the slow heating of biomass in an oxygen starved environment). Biochar is used as a soil amendment, and research has shown that it increases the water holding capacity of soils, while reducing the use of fertilizers. Similar to humus, biochar has a negative electrostatic surface charge that bonds with water and most nutrients.

Biochar is usually crushed into a powder and then inoculated with beneficial soil organisms by mixing it with compost slurries, or compost teas. Biochar is also “charged” by soaking the crushed biochar in fish emulsion, diluted urine, or another suitable organic liquid fertilizer. Biochar can also be incorporated into compost piles. ***Biochar may initially limit plant growth if not “charged” before use.*

(This will be our fifth season of utilizing biochar, and thus far the results appear to be positive in both water retention, and reductions in fertilizer use.)
LINK!

Tend the wild garden: *Native food plants are all around us and produce without irrigation...*




Northern California has an exceptional variety of native edible plants that are adapted to our Mediterranean climate. Many of these plants co-evolved with the careful tending practiced by indigenous cultures for millennia. The loss of this practice has brought numerous useful species into decline.[1,4] The suppression of fire and the invasion of Douglas Fir has also contributed to the decreased production of edible plants (especially acorn).[1,4]

Many of these plants rely on periodic disturbance (fire, animal browsing, pruning) to stimulate production. We can improve the health and productivity of native plants by simulating these natural disturbances by thinning and pruning in winter months.

Some of the most tasty wild plants such as Huckleberries, Black Cap Raspberries, Serviceberries, Gooseberries, Thimble Berries, and Hazelnuts respond well to pruning and occasional coppicing (hard pruning to the ground), as well as being fertilized with wood ash. Also, the increased sun exposure created by doing fire hazard reduction work (limbing and brush clearing) can help improve the production of native plants.

Drought Resilience in the Orchard and Food Forest:



Mature fruit and nut trees often require little, to no irrigation once established, providing one of the most water-wise sources of food available—while sequestering carbon, moderating microclimates, and stabilizing soil.

Some of the more drought tolerant fruit and nut trees, as well as fruiting shrubs are: Olive, Fig, Apple, Asian and European Pears, European and Asian Plums, Mulberry, Persimmon, Chestnut, Almond, Pistachio, Grape, Pomegranate, Feijoa (Pineapple Guava), Loquat, Seaberry, Hawthorne, and Goumi (Eleagnus sp.).

Select standard and semi-standard rootstocks: Standard (full-sized) rootstocks tend to grow more extensive root systems than dwarf varieties. Trees grafted on seedling rootstocks may also have an advantage during dry years, due to having a taproot. Some semi-dwarf/semi-standard rootstocks such as the (MM-111 apple) also have excellent drought resistance. Trees on standard rootstocks can be held to any desired size by summer pruning.

Graft new varieties onto existing mature trees: Older established trees in the orchard can have new varieties grafted onto them. This is called, “top-working.” By top-working, we can utilize the existing deep roots of established trees to form a framework for newly grafted varieties. These grafts often can produce fruit within a year or two, versus newly planted trees, which can take 2-10 years to produce.

Also, if you have an old tree that has subpar fruit, you can cut it back in early spring to a desired height and shape. New varieties can be grafted onto the established rootstock by using “cleft” or “bark” grafts. This technique can also be done with trees that have volunteered in the orchard. Both of these methods allow for new varieties of fruits or nuts to be added to your orchard during drought years, without using the larger amount of water needed to establish young trees.

For a great guide to common grafting techniques check out:
http://mkwc.org/files/9413/9489/5254/Grafting-PP-Oregon-Ext.pdf

Plant new trees or shrubs in the fall/early winter: Trees planted in the fall or early winter have the entire rainy season to establish roots before summer dry spells set in. Avoid planting new trees or shrubs during hot summer months.

Place plants where they want to be: Planting edible trees or shrubs out of their preferred habitat can waste water and limit productivity. For example, rather than planting forest edge plants such as blueberries or raspberries in a hot, exposed location in the full sun where they require more work and water; instead, try planting plants such as grapes, seaberries, or gumis, that will thrive in that same

location—with less work and no water.

