The Effect of Irrigation Systems and Peat Grade on the Production of *Hebe* 'Mrs. Winder'

C. Kirkland and A. Hunter
Dept. of Crop Science, Horticulture and Forestry, University College Dublin, Belfield, Dublin 4, Ireland

M. Maher
Teagasc, Kinsealy Research Centre, Malahide Road, Dublin 17, Ireland

M. Prasad
Bord na Mona Research Centre, Newbridge, Co. Kildare, Ireland

The performance of ebb and flood, capillary, and overhead irrigation systems was compared using rooted plants of *Hebe* 'Mrs. Winder' in 2-litre containers, with peat-based growing media having air filled porosity (AFP) values ranging from 5% to 25% and containing standard recommended doses of controlled-release fertiliser. The plants attaining the greatest height were produced on the ebb and flood beds. Plants on the capillary beds were smaller and attained the lowest root index. Plants on the overhead-spray beds were like those of the capillary beds but scored more highly for marketability. Even with Mypex sheeting, rooting-through occurred on the ebb and flood beds but not on the capillary beds. The most water efficient irrigation system was ebb and flood. Overhead was the poorest.

INTRODUCTION

Within Ireland, the nursery stock industry produces plants mainly using overhead irrigation systems with plants growing in a peat medium, fertilised by a controlled-release fertiliser (CRF). In such circumstances excess water supply drains away to become waste water. However, concerns about environmental pollution, water shortage and, to a lesser extent, water prices, may in the future lead to the introduction of regulations governing the capture and recirculation of water, as in Germany (Bruns, 1994).

This trial compared the performance of the plants grown on ebb and flood, capillary, and overhead sprayline irrigation systems, using CRF. The use of five growing media with a range of air-filled porosity (AFP) values with each irrigation system was included, to determine whether AFP interacts with these irrigation systems to affect plant performance (Verdonk and Gabriëls, 1988; Michiels and Hartman, 1993).

MATERIALS AND METHODS

Peat fractions were obtained by passing peat through graded sieves. (Prasad and Maher, 1993). These fractions were used alone or in mixes to attain a range of AFP values determined using test cylinders (Byrne and Carty, 1989) (Table 1). Rooted cuttings of *Hebe* 'Mrs. Winder' were potted into 2-litre pots, which were placed on the

irrigation beds in May 1995 Twelve independent irrigation beds, each measuring 5 m × 2 m were used. The beds were each plumbed back to an individual reservoir The plants were irrigated using water direct from the reservoir Nutrition was provided by 12-14 month Osmocote Spring (15N-9P_2O_5-11K_2O), at 5 kg m^{-3}

Table 1. Peat grades used in the experiments and their corresponding AFP value

Peat grade	AFP (% volume)
100% 0-3	5
100% 0-10	10
Nursery stock grade[1]	15
80% 6-12 mm, 20% 0-10mm	20
80% 10-25 mm, 20% 0-10mm	25

[1]A commercially available blend for 2-litre pots for the nursery stock industry

The experiment was of a split plot design. Each plot of three irrigation systems was replicated four times The five AFP treatments were replicated four times within each irrigation system.

The plants were assessed in December 1995 for height, marketability, and vigour of the plants; and April 1996 for height, fresh weight, and a root score Marketability and vigour were subjective assessments, based on the attractiveness of the plant relative to others and the plants' overall growth rate in terms of height, branching, and density of foliage. Plants received a score on a scale of 1 (poorest quality) to 10.

Table 2. The effect of peat grade on the performance of *Hebe* 'Mrs Winder'

	December		April			
Peat AFP	Vigour	Marketability	Height (cm)	Height (cm)	Fresh wt (g/plant)	Root index
5	6 0	5 9	36 4	37 9	190 7	8 8
10	6 0	6 0	35 3	37 3	194 6	8 8
15	5 9	5 9	35 4	36 7	184 7	8 5
20	6 2	6 0	36 1	37 5	191 3	8 7
25	5 8	5 7	34 9	36 2	171 9	8 3
F test	NS	NS	NS	*	***	*†
S E	0 15	0 14	0 41	0 41	3 84	0 11

RESULTS

The effect of AFP on plant performance is shown in Table 2. At the December 1995 assessment, there was no significant effect of AFP on plant growth within any of the irrigation systems for the characters assessed. But there was a significant effect of AFP on fresh weight, height, and root index at the April 1996 assessment. Plants grown in the peat grade with the highest AFP value (25% volume) were the smallest in height and scored lowest for fresh weight and root index. Plants with the greatest fresh weight were those growing in peat with 10% AFP. Very little additional growth was recorded between December 1995 and April 1996 because of the late start to the 1996 growing season.

