Deep Pipe Irrigation: an inexpensive and efficient method to irrigate crops and trees

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Irrigation is required to ensure the survival of crops or trees planted during times of inadequate rainfall. Irrigation techniques vary in the technology required (from buckets topumps and drip lines), the quality of water (e.g. drip irrigation systems require filtered water so the small holes do not clog), and the efficiency of water use (e.g. buried drip lines minimize loss of water to the air, while surface irrigation results in substantial losses of water to the atmosphere). The July 24, 2006 issue of the online publication The Overstory (Issue # 175) contained an article titled "Deep Pipe Irrigation," by David A. Bainbridge. Deep pipe irrigation is fairly simple and inexpensive, does not require high quality water, and makes very efficient use of water.

Deep Pipe Irrigation is not new, but is probably underutilized. A number of years ago ECHO published an article describing a method of irrigation that makes use of many of the same principles employed by Deep Pipe Irrigation. In an article titled "Partially Buried Flower Pots or Tin Cans Save on Watering" (Amaranth to Zai Holes, page 186-187), the following method of irrigation was described. A flower pot (15 cm diameter/6 inches) is partially buried about 7.5 cm (3 inches) deep just outside the root ball of transplanted trees, or surrounded by vegetable plants. To water the plants, pots are filled twice with water and the water is allowed to drain into the soil near the roots. Advantages of the method include efficient delivery of water to the root zone, and less weed seed germination since surface soil remains dry.

The deep pipe method is similar. A pipe 30-50 cm (12-20 inches) long and 2.5-5 cm (1-2 inches) in diameter is drilled with a series of holes, 1-2 mm in diameter and 5-7.5 cm (2-3 inches) apart down one side of the pipe. The pipe is then buried either vertically or on a slight angle (with the holes facing down), about 2.5-7.5 cm (1-3 inches) from a young seedling. If watering a tree, several pipes can be used around the tree to encourage symmetrical root growth. A screen cover can be added to the open end of the pipe to keep small animals out.

Water is added to fill the pipe (usually using a bucket). The water leaks out the holes, watering a column of soil and feeding both shallower and deeper roots with water. If shallow rooted plants are planted next to a pipe without holes, water may be delivered too deeply to be easily accessed by the plant.

Simplicity: The method is simple; it uses minimal materials, and does not require drip tape, filtered water, or pumps. Pipes can be collected after the growing season to allow cultivation. They can then be reused. There is flexibility in choosing pipe; it

probably does not matter exactly how long or wide the pipe is. The author even suggests that if pipe is not available, bamboo (with the partitions punched out), rolled veneer, or even a tightly tied bundle of twigs could be used in its place.

Water use: The method is very efficient in its water use, since water is delivered to the plant's root zone instead of the soil surface where some would be lost to evaporation. As already mentioned, water does not need to be filtered because 1-2 mm holes are not easily clogged. The method has a similar water use efficiency to buried drip lines, but does not require the extra equipment associated with this type of system.

Plant Health: Experiments employing Deep Pipe Irrigation in Africa have shown that crop yield and root spread was markedly improved with deep pipe irrigation, compared with both surface drip and conventional irrigation (Sawaf, 1980). Since the water is delivered deeper in the soil, roots grow deeper as well, allowing a better rate of survival after irrigation is terminated (e.g. after plants are well established). In another experiment in the Sonoran desert in California, USA, trees provided with 10 L (2.6 gal) of water each over three years using the deep pipe method had a tolerable survival rate, while trees each given the same amount of water over four months by surface watering did not survive (Bainbridge, 2006).

While Deep Pipe Irrigation works well by itself, it is a flexible system and can be modified in a number of different ways. First, if a drip irrigation system is available, emitters can be placed above vertical pipes. If this is done, care must be taken to ensure that water leaks out of side holes and not just the bottom of the deep pipe. This can be done in two ways: by making sure the flow rate is sufficient to fill the pipe (i.e. by adjusting flow rate and/or using a smaller diameter vertical pipe (~1 cm); or by placing the vertical pipe on a slight angle with the holes facing down, so that water leaks out as it slides down the inside of the pipe. [Eds: Another option might be to plug the bottom end of the pipe with a ball of clay.]

Second, microcatchments can be used to deliver limited rainfall into vertical pipes for more effective delivery of water to the root zone.

In conclusion, Deep Pipe Irrigation is a simple way to irrigate that makes efficient use of water, and may be suitable in many areas where rainfall is limited and/or water is scarce. [For added moisture conservation in dry areas, combine Deep Pipe Irrigation with the use of mulch, especially around new plantings. In addition to moisture conservation, the mulch buffers soil surface temperature and pH extremes; creates food and habitat for organisms; contributes to long-term fertility; and reduces weeds.]

References

Bainbridge, D. A. 2006. Deep pipe irrigation. The Overstory #175.

Bainbridge, D. A. 2006. Beyond drip irrigation – hyper efficient irrigation systems. Proceedings American Society of Agricultural and Biological Engineering Annual International Meeting, Portland, Oregon.

Sawaf, H. M. 1980. Attempts to improve the supplementary irrigation systems in orchards in some arid zones according to the root distribution patterns of fruit trees. In Rainfed Agriculture in the Near East and North Africa, 252-259. Rome, Italy: FAO.