Beat the drought with early maturing berries: When selecting berry varieties (raspberries, blackberries, blueberries, strawberries, etc.,) try cultivars that fruit in the spring or early summer, v.s. fall bearing varieties that require extra water to set fruit during the hottest time of the year.

Use wider spacing: The early settlers of our region used wide spacing when planting orchards. Many of those orchards are still alive today and have survived past droughts without irrigation. Using wide spacing allows trees to find and access water without competing with nearby trees.

Plant for drought success: Water stress is the number one killer of young fruit and nut trees. When planting new trees, *avoid placing potting soil, nitrogen fertilizers, manures, or compost, inside the planting hole.* Instead, plant bare rooted or potted trees in native soil and *amend with potassium, phosphorous, and calcium the first season* to focus on root growth—rather than vegetative growth. These amendments *can* be mixed in the soil when planting.

Before planting, soaking bare root trees in a bucket of water for a few hours with a small amount of seaweed extract added can help get trees off to a good start. Inoculating roots with beneficial mycorrhizae can also increase drought resilience and success rates.

Dig a hole the right depth to ensure that the graft union is a few inches above the soil. If it's planted too deep, the tree can suffer from crown rot. The hole can be as wide as needed to make room for planting. Have a tarp or piece of cardboard nearby to place the soil while digging. (It's easy to lose lots of soil by shoveling it in the grass.)

Use a digging fork or other suitable tool to perforate the sides and bottom of the planting hole prior to placing the tree inside. This helps roots to get established, since the process of digging (especially in clay soils) creates smooth walls in the hole, which can slow root expansion. If you have gophers, make a basket out of 1/2" galvanized chicken wire that is 2-3x the size of the root ball to place the tree in. This helps protect tree roots from gnawing gophers during the tree's early years. The wire will rust out in 2-4 years, after the tree is strong enough to withstand gopher attacks.

Place the tree in the hole, and *be sure the exposed graft union is facing north or east to protect it from hot western sun.*

Place excavated soil back in the hole and tamp-in gently to avoid air pockets. Shape soil around the tree to create a basin that holds water. The basin can be 2-3x the size of the root ball; it can be made larger as the tree grows. Compost can be placed *on top* of the soil if desired, and a thick mulch, or kill-mulch placed on top of that. (More on this below.) Keep mulch directly off of the base of the tree to prevent possible crown rot and to deter voles. Drippers can be placed under the mulch. Water in thoroughly.

If your tree has a small root system compared to its branches, prune back accordingly. Paint the base of the tree with a 50/50 mix of white latex paint and water. Paint from the soil line up to the first branches to avoid sunburn and flathead borers. Water deeply each week for the first summer (approximately 5-10 gallons a week, depending on residual soil moisture, soil type, size and type of tree, exposure, and weather.) Keep an eye out for signs of stress. Water more if needed. Protect from voles. (See below.)

Use kill-mulches: Kill mulches are used to stop grass from competing for water and nutrients. This is especially important when establishing new fruit or nut trees. To kill grass safely, while building soil, use cardboard, thick sheets of newspaper, (not the glossy type) old cotton clothes, burlap, etc., as a mulch. This is applied in spring, after rains have ceased. Another covering can be placed on top of this for aesthetics, and to prevent newspaper or cardboard from blowing away. Drip irrigation should be

(Kill-mulches being used around newly planted trees, with swales constructed above garden sites.)

placed *under* the kill-mulch.

Keep in mind that cardboard may not break down enough during the the spring and summer months to allow rains to infiltrate in the coming winter. Check the mulch during the winter months to be sure water is getting to trees. This is rarely a problem.

Note: voles can hide under kill-mulch and gnaw on the cambium of young fruit trees. This can easily be prevented by wrapping the base of young trees with wire screen, or a 4-6" section of 1-2" diameter poly-pipe that has been slit down the side to fit around the base of the tree.

