Redwood Barn Nursery
1607 Fifth Street Davis, California

Success with raised planters.

Raised garden beds are popular for a lot of reasons. They are attractive, the soil warms up earlier, they make it easier to garden in areas with heavy soil, they are accessible for people with restricted mobility. But they present special challenges in managing water and plant nutrition.

Every season, right about now, we see vegetable boxes with plants showing drought stress, older leaves yellow due to lack of fertilizer, and fruit failing to set or develop properly.

The problems.

Because the soil drains faster, raised planters need frequent irrigation. Non-native soil piled on top of native soil leads to problems: water rushes through the stuff you bought, and when it hits the denser soil below it slows and that soil gets saturated. Roots won't penetrate. The topsoil you buy is usually sandy and fast-draining. Water distribution is a problem with faster-draining soils. Plant food leaches out more rapidly due to the frequency of watering, and the purchased soil doesn't retain plant nutrients well.

What can you do?

When building the bed:

- The bottom of your planter should be open to the soil below.
- Amend your added soil with your native soil.

Managing the bed:

- Add at least an inch of bagged soil amendment each season, something with manure and other organic fertilizers, to provide a steady supply of plant nutrients.
- Add some starter fertilizer with each young seedling.
- Feed again mid-season.

Watering:

- Water at least twice as often as the rest of the garden, probably every other day.
- Water enough to penetrate the full depth of the planter.
- Drip emitters need to be spaced quite close together, with an emitter for every square foot of the bed. Soaker hoses work well, but don’t last very long and are harder to calibrate.
- You may need to run drip or soakers for a couple of hours at a time.

Over time you can increase the soil’s ability to hold water and nutrients.

- Grow cover crops in winter to add nitrogen, organic material.

Don't turn the soil, except as needed to plant seedlings or create seedbeds.
Earthworm castings provide nutrients while increasing soil density.
Cut, don't pull, your plants at the end of each season, to allow the roots to decompose *in situ*.
Spread lawn clippings on the beds through the summer, and spread leaves on the beds in the fall.
Add mulch any season of the year.

I recently gave a talk in which I repeated one of my aphorisms: in my opinion, successful gardeners in the Valley are those who are attuned to the seasons and climate, and who know when a plant needs water.
After the talk I was approached by a man who began his comment with "my training is as an engineer." Uh, oh. He continued that I seemed to be suggesting that irrigation management was intuitive, but he felt that it must be quantifiable.
Well, sure. It's simple!

- Weekly ET x plant canopy (area) x 0.62 gallons per square foot x crop coefficient = gallons needed per week.
- Infiltration rate and rooting depth determine irrigation duration and affect choice of watering method.
- Water retention determines irrigation interval.

Got it?

What it all means.

- The first factor in a plant's water use is the evapotranspiration rate (ET rate) at any given time. In our hot valley, that is usually about ¼" of water on a typical summer day, up to 1/3" on a very hot or windy day. You can look up our current ET rate at ipm.ucdavis.edu; look for the weather tools.
- An inch of water is 0.62 gallons per square foot: square foot of leaf canopy, or square foot of planting bed. The leaf canopy is the total leaf surface as if you were looking down at the plant from a bird's eye view.
- The official measured ET rate is based on turf. Different types of plants use more or less water than turf, so we use a number called the landscape coefficient (for ornamentals) or the crop coefficient (for food crops) to multiply the ET rate by in order to adjust for what we're growing.
- How much water you can apply at once depends on the soil's infiltration rate: water enters sandy soil (as in your planter) much faster than it penetrates silty or clay loam soils like your native soil.
- How often you need to water depends on the soil's water retention; coarser soils drain out faster.
- How long you need to run it depends on how many days you're trying to provide water for, and how deep the roots are.

A couple of examples.

1. Tomato plant in raised planters:
   Average ET in July: 1.75"

Leaf canopy, example using a 4' circle: 12.6 square feet.
1" = 0.62 gal/sq. ft.
Crop coefficient: 0.8 (farmers use a higher rate, but this is ok for gardeners).
Doing the math: 1.75 x 12.6 x .62 x .8 = 11 gallons per week.
Root depth: 2 to 4 feet.
Water infiltration rate: high
Water retention rate: low
Can you provide 11 gallons all at once? In sandy soil, yes.
Will it hold the water for a full week as the plant uses it? Sandy soil, probably not.

If you have a drip system with about 4 emitters over the root zone of that tomato and each emitter puts out 1 gallon per hour (gph), you could give your tomato plant two 90 minute waterings per week. In a regular garden bed with silty or clay loam soil, you could give that plant a whole week's worth of water at once. Also note that you can reduce tomato watering late in the season.

2. Pepper plant in raised planter.
   Average ET in July: 1.75"
   Leaf canopy, example using a 2' circle: 3.14 square feet.
   1" = 0.62 gal/sq. ft.
   Crop coefficient: 1.0. Peppers can't tolerate drought.
   Doing the math: 1.75 x 3.14 x .62 x 1.0 = 3.4 gallons per week.
   Root depth: 1 foot.
   Water infiltration rate: high
   Water retention rate: low

Your drip system probably has 2 emitters on the root zone of that pepper. If each puts out 1 gph, you need a total of about 100 minutes of watering during the week. It's shallow-rooted, so in a sandy soil you may want to water every other day or else it will dry out too much between waterings. 3 to 4 times a week for 30 minutes each time will probably do it.
In a regular garden bed with silty or clay loam soil, you could water half as often and twice as long: twice a week for an hour, for example.

