Multiple Pot Box for Container Plant Production[1]

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Abstract

Viburnum odoratissimum (Ker-Gawl.) plants were grown for 15 weeks in 3-liter (#1) containers in black multipot boxes that contained a water reservoir and in a conventionally spaced system on black polypropylene. Irrigation events were based on plants in multipot boxes which resulted in under-watering of plants in conventionally spaced containers. Plants grown in the multipot box production system had higher shoot and root dry weights as compared to plants grown in conventionally spaced containers, and their growth indices of the plants in multipot boxes increased at a greater rate than that of plants from the conventional system. Approximately 210 mm (8.3 in) of overhead irrigation was applied during the experiment, in addition to 340 mm (13.3 in) of rain.

Index words: overhead irrigation, nursery crops, container production.

Significance to the Nursery Industry

Production of 3-liter (#1) *Viburnum odoratissimum* plants in multipot box with a water reservoir substantially reduced the requirement for supplemental irrigation. The quantity of irrigation water applied to the multipot box system was about 84% less than that applied using the common practice of irrigating with overhead sprinklers delivering 13 mm (0.5 in) per day. Water from overhead irrigation and rain, that normally is lost between the pots, was collected in the reservoir of each box and later supplied to plants by subirrigation. Multipot boxes used in this experiment contained nine plants and were constructed of fiberglass painted black for UV protection.

Introduction

Production of marketable plants requires that containers be spaced several inches apart to allow for canopy growth. Due to this spacing, a large portion of the water applied through an overhead irrigation system falls between containers, and is unavailable to the substrate within a container (3, 8, 11). Spacing requirements and additional irrigation volumes required to compensate for deflection of overhead irrigation by plant canopies result in the application of irrigation volumes in excess of plant requirements. Consequently, only about 15 to 60 % of the irrigation applied is captured in containers for plant use (3, 11). Despite its inefficiency, overhead irrigation is typically the only economically viable method to supply water to plants grown in containers smaller than 18-liters (#5) because material and labor costs make microirrigation too expensive at current and projected plant market values (10). Microirrigation for large-scale outdoor production is also often limited by poor water quality that requires filtration and chemical water treatment, damage to irrigation tubes by rodents and workers, and the inconvenience of water lines and small tubes in growing areas.

Future water regulations affecting Florida's nursery industry may require an application efficiency of 75% for overhead sprinkler irrigation systems. The states of California, Texas and Oregon already have discharge permit programs for the nursery industry (1). Although each state's program differs, most permits require containment of all irrigation return flows and require that all or part of rainfall runoff be collected. These regulations can only be met by constructing large and costly retention ponds or modifying the present production systems.

Briggs and Green designed and tested The Closed Insulated Pallet System (CIPS) (5) where water retained in the pallet reservoir was available to the plants by a wick suspended from the containers. The container surface was covered with a foil disc and sealed around the plant stem with urethane foam and was not designed to capture rain or overhead irrigation.

The research presented here was conducted to evaluate a multipot box as a means of increasing the efficiency of overhead irrigation in container plant production.

Material and Methods

Multipot box description. Multipot boxes were constructed in two sections from fiberglass which was painted black for UV protection (Fig. 1). The lower section had four longitudinal channels that formed water reservoirs with three ridges, sized so that the box can be moved by placing fork lift tongues under the outer ridges. Each ridge was covered with 3 mm thick unsupported polyester (Troy Mills, Inc., Troy, NH) to serve as wicking material. The upper section fitted within the lower piece and had round holes [150 mm (6 in) diameter] that enabled container plant foliage to extend above the surface while the containers rested on the ridges. Boxes were designed to be placed end to end. The surface of the upper section was concave around each hole to increase the effective surface area and capture most overhead irrigation water. The lower section of the box stored the captured water and was provided with holes on both ends of each water reservoir between the ridges (total of eight holes per box) to provide sufficient drainage for the substrate in the containers. They were 13 mm (0.5 in) in diameter, located at the edge of

