EFFECT OF IRRIGATION METHOD ON PLANT GROWTH AND WATER USE

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Interest in water use for nursery production in Oregon became acute in 1977 when Water Masters in some districts started enforcing a 1909 law following the dry 1976–77 winter season. This law states that 30 acre-inches can be used during the irrigation season from April 1 to September 30 with a standard water rights permit. Water for commercial use, a separate permit which could include nursery use, is not restricted but has a lower priority in case of a water shortage.

To find out how much water was used by Oregon nurseries, a survey was conducted of six crop groups by Bluhm, et al (2) in 1978 and 1979. Water use in acre-inches was: container nurserystock 53–170, forcing azaleas 86–114, miscellaneous greenhouse crops 33–87, field rhododendrons 19–36, deciduous trees 21–34, and conifer seedlings 8–164. Summer cooling and frost protection were responsible for the very high use in container nurserystock and conifer seedlings.

Water use in container production always exceeded 30 acre-inches and the acreage grown was much larger than other high users so this was the area needing research first. Water use in 3 gal. and larger containers is reduced with drip irrigation in many California nurseries but drip irrigation is not practical for smaller containers. In Europe where energy and water costs are high, sand beds and capillary matting are used for irrigation (3, 6). Trials in the U.S. have shown reduced water consumption and better growth with capillary irrigation (1, 4, 5).

Two level sand beds 7 × 30 ft. were constructed during 1982 using an Irish design. The beds were framed with 2 × 6 in. lumber and lined with 6 mil black polyethylene. A 4 in. tile in the bottom of the bed distributes water during the growing season and serves as a drain line when the plastic liner at end of the bed is lowered so the tile can be connected to a field drain during the rainy season. Water level is maintained 1 in. below the Mason sand (fine sand) surface by a stock tank float valve which requires no power. Water use by this system and by sprinkler irrigation with and without a tensiometer override were measured by water meters (Table 1).

A sloped (1 ft. fall in 78 ft.) sand capillary bed with 2 × 4 in. wooden check dams for each 2 in. fall was constructed in 1984. Water application through two drip lines was controlled by a "Water Bug", (Flowering Plants Ltd. England). The "Water Bug"

Table 1. Water use June through October, in inches, with several irrigation methods, 1983–85.

	1983	1984	1985
Level capillary sand bed	16.3	19.3	23.8
Sloped* capillary sand bed	—	—	24.9
Overhead irrigation	93.1	100.3	115.2
Overhead with tensiometer override	75.7	—	—

*Water Bug Control—Flowering Plants Limited

electronically senses the moisture content of the sand to determine when and how much water to apply.

Two potting mixes, 70 peat:30 fine sand, and 90 bark (½ in. minus):10 fine sand by volume were used in 1982 and 1983. Nitrogen at 1 lb per yd.^{3} from Osmocote 17-7-12 was used with both media in 1982. In 1983 and later years, the level of N was raised to 1.8 lbs per yd^3 of bark medium.

Two products, Gloquat "C", a quaternary ammonium chloride from England, and the herbicide Oryzalin-Surflan were used to control the major problems with out-of-door sand beds—weeds and emerging roots. Some plants, such as forsythia, which will root in water should not be grown on capillary beds but are good indicator plants for root control trials.

Test plants used in 1982 and 1983 were *Chamaecyparis lawsoniana* 'Ellwoodii' and *Erica erigena* (Syn. *E. mediterranea*), both of which are susceptible to root rot diseases. No root rot has developed in five years of operation. A number of other genera have been used since then including *Forsythia, Ilex, Juniperus, Photinia, Prunus, Rhododendron,* and *Viburnum.*

RESULTS

pRooted cuttings planted in 4 in. or 1 gal. containers in 1982 were shifted to 1 gal. and 3 gal. containers, respectively, for 1983. Height and width of Ellwood cypress and width of the heath were significantly greater with capillary irrigation than either overhead system. Plants grown in 70 peat:30 sand were larger and heavier than in 90 bark:10 sand, even with the increased level of nitrogen in the bark mix when they were shifted.

New heath cuttings potted in 1983 in bark:sand mix were larger with overhead irrigation than those in either bark:sand or peat:sand, with capillary irrigation. High salinity is the probable explanation for the decreased growth in 1983.

