Watering Container Plants Five Different Ways

John Clemens, C. Bruce Christie and **Chris J. Barnaby**
Department of Horticultural Science and the New Zealand Nursery Research Centre, Massey University, Palmerston North

INTRODUCTION

Irrigation affects the growth and quality of container plants in nurseries. Factors of importance may be the frequency and intensity of watering, and the quality of the water supply. Of fundamental significance, however, may be the very way in which the water is delivered to the plants (Welsh, 1989) Many nurseries rely heavily on overhead sprinkler systems; at the same time there has been enthusiastic advocacy of subirrigation systems, such as, those incorporating capillary and ebb-and-flood methods. A container plant growing-on area was established in the open at the Nursery Research Centre in which different irrigation regimes could be compared.

There were a number of objectives that could be wholly or partially fulfilled by the use of the facility Firstly, it was intended as a demonstration area; a place where people from the New Zealand nursery industry could gather ideas and get a feel for the effects different irrigation methods (and other factors interacting with irrigation) could have in their production systems Secondly, there was a need to carry out applied research to assess the effects of, for example, irrigation, fertilisers and herbicides on plant performance. Thirdly, physiological measurements needed to be made to shed light on the reasons for differences in plant performance, and in this regard plant nutrient status and water relations measurements are in progress Lastly, there is a need to understand at a fundamental level the factors affecting the movement of water into and through the plants with a view to predicting how different irrigation systems are likely to perform under different climatic regimes.

For demonstration purposes the comparative irrigation facility has received considerable interest The results of some of our first growth trials are described below.

MATERIALS AND METHODS

A comparative irrigation facility was established at the New Zealand Nursery Research Centre in spring 1989 in which five different irrigation regimes (and treatments applied to plants within them) could be compared. Each of the irrigation treatments was applied to an area of approximately 7 5 m^2, these being contiguous and randomly assigned to positions with three blocks. The effect of one irrigation treatment on its neighbours was minimised by the use of low, transparent baffles and of guard rows surrounding a central area used for experimental plants. The facility was not covered and plants were grown under ambient conditions.

The five irrigation treatments were: 1) a constant water table capillary system in which pots were placed on capillary sand kept continuously moist, 2) an ebb-and-flood system in which the bottom 50 mm of the pots (which were raised up on wire supports) was submerged nightly for approximately 60 min before the water was drained away; 3) a drained capillary sandbed system in which the capillary sand on

which the pots were stood was moistened twice daily (20-30 min) by surface emitters, the excess water draining away between each irrigation; 4) an overhead sprinkler system in which water was applied nightly (20-45 min) to plants standing on a drained capillary sandbed as in 3 above; and 5) an overhead sprinkler system as in 4 above except that the pots were placed on a course (10-20 mm) aggregate to deny the plants capillary watering

Two sets of experiments, each lasting approximately 6 months, were established on the comparative irrigation facility. In each case liners were potted into rigid plastic pots (2.5 l, 175 mm diam, RX Plastics Ltd, Christchurch, NZ) that had completely flat bottoms with holes designed for capillary uptake of water from moist, level surfaces. A standard peat and pumice potting mix (80:20, v/v) containing (unless otherwise indicated) Osmocote (Sierra Australia Pty Ltd, Australia) controlled-release fertilisers (N:P:K: 18:2 6:10, 8-9 mo, 1.44 kg/m^3; 14:6 1:11.6, 3-4 mo, 0.5 kg/m^3), PG Mix (Smiths Horticultural Distributors Ltd, New Zealand) (N:P.K:14.7:14.9, 1 44 kg/m^3) and finely-divided dolomite (3 kg/m^3). In general there were 3 external replicates (blocks) of all irrigation treatments and 3-5 internal (single plant) observations of each treatment within these. Data were subjected to analysis of variance and means taken as significantly different for $p<0.05$.

In the first experiment (established November 1989) plants of *Eucalyptus regnans, Raphiolepis umbellata* and a *Coprosma* cultivar were grown under the five irrigation treatments. Half of the plants were grown with the standard fertilisers added to the potting medium, the remainder receiving half of this amount. At the conclusion of the experiment the plant tops were harvested and measurements made of leaf area, and leaf and stem dry weights. In the second experiments (established May 1990) various treatments were applied to plants of *Coleonema pulchrum* 'Sunset Gold', *Photinia* × *fraseri* 'Red Robin', *Citrus limon* 'Meyer' and the *Coprosma* cultivar which had been supplied as liners heavily infested with liverwort *(Marchantia)*.

