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CAPILLARY BEDS

A capillary bed is a dual purpose asset: In the Summertime it provides irrigation, and in the Wintertime it becomes a perfectly drained standing ground. Little capital is required to install capillary beds, and management risks are low. No water reservoir, high pressure pump or electronics are needed. In the case of emergency, you have a 72-hour buffer in which to get repairs completed.

Construction

Site Preparation: The most economical way is to bring in large earth moving equipment and level, say, 5-10 acres. For complete accuracy, the ground should be laser levelled. In Ireland for large volume contracts the approximate cost of moving a cubic meter of soil is 75 cents. Once the ground is level you can cost fairly accurately materials and labor from the schedule below. Our largest bed is 41' wide x 255' long. At Costin's Nurseries, in constructing a bed, a meter of soil is removed from the site. There must be zero fall in all directions. This is done with a small scraper.

Edging: We dig out by hand a very shallow trench, 2-3", to make a foundation for the garden edgings. We take a bit of time to correctly level the edgings so that both sides and ends are absolutely on the same level. Concrete edging is installed around the outside of the bed making the bed 100 millimeters (4 inches) deep. I seek perfection as the cheapest longterm means of running a business. Initially I used timber edgings, but found in the wet damp Irish climate that these tended to rot. Edge of bed repairs were an increasing and irritating cost. For this reason I now use concrete garden edgings.

Bed Liner: If the ground is very stony, I put 2 sheets of black polyethylene (500 gauge) under the Capillary Beds rather than one. In Oregon it may be cheaper to spread a layer of bark or fine sand before laying out the polythene. The polythene sheets can simply be overlapped by folding about 5 ft. to create a water seal. However, we use a 2" wide cellotape product to join the sheets together as we feel it is more economical.

Drainage Pipes: The bed is filled with 5 centimeters (2 inches) of scoria and a grid of drainage pipes is placed on the scoria. The pattern of drainage pipes is very important. Trials at ADAS (1985) indicated that one internal drain pipe is sufficient to drain a bed width of about 2.5 meters; this provides a guideline to determine the number of pipes for any width of bed, although

that will be affected by the type of sand as well as the width of the bed. Recent work, also at the Glasshouse Institute (ADAS, 1985), demonstrated that sandbeds with internal drainpipes do not cause the spread of phytophthora root rots to the extent once feared. A 50mm slotted alkathene drainpipe is commonly used.

Reservoir & Ball-cock: True capillary beds must be operated by a ball-cock. This determines the water table at all times and is the controlling mechanism. The other factors - water table, soil particle size and aeration - are important, but it is the ball-cock that is paramount.

A reservoir is constructed at the end complete with ballcock. Any form of a container can be used for the header tank, but the 10 gallon domestic tank made of polypropylene is easy to work with. Using a plumber's brace, a small hole (2 to 2.75 inches, corresponding with the diameter of the drain pipe), is cut in one end wall of the tank and the drainpipe is fitted to the tank. We run a 2" water main around the Nursery and connect the ball-cock directly to it through a 1" or 3/4" connector.

The water supply and level in the bed is then controlled by the ball-cock. Ideally, the water level should be 2 to 5 cm (0.79 -2.0 inches) below the surface of the sand when the bed is working. Obtaining and maintaining this level should present no problems provided the surface of the sand has been levelled accurately by the method described above. The ball-cock is then set and continues to supply water to the bed until it reaches its cut-off level. Depending on what this level is, the ball-cock may have to be adjusted up or down until the cut-off point, corresponding to a water level 2 to 5 cm below the same surface, is reached. At this level the surface of the bed is never flooded and the base of the pot never stands in water. The water rises by capillary action to the base of the pot across this gap.

Different plants have different water requirements. Our Nursery is now large enough that we can have dry beds for Mediterranean type plants or Californian type plants that require it hot and dry. *Cistus, Pinus, Fremontidendron, Garrya* are cases in point. On the other hand plants that require a lot of water we associate them on a wet bed, *Cordyline, Cortaderia* etc. The only difference is that the Capillary gap between the base of the pot and the water table in the sand bed will vary from less than an inch for the wet bed to 2" for the dry bed.

Water taken up by the plants lowers the level of water within the sand, as the level drops the ball-cock is activated and the water level is restored within the bed. However, this can be done over a period of 14 hours from 6 am to 8 pm, so even a trickle supply will replenish a bed within that period. Taking this example, it can be seen that over a whole nursery operating automatic capillary beds, there is no peak demand period or peak pressure requirements. Consequently, there is no need for a large reservoir, enormous pressure pumps or indeed elaborate control. Even if the water supply to a capillary bed is interrupted, the water held within the sand is adequate to sustain the plants at optimum conditions for three days, even during the warmest growing period.