Orchards love ponds: Well placed ponds can do wonders for orchards. Ponds not only can supply supplemental water to growing trees, but can also offer other useful functions like: cattails for mulch and food, pond weeds for fertilizer, climate moderation, and nesting habitat for Redwing Blackbirds that feast on codling moths and other orchard pests.

Ideally, ponds should be situated above orchards for gravity flow, as well as providing subsurface seep-flow to downhill trees. *All ponds should be engineered by an experienced contractor, and may require a permit to be constructed. Ponds may also promote the breeding of nonnative species, such as bullfrogs.*

Water when it counts: Most mature fruit trees will produce well without supplemental water. If irrigation is needed, the most important time for mature trees to receive water is when they are flowering, and when ripening fruit. Luckily, most fruit and nut trees flower when there is available moisture in the soil. If you feel the need to irrigate, focus on trees that are fruiting. In many cases, established fruit trees can produce quality fruit without supplemental irrigation.

Micro-irrigation works: Instead of installing drip irrigation when only planting a few new trees, try drilling a pinhole in the bottom of a five gallon bucket and setting it right next to the tree; place a lid on

the bucket to reduce evaporation; fill when needed. A burlap sack or old t-shirt can be used to cover the bucket to help protect it from sun damage and to keep water cool. Make sure the area near the bucket is free of weeds and grass, so all water reaches the tree's roots. Use a kill-mulch around the tree and bucket.

Newly planted trees can also be watered by placing a perforated plastic pipe (2-4” in diameter) in the ground near the tree; fill with water as needed; cover the top of the pipe to prevent rodents and reptiles from getting trapped inside.

Plant the rain: In orchard systems, the most cost effective place to store water is in the soil. For every inch of rain that falls on an acre—27,000 gallons of opportunity is awaiting. Increase infiltration and water storage in orchard sites by designing pathways, plantings and hedgerows to follow the land's contour; helping to slow, spread, and sink water into the ground.

Swales (berm and basins) can be incorporated into orchard systems to catch and store water. Small swales, sometimes called “fish scale swales” can be placed above, below, or adjacent to existing fruit trees to capture and infiltrate surface water during heavy rain events. Run-off from sheds, houses, greenhouses, seasonal creeks, and roads can be directed towards plantings, swales, or basins, to help keep the orchard green—longer into the dry season.



(Various swale designs constructed in orchard/food forest sites.)

Avoid compaction: Walking, using heavy equipment, or ranging large animals on soils, especially when wet, can seriously affect their ability to absorb and retain moisture. When possible, stick to established paths and keep foot traffic to a minimum in planted areas during the wet season.

Compacted soils benefit from periodic aeration with a digging fork/broadfork, etc., as well as applying mulches and/or adding calcium (oyster shells).

Repair gulleys: Gulleys dehydrate the surrounding landscape by draining (daylighting) subsurface groundwater to their low points. Gulleys can rush water off of the land at rates 10 to 1,000,000x faster than natural drainage rates.[3]

Building brush or rock check-dams helps to slow water down, increasing infiltration and the recharge of groundwater.

(A brush check-dam built adjacent to an orchard site to repair a badly incised gulley.)

Plant windbreaks: Dry summer winds can quickly desiccate orchard sites. Temporary windbreaks can be erected for new plantings to help them get established, or permanent windbreaks can be planted to provide multiple uses such as food, fuel, fiber, forage, mulch plants, and habitat for beneficial insects.

Lay off the nitrogen: Avoid applying nitrogen fertilizers during drought years to help prevent excessive growth which requires more water.

Summer pruning may be best during dry years: In general, winter pruning promotes the growth of young, new shoots in spring and summer; while summer pruning controls growth. During drought years it may be more effective to limit, or put off winter pruning. Trees that require shaping or their growth held back can be pruned in summer. July is usually the best time to do this.

*Hardcore tip: If a tree is close to death from lack of water, heavy summer pruning of 1/3 or more of the trees vegetative growth can be used to save it. This intense pruning helps prevent the tree from transpiring more water from its leaves than is available in the soil. The tree will be set back for 2-3 years, but will survive.[2]

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(All photos and drawings by Kyle Keegan)

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