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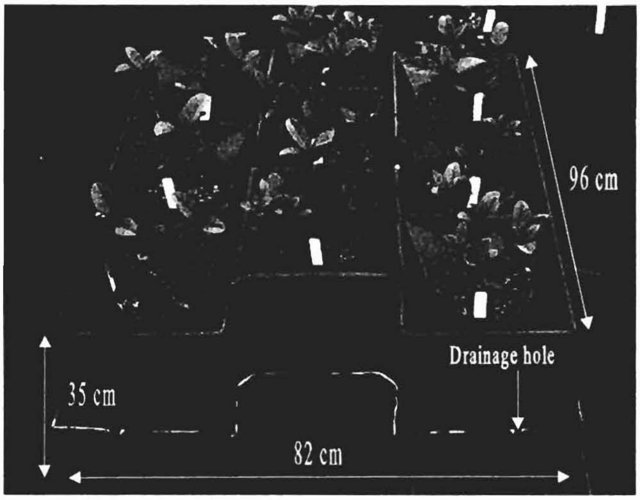

Fig. 1. Photograph of multiple pot box that contains nine #1, 3-liter (1 gal) containers.

the lower section of the box, and 100 mm (4.0 in) from the bottom (Fig. 1).

Experimental procedures. The field research experiment was located in Gainesville, FL. A substrate of pine bark, Canadian peat, and sand (2:1:1 by vol) mix, amended with 4.2 kg (7 lb) of dolomitic limestone and 0.9 kg (1.5 lb) of Micromax (The Scotts Company, Marysville, OH) per m^3 (yd^3), was placed in seventy-two, black #1, 3-liter (1 gal) containers. Half of the containers (C-650 the Lerio Corporation, El Campo, TX) were modified by drilling four equally spaced holes in the bottom of the containers to assure contact with wicking material in the multipot boxes. Each hole was 13 mm (0.5 in) in diameter and 19 mm (0.75 in) from the bottom edge. On September 5, a multiple branched liner of *Viburnum odoratissimum* was planted in each container by removing the substrate and refilling the container. Plants were hand-watered as needed for four days. A multipot box containing nine plants and the same number of plants in conventional containers set on black polypropylene ground cloth were placed in the center of each of four irrigated areas 6.1 m × 6.1 m (20 ft × 20 ft) on September 9. Conventional containers were spaced in three rows 30 cm apart (1 ft centers). Each area was irrigated with four sprinkler heads (PGM-04-A, Hunter Industries, San Marcos, CA) mounted at 1.3 m (4.3 ft) and located at the corners of each area. Irrigation water was applied at a rate of 18 mm/hr (0.7 in/hr) with a uniformity of 90% (Christensen Coefficient 0.9, (4)). Each container received a topdress of 14 g of Osmocote 18N–2.6P–9.7K (18–6–12) controlled-release fertilizer (The Scotts Company, Marysville, OH) September 9. A copper-constantan thermocouple was placed in the center of the substrate of the center container of each treatment and block at a depth of 76 mm (3 in). Temperatures were recorded daily at 1200 hr using a CR10 data logger (Campbell Scientific, Inc., Logan, UT). Ambient temperatures were measured with a sun-protected thermocouple 1.5 m (5 ft) above grade.

Plants were irrigated for 1.7 hr on September 14 and 0.5 hr daily on September 17–25. Subsequent irrigations were applied when the reservoir in the bottom of the boxes receded to approximately 25 mm (1 in) and continued until

Table 1. Dry weights of *Viburnum odoratissimum* grown 15 weeks in 3-liter containers in multipot boxes or in conventional production system.

Production system	Shoot dry weight	Root dry weight
Conventional	7a[z]	3a
Multipot box	28b	9b

[z]Means (n = 36) significantly different by F-test ($P = 0.05$).

depth of water in the reservoir was about 60 mm (2.5 in). The depth of water in the reservoir was measured by placing a wood dowel vertically through a hole in the box surface. Rainfall was collected in a rain gauge and recorded. Initial plant heights were recorded by measuring from the substrate surface to the tip of the tallest leaf. Plant widths were recorded in EW and NS directions. Measurements were repeated every 13–14 days for a total of six times. A growth index (GI) was calculated as the average width plus height, divided by 2. On December 20, plant stems were severed above the uppermost roots, substrate washed from roots, and root and shoot dry weights determined after drying to a constant weigh at 70C (158F).

