Water for Food

The wicking worm bed revolution

By Mairéid Sullivan

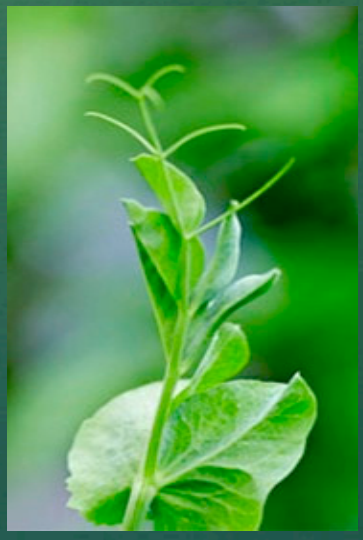
The Wicking Bed Garden System

a revolution in food production

The wicking bed system can be described as a revolution in food production because it means food can be produced with reduced and erratic rainfall.

The wicking bed system also captures carbon from the atmosphere and integrates this into the soil structure.

Decomposition is caused by a combination of anaerobic bacterial and fungal breakdown as the organic material is subject to a wet and dry cycle. This naturally gives a lower rate of return of carbon to the atmosphere.



Introduction

The Wicking Worm Bed is a horticultural system developed especially for dry areas.

"The wicking worm bed is a highly productive growing system which not only produces more food from limited water, but also recycles waste organic material to provide plant nutrient and capture carbon. The essence is to form an underground reservoir of water or pond contained by a waterproof container or liner below the surface of the soil. Plants are productive because they have a continuous supply of water and nutrients." Colin Austin, wicking bed developer

In essence, a subsurface organic sponge is contained within a waterproof liner, which allows nutrient-rich water to wick up to the root zone giving high productivity with minimal water loss by evaporation or seepage beyond the root zone.

Water is channeled into the wicking bed underground water reservoir, which prevents evaporation and allows the plants to continue growing to maturity when rain is infrequent.

In the wicking bed system, organic material is decomposed in semi-anaerobic conditions, such that decay is fungal rather than bacterial, so carbon becomes embedded in the soil. Conditions inside the wicking bed encourage microbiological activity to help regenerate the soil.