Plants of *Coleonema* were potted into the potting mix which had been amended by addition of different rates of dolomite (0, 1, 3,5 and 10 kg/m^3). The mix also had a liverwort inoculum incorporated (ca 10% v/v) which was of heavily infested material collected immediately prior to potting from the surface of the liner growing medium. Pots were placed on the constant water table capillary and the overhead drained irrigation systems. There were 3 blocks and 2 internal replicates. Liverwort coverage of the surface of the growing medium was recorded after 6 months and the tops of the plants harvested and dry weight recorded. Again using plants of *Coleonema* and the liverwort inoculum, five fertilizer treatments were applied to the potting medium: 1) the standard mix, 2) standard mix at half rate, 3) as for #1 without the 8-9 mo Osmocote, 4) as for #2 without the 8-9 mo Osmocote, and 5) no fertiliser (control). Plants were grown under the 2 irrigation regimes. Liverwort coverage of the surface of the growing medium was estimated on a 1-10 scale at the end of 6 months. Plants of *Photinia, Citrus* and *Coprosma* were potted into the experimental pots (on this occasion without the incorporation of a liverwort inoculum) and grown under two irrigation regimes (constant water table capillary and overhead drained systems) Immediately after potting, 7 preemergence herbicide treatments were applied to the surface of the potting medium. These involved 3 levels (the recommended or normal rate, half and double the

recommended rate) of Rout Ornamental Herbicide (oxyfluorfen 2% and oryzalin 1%, Sierra Chemical Company, USA), 3 levels of Ronstar SG (oxadiazon 2% and simazine 0.5%, Rhone-Poulenc New Zealand Ltd, NZ) and a control with no herbicide added to the surface. Herbicides were applied as directed by the manufacturer. Plants were harvested at the conclusion of the experiment, shoot dry weights recorded and surface cover of liverwort estimated.

RESULTS AND DISCUSSION

The results of these trials are shown in the accompanying figures. These show that there were large differences between the irrigation methods in terms of plant growth. In general, any irrigation regime that delivered water to the base of the pot rather than to the growing medium surface gave better plant growth. Over a number of trials, including some not reported here, the constant capillary system outstripped the overhead drained system by 25-50%. Other systems were of intermediate performance (Figure 1).