Results and Discussion

Mean shoot and root dry weights of plants grown for 15 weeks with the conventional container system were lower than weights of plants grown with multipot boxes (Table 1). The lower dry weights for the conventional system were due to the limited amount of irrigation applied (Fig. 2). These plants wilted periodically during the experiment and had smaller increases in GI as compared to plants grown in multipot boxes (Fig. 3). Fifteen weeks (November 19, 1996) after initiation of the experiment, plants in multipot boxes were marketable according to Florida Grades and Standards (1) at the grade of 'Florida Fancy' for 1 to 2 gal category. On the same date plants in conventionally spaced containers did not meet this category.

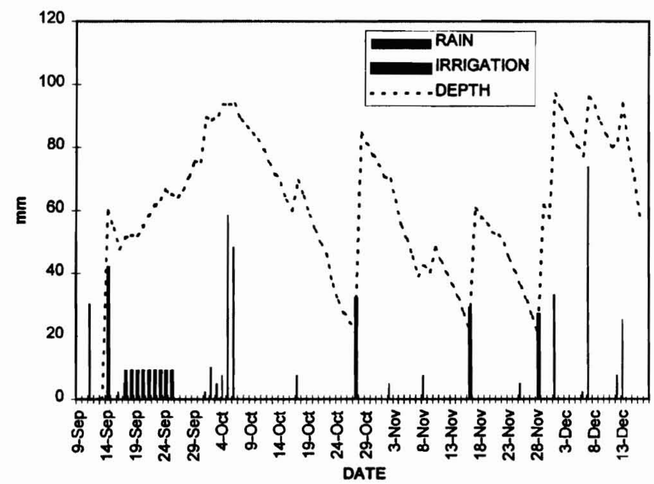

Fig. 2. Overhead irrigation, rainfall, and average depth of water collected to grow *V. odoratissimum* in #1, 3-liter (1 gal) containers in multipot boxes with a water reservoir or spaced 30 cm (1 ft) apart.

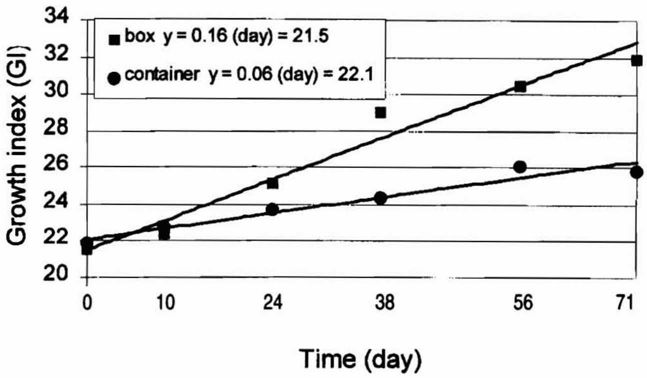

Fig. 3. Growth index [(average width + height) / 2] of *V. odoratissimum* grown for 15 weeks in #1, 3-liter (1 gal) containers on black polypropylene or grown in black multipot box. Slopes different by t-test at *P* 0.05.

The total amount of water applied by irrigation during the 15-week experiment was 210 mm (8.3 in). According to the literature, typical water application in container nurseries is between 13 and 25 mm/day (0.5 and 1.0 in/day) of water (7, 9, 4). Assuming the most conservative amount of 13 mm/day (0.5 in/day), presented by Harrison (9), a nursery operation with the conventionally spaced container system would apply about 1360 mm (53 in) of irrigation during the time of our experiment. The most commonly reported amount of irrigation, 18 mm/day (0.7 in/day) (7,4) would result in a total of 1,880 mm (74 in) of water applied.