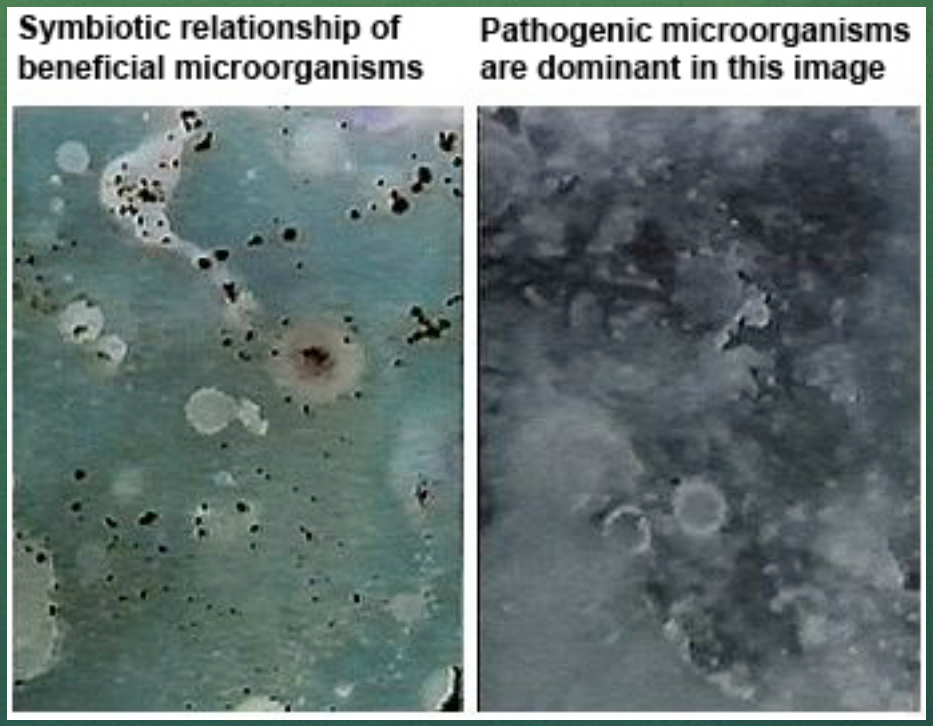
Soil Regeneration

Tests carried out in the 1970s showed that soil could be rapidly regenerated by controlling the moisture level in the soil to encourage the right type of microbiological action.

This technology is important as it captures atmospheric carbon and so can offset climate change.

However, it does require water to maintain the soil moisture levels. In a dry continent like Australia, this presents a major challenge.

Subsequently, technologies such as improved irrigation scheduling, local water harvesting, subsurface irrigation and the wicking bed were developed for the more effective use of water.

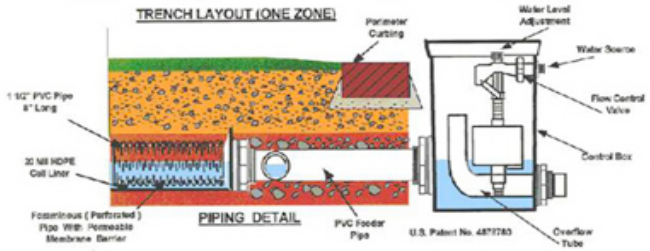


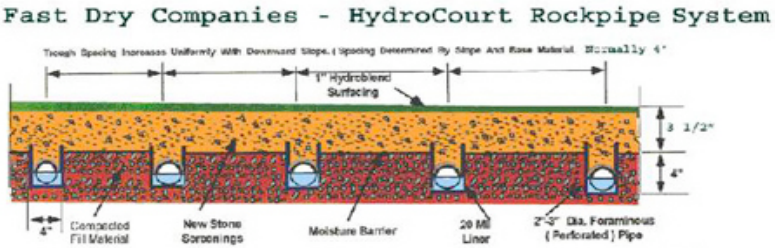
Subsurface and Flood Irrigation

Subsurface irrigation was seen as a way of saving water lost by evaporation.

A wide range of experiments led to the conclusion that practical difficulties severely limit its application.

The experimental focus was switched to developing a computer simulation of flood irrigation to improve efficiency.





Technically successful, but with limited commercial uptake, this was not regarded as an agricultural success but it did lead onto the highly successful wicking bed technology.

In conventional above ground irrigation the wet soil on the surface acts as a partial seal preventing air infiltrating into the soil below. In wicking beds, water is applied from below so the surface is dry, allowing better air infiltration.

Shapes, Sizes, and Materials

Any size or shape bed will do as long as there is provision for drainage.
Several varieties of beds have been used: E.g. in-ground trenches for watering fruit trees,
old bath tubs, rain water tanks, small plastic boxes,
railway sleepers, shade cloth frames, chicken wire and straw, etc.

shade-cloth

chicken wire and straw

in-ground trenches

railway sleepers

red gum timber

small plastic boxes

recycled rain-water tanks

Constructing timber-framed Wicking Beds

Materials needed to build two 5 x 1 meter beds (16 x 3 feet):

- **The Frame: 20 sleepers, each 3.5 meters x 75 mm (8 feet x 3 inches). will last longer than treated pine, which should be avoided in an organic garden because it will poison the soil. The price is almost the same.**

- **Plastic sheet: 11 meters long (36 feet). We used black 200 um plastic sheeting, which usually comes in roles 20 x 4 meters wide. Look for pool lining or an industrial strength plastic at a farm supply outlet. HINT: we found a hole in one role of plastic, and sealed it with pool lining glue.**

- **Shade cloth: 10 meters (33 feet) 70% shade cloth, for placement on top of the screening rocks. (Or, cut and overlap shorter off-cut pieces.)**

- **Agricultural tubing:**
  1/ Agi-pipe: 10 meters (33 feet) x 65 mm Agi-pipe.