Trials in 1985 (Tables 2 and 3) were designed to evaluate pot type (solid or mesh) bottoms, chemical root control, and irrigation system on the growth and flowering of *Forsythia* × *intermedia* 'Lynwood'. Mesh bottom pots establish capillarity readily but also permit extensive undesirable root development outside of the pot. Gloquat "C" was the most effective root restricting treatment for

Table 2. Growth of *Forsythia* × *intermedia* 'Lynwood' as influenced by irrigation method and root control treatment, 1985.

Irrigation method	Root treatment	Height (cms)	Width (cms)	Number of branches	Fresh weight of emerged roots grams	Number of flowers nodes
Level	Check	70.5a	62.1a	22.5a	88.0b	74.0bc
capillary	Gloquat "C"	63.7ab	57.6ab	24.7a	15.2a	76.1bc
bed	Surflan	66.5ab	62.1a	22.9a	85.2b	65.4c
Sloped	Check	66.9ab	51.7bc	16.9b	175.6c	90.3ab
capillary	Gloquat "C"	59.0b	46.0c	16.3b	39.0a	97.9a
bed	Surflan	64.6a	49.4c	16.5b	166.3c	93.9ab

Numbers in a column followed by the same letters are not significantly different. Duncan's Multiple Range Test, 5%.

Table 3. Influence of irrigation method and pot type (solid or mesh bottoms) on growth of *Forsythia* × *intermedia* 'Lynwood', 1985.

Irrigation method	Pot type	Height (cms)	Width (cms)	Number of branches	Fresh weight of emerged roots grams	Number of flower nodes
Sprinkler	Solid	41.4c	40.0	24.7a	0.1a	110.3a
	Mesh	52.0bc	36.0d	24.4a	44.1ab	100.4ab
Level	Solid	71.9a	60.3ab	21.9a	72.3bc	61.8c
capillary bed	Mesh	69.0a	64.0a	23.2a	103.6cd	71.1bc
Sloped	Solid	62.2ab	49.1bcd	14.3b	148.1de	84.6abc
capillary bed	Mesh	67.7a	54.3abc	19.4ab	203.1e	96.1abc

capillary beds and provided longer weed control in the sand bed than Surflan. Weed and root control with Surflan was variable and in some trials was more effective than in the 1985 test. Plants were smaller but had more flower buds with sprinkler than capillary irrigation.

It was possible to grow plants in 4 in. to 3 gal. pots on the same capillary bed. With overhead irrigation, it is necessary to irrigate for the plant with the greatest water need and the other plants may receive excess water. The tensiometer override did reduce water use over a manually set time clock but did require some manual turning on when plants started to wilt in the porous media. Growth was also reduced with the tensiometer.

Water use with capillary irrigation was about 1/5 that of sprinkler application so it is possible to grow container nursery-stock with 30 acre-inches of water or less. Water use for capillary irrigation closely parallels evaporation from a free water surface.

Capillary irrigation does provide a method to use less water and to reduce use and run-off of fertilizers and other agricultural chemicals. In most cases growth will be as large or larger than with plants grown with overhead irrigation.

LITERATURE CITED

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PERLITE: START TO FINISH

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Few propagation mixes today are devoid of at least some perlite and so this common tie deserves elaboration. We will first identify its origins and processing and then examine how perlite uniquely meets traditional grower applications, with a passing comparison to several other inorganic amendments.

Origins—Perlite is found worldwide as a naturally occurring igneous glassy rock (an amorphous silicate) similar to obsidian and rhyolite. It is distinguished from them by possessing 2 to 6% combined water collected from free surface or atmospheric moisture present as it cooled. The raw rock ranges from translucent to gray or black and is quite friable, with a loose density of 60 to 70 lbs./ft.^{3}.

Perlite ore is generally surface mined via tractor ripping and scraping. The ore is then crushed, dried and screened, to size segregate it, before being transported by truck, railcar, or barge to expansion plants.

Processing—Precision expansion of a variety of finished products is achieved by proper selection of ore size, furnace draft and temperature. Processing consists of heating the ore from between 1100° to 1600°F, so that, while the outer kernel softens, the bound water abruptly flashes to steam and is released from the