After the initial nine irrigations for plant establishment, plants were irrigated only three times because rain (Fig. 2) provided adequate water for plants grown in multipot boxes. The maximum collection of water in the boxes, 95 mm (3.7 in), was obtained four times during the experiment (Fig 2). This indicates that an overflow occurred and that during the frequent/large rain events of October 1–6 and December 1, 7, and 13, a significant portion of the rainfall was not 100%

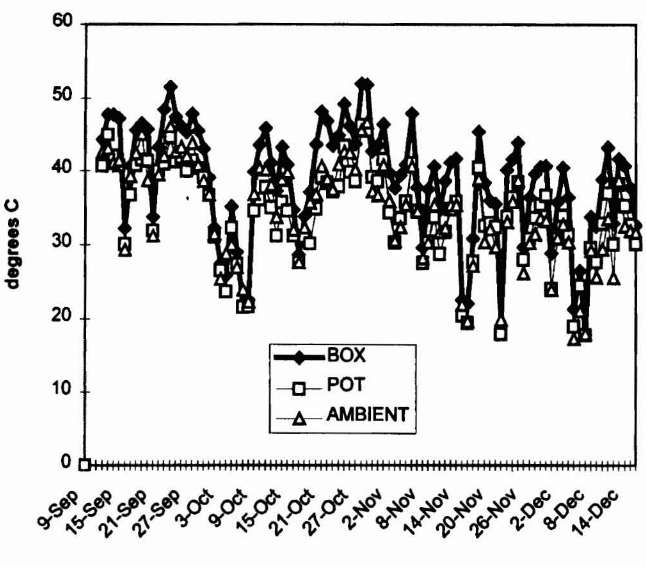

Fig. 4. Temperatures recorded daily at 1200 hr in the center of a pine bark:Canadian peat:sand (2:1:1 by vol) substrate in #1, 3-liter (1 gal) black plastic containers spaced 30 cm (12 in) apart, or placed in black multipot boxes, and ambient temperature.

effective because the total rainfall exceeded reservoir capacity in the boxes. Smaller rainfall events, distributed in time, were highly effective since the water was stored in the reservoirs and available for later use by the plants. The total rainfall during the experiment was 338 mm (13.3 in). The longest time without rain was 16 days. Other extended rainless times were 10, 13, and 15 days.

Temperatures in the center containers in the multipot boxes were often 40 to 50C (104 to 122F), a temperature higher than those of containers spaced 30 cm apart (1 ft), and higher than ambient temperatures at 1200 hr (Fig. 4). The high temperatures were most likely due to the limited air circulation within the multipot boxes. Even though temperatures were higher in containers of multipot boxes, the root mass was larger. It is possible that the root growth could have been even larger with slightly lower maximum temperatures. We did not determine the duration of high container temperatures in our study, although multipot boxes may not have had the wide daily fluctuation in temperature that occurs in spaced black containers. Higher temperatures at night combined with readily available water in the root zone could have contributed to faster plant growth. Further research is necessary to confirm that hypothesis.

Data from this experiment indicate that marketable 1-gal (#1) *Viburnum odoratissimum* can be produced in 3 months using multipot boxes. Typical production time for *Viburnum odoratissimum* is 6 months when liners are placed in one-gallon containers in the middle of March and irrigated 15 mm/day (0.6 in/day) (Beeson, unpublished). Six months is also a typical time quoted by Florida growers.

Over 4 months of experiment, 84% less water was applied to the multipot boxes than would have been applied with an overhead irrigation system that delivered 13 mm (0.5 in) daily. According to Beeson and Haydu (4), the plants require at least 18 mm (0.7 in) per day to avoid water stress during peak evapotranspiration. Using this less conservative water application, the water savings would amount to 89% during 4 months.

The experiment was conducted during months of relatively low rainfall in North Florida. The water savings can be only greater during other months when the rainfalls are more frequent. It is likely that during the rainy season only the first irrigation may be necessary and the rest of needed water can be provided by the rain.

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