- **2/ Alternatively, another method recommends using PVC pipe slotted by hand, only at the bottom and facing down, to prevent the pipe clogging up.**

- **70 mm PVC pipe.**
  (Purchase all parts at one time,– to be sure they fit.)

Drainage

It will take some time for water to wick up into the soil
after the reservoir has completely dried out.

During hot and dry seasons, over-fulfilling the water reservoir
for a short time will allow the water to soak up into the soil
more quickly.

For easy control of water levels, we placed a plumbing tube
into the drain hole, with an 'elbow' attached on the outside.

And, we attached a small tube to the elbow,
which can be turned up, to hold the water in,
or turned down to drain, for easy control of water levels.

Rocks, Soil, Compost

- **Rocks:**
  ½ cubic meter 7 mm or 14 mm screening rocks.
  (Don't use smooth river rocks)
  Screening rocks also help 'wick' the water up through the soil.

- **Soil:**
  1 cubic meter organic garden soil

- **Compost:**
  1 cubic meter – organic mushroom compost is highly recommended

  NOTE: Left-over soil can be used in other parts of the garden.

Step 1

Build the frame on completely level ground, for even water distribution. A layer of sand or sifted soil on the bottom of the beds will help to prevent sharp objects from cutting into the plastic sheeting.

Step 2

Place the Agi-pipe (or slotted PVC pipe) along the full length of the bed.

Step 3

Cover the bottom of the bed with screening rocks to just above the Agi-pipe.

Place the upright PVC pipe in position, touching the bottom of the bed, and set it as close as possible to the mouth of the agi-pipe, so that the water will flow into the agi-pipe

You can monitor the water level via the PDV pipe.

Step 4

Cover the rocks with the shade cloth.

Step 5

If re-using old garden soil, sift the soil into the bed, removing stones, seeds, weeds and roots. Then add a generous mixture of organic compost, mushroom compost, lime, and blood & bone, –leaving a space at the top for mulch.

A good rule of thumb is to make the soil layer equal to the natural root depth of the plant (about 300mm for above-ground veggies). After adding the soil, fold the plastic down below the soil level.

Note:
Sifting the old soil,–bending, and reaching out with a heavy tray of soil, then shaking it to sift it out, can be backbreaking work, so we used new soil in the second bed.

Step 6

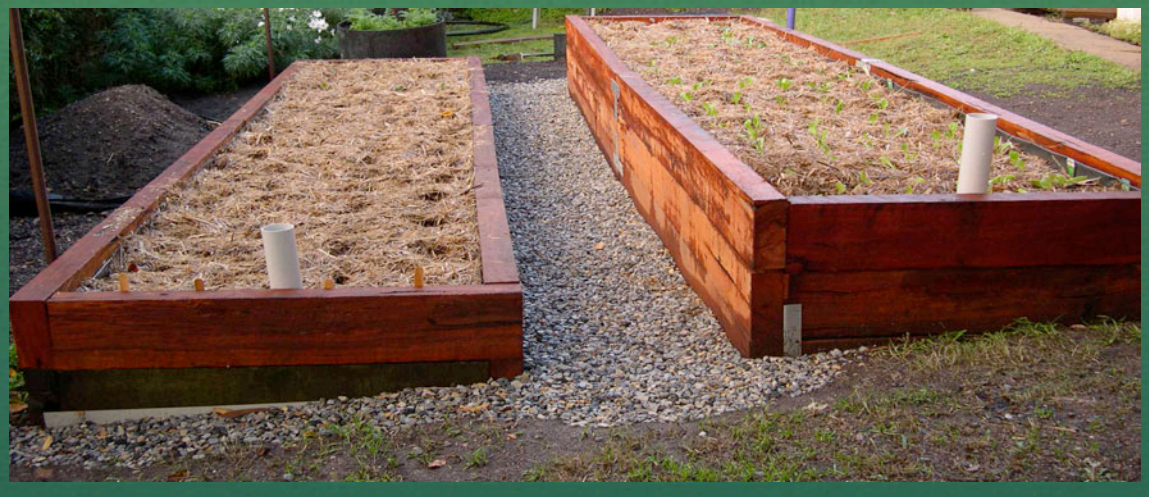
Drill the drainage hole at the end of the bed, just above the level of the shade cloth, and pour water into the reservoir via the upright PVC pipe, filling the reservoir up to the drainage hole