Plants on the ebb and flood (E/F) bed were the most vigorous, tallest and had gained the greatest fresh weight by the end of the trial (Table 3). Those on the capillary beds (Cap) scored lowest for height, fresh weight, and root index. Plants grown under overhead spraylines (OH), although smaller than those of the ebb and flood beds, attained a higher marketability score because they were more compact with shorter internodes and a better foliage colour.

Table 3. The effect of irrigation on the performance of *Hebe* 'Mrs. Winder'.

	December		April			
Irrigation system[1]	Vigour	Marketability	Height (cm)	Height (cm)	Fresh wt. (g per plant)	Root index
E/F	6.3	5.7	36.0	37.4	203.8	9.8
Cap	5.2	5	33.4	35	155.8	7.3
OH	5.1	7.1	34.0	35.5	181.9	9.0
F test	***	***	**	**	***	***
S.E.	0.24	0.23	0.39	0.42	5.94	0.19

[1] Abreviations: E/F, ebb and flow; Cap, capillary; OH, overhead spraylines

Table 4. EC and Ca levels on the top and bottom half.

	EC(mS cm^{-1})		Ca(mg $litre^{-1}$)	
Irrigation system[1]	Top	Bottom	Top	Bottom
E/F	1.57	0.56	121	55
Cap	4.10	1.71	210	98
OH	0.75	0.72	55	41

[1] Abreviations: E/F, ebb and flow; Cap, capillary; OH, overhead spraylines

Plants grown on the capillary (Cap) beds scored the lowest root index. This was because root growth was concentrated in the centre of the pots and were poorly distribution in the upper and lower regions of the growing medium.

At the end of the trial the growing medium electrical conductivity (EC) levels for containers from the capillary beds were more than double those of media in containers from the ebb and flood beds, and more than five and a half times those for media which had been under the overhead spraylines (Table 4).

Plants grown on the E/F beds rooted into the gravel under the Mypex. This was not the case with the plants grown on the capillary beds. Rooting through occurred to a lesser extent on the overhead spray lines.

DISCUSSION

The low scores recorded for plants grown in peat with an AFP of 25%, may have been because the high air filled porosity reduced water availability to the plants. This reduction may have been a limiting factor for plant growth. A significant difference between the peat grades was expected (Bragg and Chambers, 1988).

The poor performance levels attained by the plants grown on the capillary beds, may be a result of the build up of salts within the pots, as shown by the EC levels recorded at the end of the trial. The summer of 1995 was unusually warm and dry. This resulted in little or no leaching of salts from the pots by rainfall and the continual build up of salts in the upper section of the pots by evaporation from the surface of the peat. Beel (1988) recorded a similar situation with greenhouse plants where, after 4 weeks, the salt concentration in the upper part of the pots was twice as high as the bottom. The base of the pots on the capillary beds was also continuously saturated because of the capillary action of the water. This basal saturation, combined with the build up of salts in the upper regions of the pot, reduced the volume available for root growth.

The high water table of the capillary beds prevented rooting through of the plants. Rooting through occurred on the ebb and flood beds which provided stability during windy weather but caused problems when removing the plants from the beds. These results are contrary to those found of Labous and Willis (1994), which showed rooting through to be most severe on capillary beds and negligible in gravel beds. The reason for this difference, may be because the pots on the ebb and flood beds, in the Writtle trial, were flooded to a depth of 12 mm for 1 h, while in this trial the pots were flooded to a depth of 5 cm for 5 min. This reduced the time of basal saturation during which the roots are deprived of oxygen and may die.

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