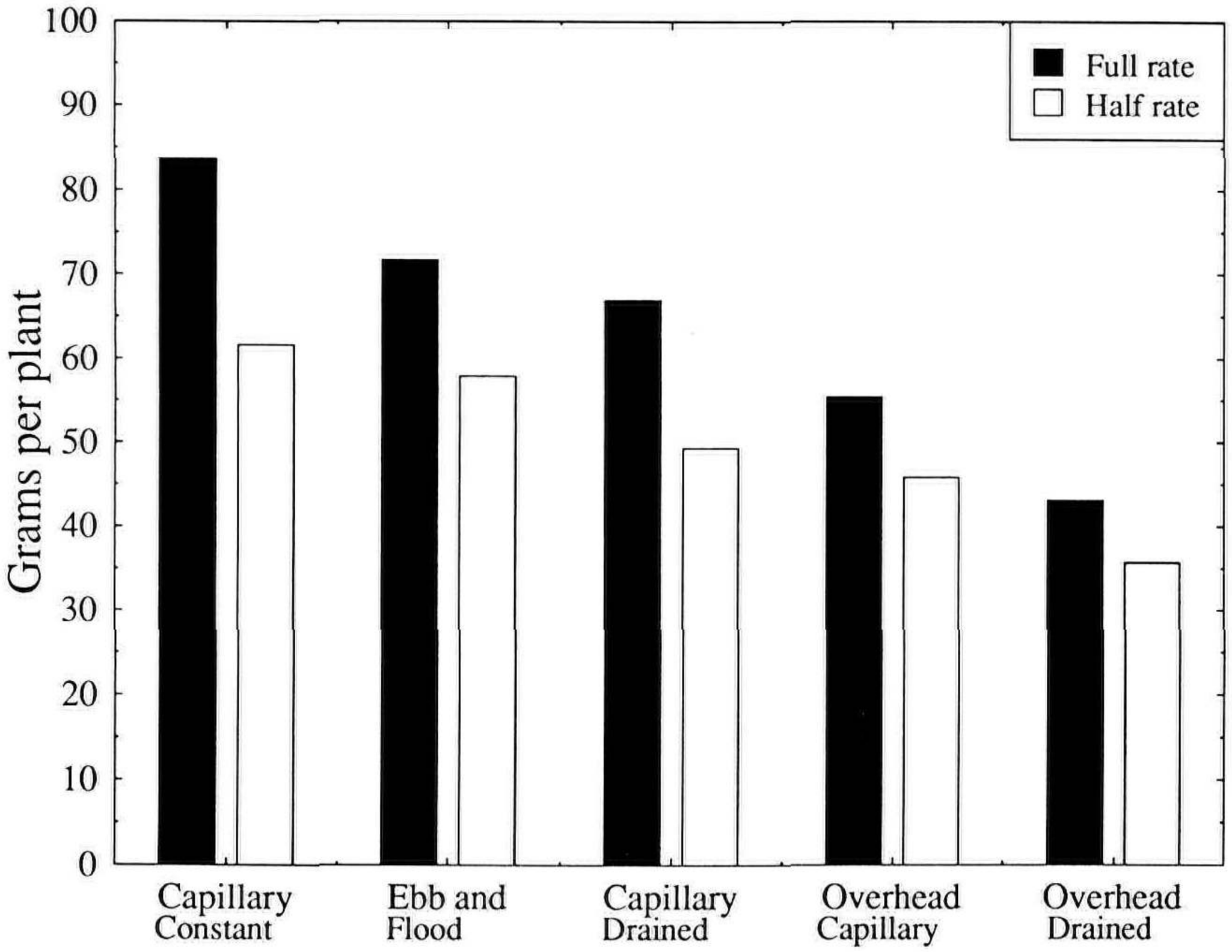

Figure 1. Effect of irrigation method and level of fertilizer on shoot dry weight of *Eucalyptus regnans*.

Liverwort growth on the surface of the potting medium could be a problem, particularly with plants irrigated by the capillary systems. Rout and Ronstar SG herbicides controlled this adequately for both constant capillary and overhead drained irrigation (Figures 2). The herbicides gave little evidence of toxicity to *Coprosma* and *Photinia* with plants in all herbicide treatments growing as well or better than controls. When treatments gave better growth than controls, e.g. normal rate of Rout applied to *Photinia*, presumably this was due to release of the

plant from competition with the liverwort coupled with no undesirable effect of the herbicide on plant growth (Figure 3).

Not surprisingly, when liverwort was deliberately mixed with the potting medium, the higher the level of fertility the better the liverwort grew on the surface. Pots with no added fertilisers had the lowest levels of this weed (5 and 28% ground cover in overhead drained and constant capillary respectively). Increasing the level of dolomite in the mix to 10 g/l raised the pH to approximately 6.5. At this dolomite rate liverwort ground cover was reduced from 85-100% in the controls to approximately 65%, indicating that amendments to increase pH may be of use as part of a strategy to control this troublesome weed.

Coprosma and *Photinia* responded to the irrigation treatments as anticipated. However, the *Citrus* grew poorly under both experimental irrigation treatments and there was no significant difference between the treatments at the time of harvest. Growth of the *Citrus* was also significantly lowered by the herbicide treatments.