The garden bed is watered from the top via the PVC pipe, creating an underground stream which waters the plants from below. Note that water will 'wick' up 300 mm through the soil.

Step 7

Cover the soil with a layer of organic mulch. (This example uses sugarcane mulch.)

Plant seedlings and water from the top until they are established, then continue watering from the fill pipe only to allow the surface to remain dry. Water only when you cannot see free water at the bottom of the fill-pipe. This can take a few weeks in winter or five days in summer. Placing a screen net, for ventilation, over the PVC pipe will keep insects and snails out.



Prevent “wet feet”:
Submersion of roots in water for too long will cause “wet feet” which reduces growth, and can rot the plants. Fill the reservoir with water up as far as the drainage hole, then wait until the soil is dry before adding water again.

Note: The reservoir can be deeper, for those who wish to build higher beds.

Worm Power

Composting worms will turn anything that was once alive into compost.
Worm castings provide a high quality fertilizer, including calcium, magnesium, nitrogen, potassium & phosphorus and a broad spectrum of trace elements.

Compost worms maintain a free source of nutrient rich diet for plants, depending on the quality of the food scraps fed to them, and they provide a very good structure to the soil, keeping nutrients available by slow-release, and helping to retain water. Microorganisms formed in a worm's gut bind raw minerals from the soil to certain organic acids or sugars in a process called chelation.

Plants can easily absorb these chelated forms of minerals. Worm castings are thought to contain a chitinaze-enzyme, which melts the chitin that most insect exo-skeletons are made of. Worm castings act as a pest repellent/pesticide and act as a line of defense against pathogenic bacteria and fungi.

Bio Box:

It is easy to maintain a compost bio-box directly on the wicking bed, where bacteria, fungi and worms can breed up and re-fertilize the soil. An in-ground bio-box makes it easier to regularly top up with organic waste, directly from the garden, especially while picking food for the table.

Note: We use large planter pots for our in-bed bio-boxes, with many extra holes, so the worms have easy access to compost. We also use a slightly larger pot tray as a lid, with many smaller ventilation holes, —with a stone on top to keep the lid on.

Advantages of incorporating a worm farm within a wicking worm bed

Using a worm farm or Bio Box can dramatically increase compost recycling, creating a rich organic blend of nutrients and trace elements high in humates, beneficial bacteria and fungi, ideal for plant growth & soil conditioning, that will enhance the flavour and quality of your back yard produced vegetables.

The effective area of your worm farm increases the worm farm size to the actual size of your garden bed. This could be up to a ten-fold increase in capacity.

The worms will reproduce to fill the volume of the garden bed. The only restriction to their numbers will be the amount of food scraps you feed them.

They can never over breed as they have a natural mechanism to stop breeding when overcrowded.

What this means is that you can recycle up to ten times the amount of scraps over a conventional worm farm.

Advantages… continued:

When you see two dozen worms per shovel full of soil,
the worms will maintain the soil quality for you.

"You'll have a worm farm that is buffered from the weather. If the sun is too strong and heats up the worm farm during the day, the worms will escape into the soil, but they will return as soon as the sun sets. If it is very cold the worms will also escape the worm farm into the warmer soil and come back up for a feed when the weather warms up.