Monitor and adjust

Note how many variables are involved! That's why plant professionals have a hard time giving simple answers to questions about watering. During our recent heat wave, for example, the ET rate measured at the Davis weather station was almost 30% higher than average at 2.25" for the week! An extra soaking, or a longer watering interval, was necessary last week.
You can use higher output emitters, or more of them, or water with a hose which puts out water much faster. Just make sure the water is soaking in, not running off.
It's important to monitor soil moisture and plant performance and adjust your watering as needed. Poke around with a trowel the day after you water to make sure that areas didn't get missed. Plants drooping mid-day just mean it's a hot day, but if they're still drooping at sunset you need to water.

Irrigation compatibility

Notice also that tomatoes and peppers aren't really compatible for watering. You'd need to water more often for the peppers, and deeper for the tomatoes, than is optimal for the other crop. Most other vegetables are compatible with the peppers. Deeper rooted vegetables that you could water with the tomatoes include pumpkins, winter squash, and watermelons.
Corn is even shallower rooted than peppers, requiring frequent water and lots of it. Your corn needs to be in a separate bed.

Common questions:

Will it help to add earthworms? How about mycorrhiza?

Both are almost certainly already present further down in your native soil, and will move up into the root zone and multiply under favorable conditions. Soil that is shaded and moist is favorable for both. Mulch with coarse bark to shelter the soil and build earthworm and mycorrhizal populations.

Why not till or turn the soil?

Farmers know that no- or reduced-till farming conserves energy, improves soil structure, conserves carbon, reduces erosion, reduces soil compaction, enhances water penetration, and improves nutrient availability. Many of those same benefits accrue in your garden over time as you leave the soil undisturbed. In your raised planter, the roots, organic material, and the things that live on them gradually help to create a soil that retains moisture and nutrients.

We have come to understand the role that soil organisms play in plant health and vigor. Soil mycorrhiza are fungus that live symbiotically on or in plant roots and help make nutrients available to them. Along with the worms, beneficial nematodes, and other soil-dwelling life, they make up the soil web of interconnected species. Turning and tilling the soil breaks up those connections and they take time to redevelop.

Undisturbed soil provides habitat. Some important pollinator species and other beneficial animals require undisturbed soil. Soil dwelling bees, lizards and toads, and gopher snakes are examples of beneficial wildlife that live in or near uncultivated soil and provide pollination and pest management services free of charge.

Soil dwelling bees that I've seen include bumble, sweat, digger, squash, and alkali bees, all of which are beneficial and non-aggressive. Squash bees, for example, are important in our gardens since they start their workday earlier than European honeybees, foraging before sunrise when squash blossoms are open and their pollen is most abundant. They enable fruit set when temperatures aren't optimal for European honeybees, which are basically weather wimps.

So stop with the seasonal rototilling! It's ok to lightly cultivate weeds, and amend the soil for seeds and seedlings. But double-digging, all the rage in the 1970's? That's out. To best build your soil: mulch, water correctly, and leave it be.

Raised bed photos courtesy of Fred Hoffman, http://farmerfred.com/

Every year in June I find these bees somewhere on my farm. These are the male digger bees, settling in for the night. Here they're on Verbena bonariensis, but I've often found them on lavender and mint flowers, Queen Anne's lace, or even bloom spikes of grasses. The females are nearby somewhere in the ground. Digger bees are not aggressive and they do pollinate flowers. They don't like cultivated soil or mulch, so leave some corner areas undisturbed.

The population of male digger bees can really crowd an individual flower. They are so docile that you can get up very close, even carry the blossom around and they won't fly off. And don't worry: the males have no stingers anyway.

Squash bees are important native pollinators in your garden, even though you've probably never seen them. They browse before sunrise, and are specific pollinators of squash, pumpkins, and gourds. They nest and overwinter in tunnels beneath squash plants, so if you till you disrupt their lifecycle. They also like undisturbed soil that isn't mulched. USDA photo.

http://redwoodbarn.com/DE_raisedbeds/raised%20beds%20peppers.jpeg

This picture of a raised bed with peppers early in the season illustrates the problem of water distribution in sandy topsoil, requiring hand watering early in the season. You need an emitter for every square foot of soil. A fourth line of drip emitters solves the problem in a four-foot wide bed. Photo courtesy of Fred Hoffman.

http://redwoodbarn.com/DE_raisedbeds/peppers%20-%20Version%202.jpeg

The same vegetable bed later in the season. The plants have grown in well, but the system had to run much longer than expected in order to get adequate water distribution. Photo courtesy of Fred Hoffman.

Tomato plants are deeper rooted and can go longer between waterings than other summer vegetables, so it's often best to plant them in a separate bed that you water about half as often and twice as long as the others. Pumpkins, winter squash, and watermelons are also deep-rooted, so they could be planted in the same bed. Photo courtesy of Fred Hoffman.

Other wildlife may settle in if you stop tilling and stack a few rocks near your garden in a sunny spot. Fence lizards eat a variety of insects, including spiders, grasshoppers, and beetles.