Large differences have been demonstrated as a result of the applied treatments. However, a slightly different or possibly a qualitatively different picture may have emerged had the treatments been applied in a different growing environment, for instance, with heavier rainfall or greater evaporative demand. Altering the specification for the treatments may also have led to different results. It is likely

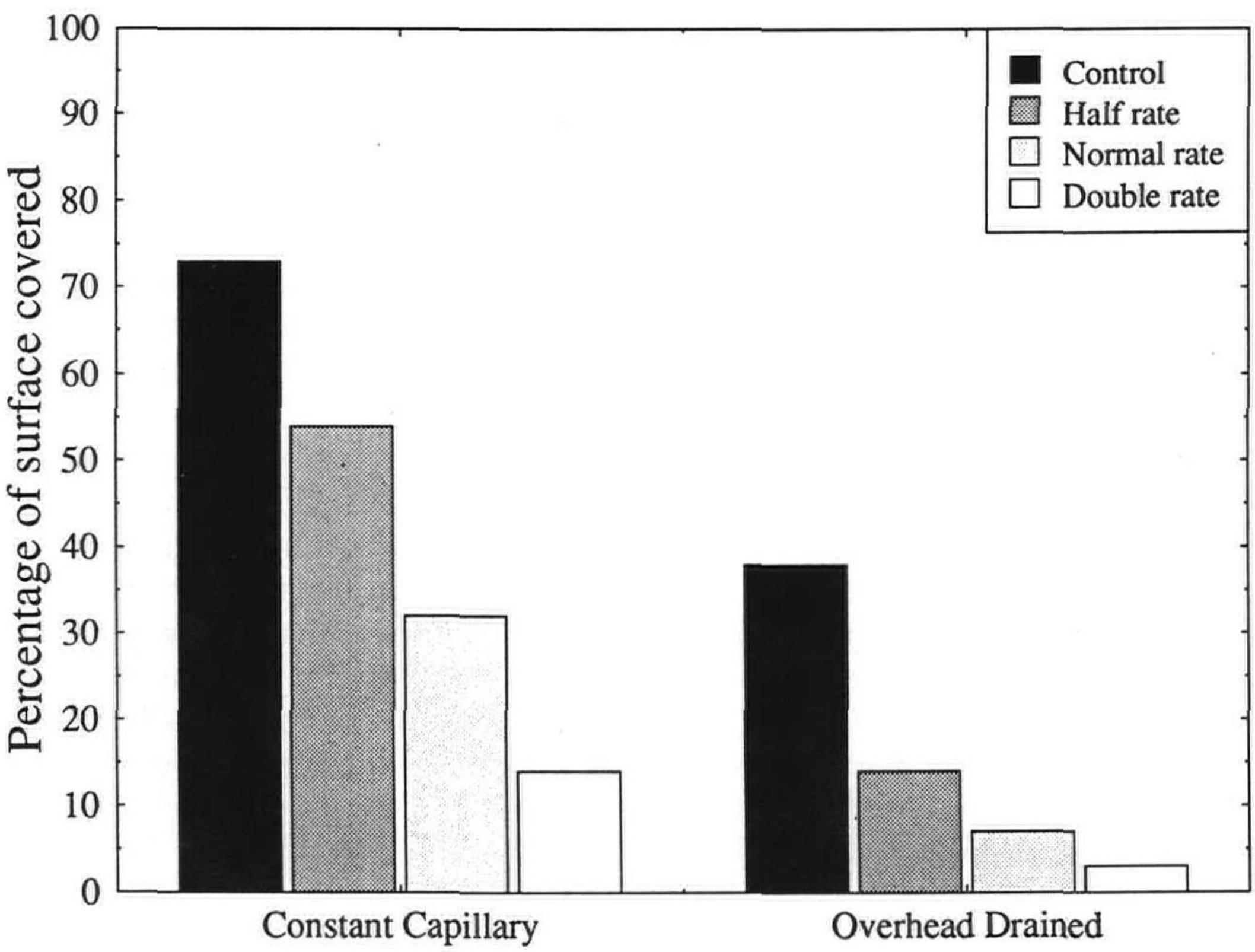

Figure 2. Effect of two irrigation methods and Rout herbicide on coverage of container medium surface by liverwort.