You'll no longer need to do the extra work of removing the worm castings from your worm farm and manually incorporating it into your garden bed. The worms now do this work for you. The worms will come up and down through the holes in the base of the worm farm. The worms will come into the worm farm to eat the scraps, then they will leave the worm farm and spread their cast throughout the garden bed for you. All you have to do is keep feeding them the scraps directly into the worm farm."

Source: Kookaburra Worm Farms
www.kookaburrawormfarms.com.au

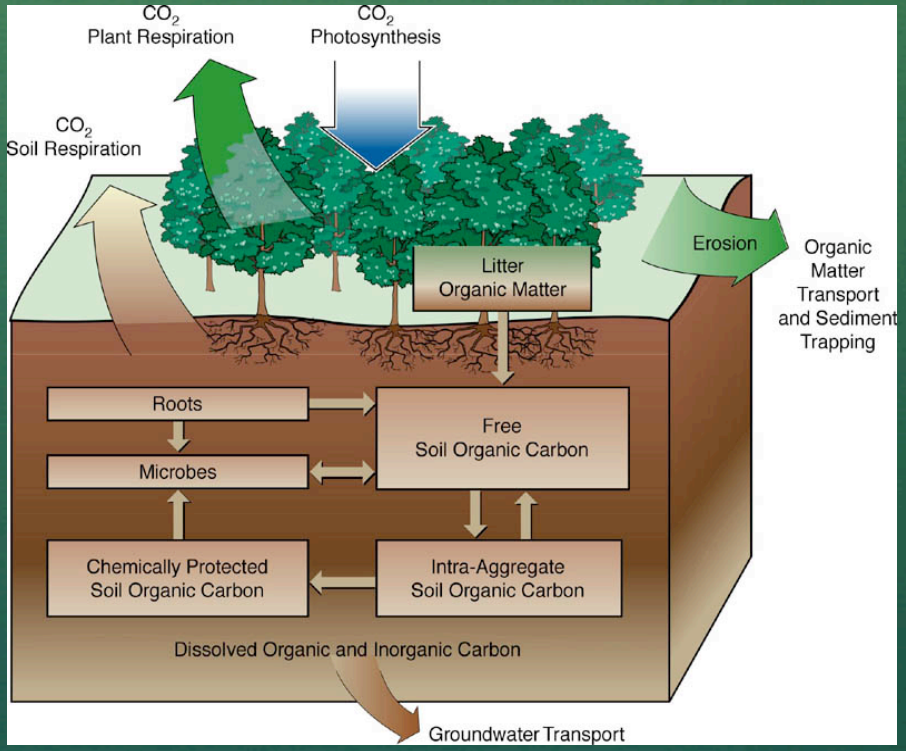
In Conclusion

"vibrant, living soils are a dynamic part of the carbon cycle" Dr Christine Jones

It is now over a decade since the wicking bed concept was developed and the first bed installed. Since that time numerous environmentally sensitive growers have confirmed water saving and improved productivity. The reduced waste of nutrient rich water to the water table is self-evident. The improved soil quality is evident to growers with a feel for soils, so there is little doubt that the organic content of the soil is increasing.

"*In a healthy ecosystem, vibrant, living soils are a dynamic part of the carbon cycle. The carbon compounds added to soil as exudates from active plant roots and the decomposition of plant and animal residues, fuel the biological processes that improve soil structure, which in turn increases oxygen and moisture retention and creates better conditions for more life.*"

Dr Christine Jones,
Healthy Soils through Communication
2006 Symposium, Federation of Biological Farmers Inc.,
Victoria, Australia



Credits

This presentation chronicles the building of timber-framed raised wicking beds by Ben Kettlewell & Mairéid Sullivan in May, 2009: www.LyrebirdMEDIA.com

Australian engineer and inventor, Colin Austin developed the wicking worm bed system while working as a volunteer in Ethiopia. He provides comprehensive information, along with photo essays and links to videos on his website: www.WaterRight.com.au