soil moisture was depleted) to activate the sprinkler system controller. Tensiometer cups were placed in the area of maximum root zone, and the depths were changed as the roots developed. Each variety of plants of the same stage of growth contained two tensiometers. The clock was set to operate the sprinkler at 3 a.m. following activation by the tensiometers. This hour was chosen because wind velocities were low and operation was convenient. The main advantages of this system over the manually operated system included the relatively precise determination of water need by the tensiometers, and that less water was used annually (about 5 ft) with less dependence upon labor.

Benefits

Irrigation costs with hand watering were 2 cents per can per year; with manually operated sprinklers, .5 cent per can per year; and with automatic sprinklers, .1 cent per can per year. In determining these comparative costs, the basic water supply components of pipes and pumps were not included, since they remained the same in all three methods of irrigation. Actual costs, therefore, were slightly more than the above. The sprinkler systems were amortized over a ten-year period.

Savings in water (purchased at a rate of $30 per acre-foot) plus visual improvement of growth and relief from worry influenced the cooperator to adopt the automatic system for his entire nursery.

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Irrigation for nursery container plants . . .

PLASTIC TUBE IRRIGATORS WITH ELECTRIC CONTROL

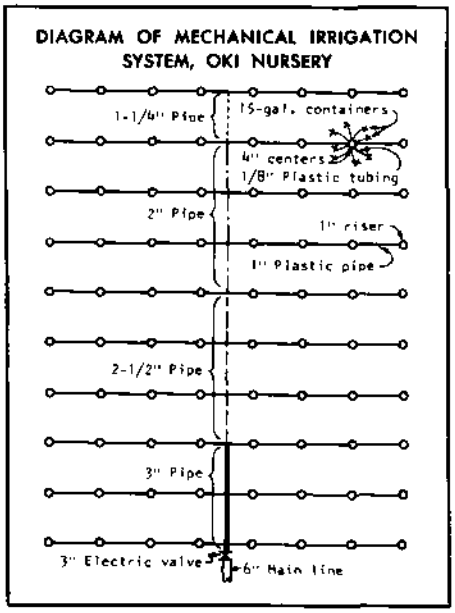
N. W. STICE · L. J. BOOHER

Large container-grown plants can be irrigated and fertilized by using nine ⅛-inch-diameter plastic tubes radiating from a central riser. Each master unit of the system is operated by a clock-controlled 3-inch valve and is capable of irrigating 720 containers simultaneously in five minutes. Four of the units now operating at a Sacramento nursery, where this study was conducted, can irrigate 2,880 containers in 20 minutes.

THE IRRIGATION and fertilization of large numbers of container plants often present problems for the nursery operator. Plants growing in gallon cans are usually irrigated and fertilized by overhead sprinklers. However, this system will not provide uniform water applications for larger trees or shrubs grown in 15-gallon containers.

At the Oki Nursery in Sacramento, a system has been installed to irrigate individual containers by using one-eighth-inch plastic tubes. Assistance with design of the system was obtained from the extension irrigationist, University of California, Davis, and the Sacramento County Farm Advisors' office. Each master unit of the system is operated by a 3-inch, electric-clock-controlled valve and is designed to irrigate 720 containers in five minutes. The 15-gallon containers are placed on 4-ft centers, so that the area covered is 16 × 720 or 11,520 square ft, excluding roads and driveways.

Nine ⅛-inch plastic tubes water nine containers from one valve.



Plastic cap on each riser is drilled to take nine 48-inch plastic tubes.

Nozzles inserted through redwood stakes prevent twisting and turning of spray.

The site for the containers was graded to provide surface drainage to a small ditch in the center which carries excess water out to a natural drain. The entire area is covered with an inch of crushed rock.

Water delivery

The nozzles to each container deliver water at the rate of .4 gpm (gallons per minute) or at about 23 lbs pressure per square inch—requiring a flow of 288 gpm through the 3-inch valve for the 720 containers. Water is pumped from a well to a 6-inch asbestos-cement main line pipe, which also serves an overhead sprinkling system for several acres of gallon cans. To avoid nozzle plugging, sand traps were installed in the main line.

At present, four of these units are in use serving 2,880 containers. The plants are irrigated daily in the summer months with each unit operating for five minutes. Twenty minutes are required to irrigate 2,880 plants with two gallons of water for each container. The soil mix used in the containers is porous sand and organic matter, allowing rapid water penetration. Except for periods of extreme high temperatures, irrigation every other day would be adequate; but because the containers drain readily, and fertilizer is supplied with the water, daily applications are made. All pipe in the system is P-V-C plastic with cemented joints, and is large enough to reduce friction loss to a minimum to assure delivery of the same amount of water to each container. The pipe size is reduced from 3 to 2½ to 2 to 1½ inches in the supply line to correspond with the drop in volume of water flowing to the laterals. All laterals and risers are 1 inch (see diagram). The plastic cap on each riser is drilled to take nine ⅛-inch plastic tubes, each 6 ft long (see photo).

Stoppage occurred in several tubes when the cement was not carefully applied. Since the nine tubes served nine containers with the riser placed close to the middle container, the tube going to the most distant container sometimes was suspended in the air—thus interfering with nursery operations. Increasing the length to 8 ft would allow all tubes to rest on the ground. All tubes should be the same length to assure delivery of the same amount of water to all containers.

Nozzles

Small plastic nozzles were attached to the end of the tubes to spray the water evenly over the soil surface. Uniform soil wetting can not be obtained without some spreading device where the water is applied at a slow rate to a very porous soil mix. Also, the nozzles must be held in place at the right height and angle. Taping them to stakes pushed into the container's soil was tried first, but there was a tendency for the tubing to twist each time the water was turned on. The method now in use is to run the ⅛-inch tubing through a hole drilled in a 1-inch redwood stake. The stake is driven into the ground at the outside edge of the container leaving the end of the tube at the proper height. The nozzle is then inserted into the end of the tube, expanding it enough to make a tight fit and prevent twisting and turning.

Costs

The cost of materials was estimated in this study at 90 cents per container. The total cost of the system was about $3,000. (Volume purchases can probably reduce costs for a large system.) Hand watering took about 45 seconds per container or 36 man hours for the 2,880 containers. The size of the units can be varied to fit the needs of the grower, the water supply, and the number of plants involved. The system described here will be expanded to serve 12,000 containers requiring 1½ hours to irrigate, compared with 150 man hours for hand watering.

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