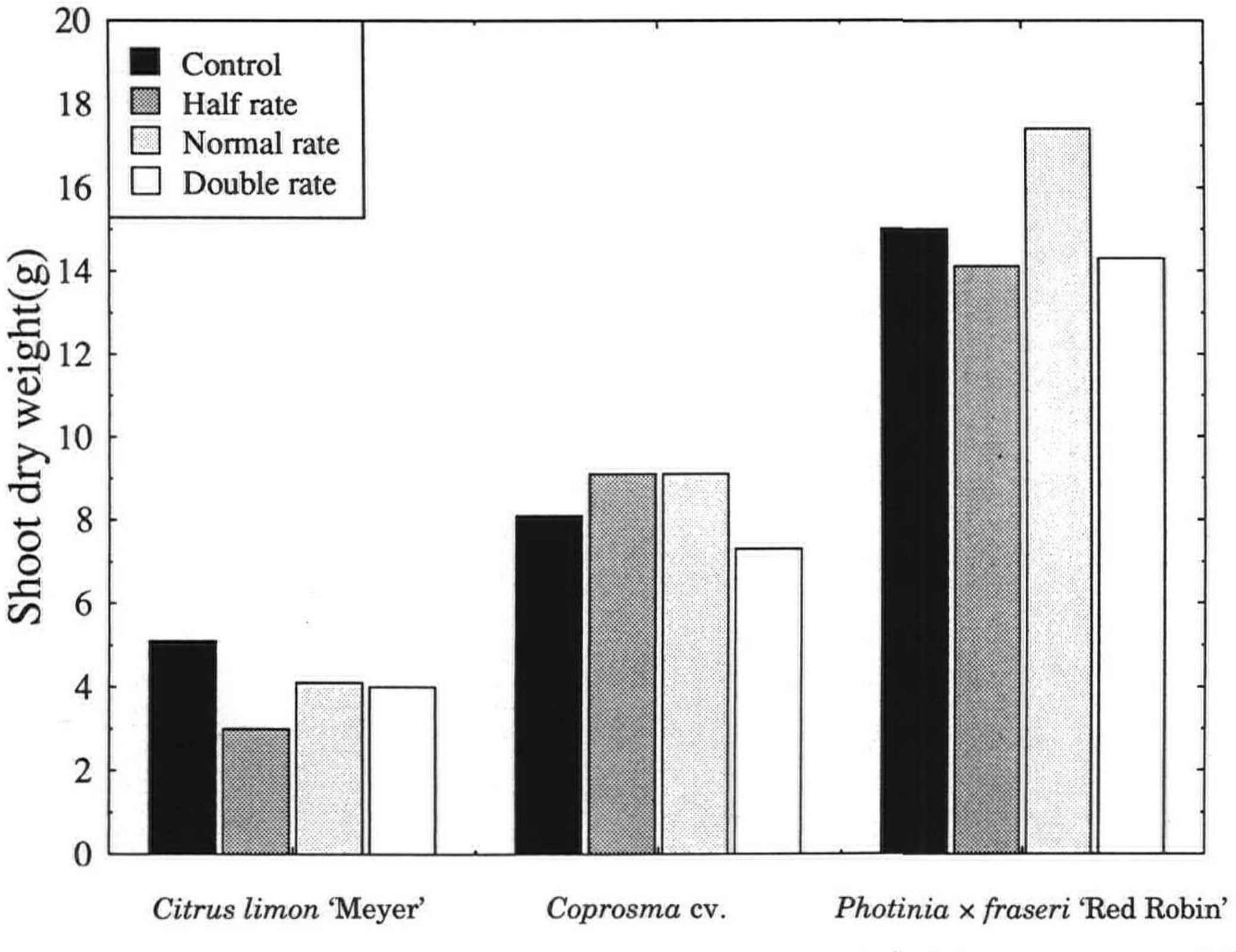

Figure 3. Effect of Rout herbicide on growth of three container plants.

that the better performance of the subirrigation treatments was due to less leaching of available medium nutrients. Water stress experienced between irrigation episodes was unlikely to have caused such depressed growth in the overhead irrigated plants.

It is clear that although the capillary systems have their advantages, especially the constant water-table system, there is still a need for fine tuning of the interacting factors including irrigation frequency, intensity and timing, growing medium, pot dimensions and the plant itself. In attempts to optimise these factors to promote plant growth and quality, there is a need to consider weed control and factors not covered in this paper, such as, cost of establishment, the hardening off of plants (Clemens and Jones, 1978) and rooting from the pot into capillary beds. For weed growth, standard hygiene practices will have a dominant role to play. Fertiliser formulations and levels appropriate to the irrigation system being used would also be beneficial.

LITERATURE CITED

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