Overflow: An overflow pipe is linked up to the drainage system already installed. All our beds now have an automatic overflow which is set at the same level as the ballcock. This is simply an L bend at the end of the outflow pipe. In the Wintertime we turn it 90 degrees to face down and completely drain the bed. Root death problems from plants standing in stagnant water is in our

climate a problem that concerns many Nurserymen. It does not occur on drained Winter Capillary Beds.

Sand Fill: The sand must be the best quality available, preferably water treatment grade. The best way to test it is to put a handful in a jam jar fill it with water, shake it and let it settle overnight. Good sand contains no dust or dirt. Suitable ranges of sand particle sizes suggested by ADAS (1985) are: 4.0-5.0mm (30-45% by weight), 0.5-0.2mm (40-60% by weight), and 0.2-0.02mm (5-15% by weight).

About 4" of sand is the maximum that has to be used on a Capillary Bed. If the site is properly and correctly levelled beforehand, there should be zero fall in all directions. You can reduce the level to 3" of sand. However, from a practical point of view 4" seems to be a good depth to accommodate minor undulations in the site. If someone does not go to the trouble of getting the site absolutely level, they can heap extra sand onto the bed to get their beds absolutely level, but this increases the cost as levelling is much cheaper than sand.

We bring the sand onto the bed by a Clark Bobcat, skid steer loader. We roughly level out the sand and then leave the bed to flood. After a day or two when the sand is thoroughly wetted and all the air in it has been displaced by water 2 workers move in with T pieces and level the bed. They then leave it for a day and come back a day later to relevel the bed by either shifting sand around with the T pieces or bringing in extra sand where there are particularly low spots. During all this time the bed is flooded and they use the water as a level to completely level the sand. We find this system works very well for us, there is no modern technology involved, the Romans used water levels 2,000 yrs. ago.

Costs: Labor, Equipment, Materials

Costs for constructing 1 capillary bed can be influenced somewhat by how you approach the construction details, but will be similar to those listed:

- Site Preparation: Bobcat and 1 man levelling - 2 men days.
  Edging: 198 Concrete curbs (Garden Edgings) each 36 x 5 x 2 inches. At $1.40 each.
  Labor for installing edging - 2 men days.
- 4 Sheets of 600 gauge black polythene 75 x 46 Ft. at $45.
- 130 Cubic Yds. of dust free sand - $50 per cubic yd.
- 2 Lengths of 2 inch slitted plastic land drainage pipes.
- 21 2 inch T pieces.
- 21 Couplers.
- 1 each 10 gallon header tank ball-cock.
- 21 Lengths of 4 inch sewer pipe.

Frequently asked questions regarding plant production on capillary beds

- **Root Growth and Development:**

In my l5 years of growing plants on Capillary Beds I can quite categorically say that roots will not leave the pot if they are grown on a proper capillary bed. That is one where the water table is kept constant by a ball-cock supply vale. The only reason roots will move into in sand is in search for water. This only occurs where the water is supplied on an irregular basis. It does not happen on a properly constructed Capillary Bed. The Botanical logic is obvious.

The maintenance of the water at a constant level beneath the sand surface and base of the pots offers a number of growing advantages that have not been elaborated on before. Unlike overhead irrigation systems where more roots can be found outside the pot than in, the constant water level in a capillary bed acts as a root pruner. Each pot takes up whatever quantity of water it requires and because the supply is constant and does not move up or down, roots do not have to develop outside the pot in search of water. At the end of a growing season it is possible to go through a nursery and find that very, very few plants have rooted through.

The root systems of plants grown on capillary beds are much finer and there are more juvenile roots when compared with similar plants irrigated by an overhead regime, and subsequent establishment benefits are apparent. There is also little root curl. Plants such as eucalyptus and quercus, usually notorious for large heavy root systems, develop an excellent root pattern.

- **Leaf Scorch**

In greenhouses and tunnels it seems to be impossible to scorch or damage even the most delicate plants on the warmest days of the growing season if they are watered by capillary beds. It seems that plants cannot be scorched if they have an adequate supply of water.

- **Pathogens**

Diseases are a lesser problem on plants on capillary beds. The constant water table providing plants with water at all times means **plants rarely get into a stress situation.**

The roots do not develop through the bottom of the pot so do not pick up soil-borne diseases.

Water splashing between containers is eliminated, and therefore the incidence of phytophthora is decreased. This leads to fewer root associated deaths.

There is no waterlogging, providing the drainage pipe is working well. An inch of rain will drain off our beds in less than half an hour.

Reference:

ADAS, Ministry of Agriculture, Fisheries and Food. 1985. Construction of Efford Sandbeds. Leaflet 902, Published 1985.
