

Ornamental Crop Production

irrigation technics and dependable soil mixes basic to maximum production and minimum growing costs in industry

O. R. Lunt

Commercial production of ornamentals—cut flowers, potted plants, nursery stock—in California has an annual wholesale value of approximately \$65 million or about one half the value of the combined citrus and avocado production of the state.

The management problems of the ornamental growers—representing one of the larger specialty crops—are different from those of most agricultural field crops. Treatments essential for the production of some ornamentals would be economically prohibitive for most field crops. For example, the gross value of an acre of glasshouse grown carnations or chrysanthemums will usually exceed \$50,000 per year and production costs are proportionately high. Large investments—in labor and facilities—are required for the production of such high value crops and dependable growing practices must be followed. Any development leading to even a partial crop failure would cause a considerable economic loss. In growing glasshouse or lath house crops the fertilizer expense—when correctly selected and applied—is likely to be about 1% of the total cost of production, but underfertilization or overfertilization can have disastrous effects on profits.

Many ornamental crops are grown as

field crops and soil and water management are similar to those of vegetable crops. However, when ornamental and nursery crops are grown in shallow containers—such as cans, pots, or benches—growing problems related to soil properties usually can be attributed to: 1, lack of standardization of the soil mix; 2, improper drainage; 3, accumulation of excessive quantities of soluble salts; 4, inadequate fertility control; 5, toxicity resulting from steaming and other problems related to disease control; or 6, a combination of two or more factors.

Soil Mixes

Standardization of the soil mix is particularly important where the soil is sold with the crop—as is the case in many nursery operations—because soil fertility and management practices will change with each mix.

In recent years, there has been a trend toward standardization on mixes of fine sand and a coarse organic amendment. Sands are readily characterized and therefore it is easy to write specifications for them. Also they are adaptable to mechanical handling. Physical properties of sand and peat—or a similar organic amendment—mixes are desirable, because they are easily leached, are nor-

mally free from steaming hazards, are easily managed from the point of view of disease control, and sources are widely available. However, sand-organic amendment mixes have essentially no retentive capacity for many fertilizer elements. Consequently careful attention must be given to fertilizer programs. Scheduled fertilization—dry, liquid, or both—is essential with sand growing mixes.

Desirable sand would have a composition of 50% or more of its particle size in the range of 0.4 millimeter diameter—approximately 35 mesh—to 0.1 millimeter diameter—approximately 150 mesh—and not more than about 10% or preferably 5% material smaller than 0.1 millimeter. Incorporation of one third to one half by volume of peat or similar material will lighten the mix and increase air space.

Water and Air Relationships

Soils in shallow containers have water and air relationships that are different from those of field soils and irrigation and other practices must be modified. The table on page 18 summarizes the volume proportions of water and air space occurring in a number of soils and soil mixes for both deep and shallow soil conditions when drainage essentially ceases following an irrigation.

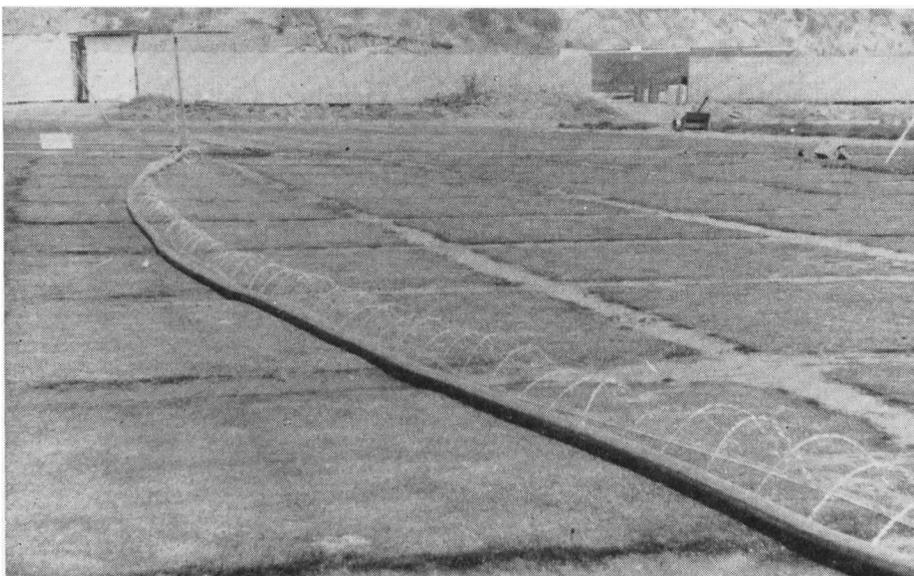
A sandy soil under container conditions will usually retain as much water as a clay soil in the field. The Diablo clay soil—shown in the table—was exceptionally well aggregated, having a bulk density of about 1.0, and drained unusually well under bench conditions.

Almost any soil—amended or unamended—when used in a relatively shallow container will retain a large volume of available water. Expressed as a volume percentage the moisture content will usually fall between 25% and 50%. Consequently texture has only a small effect on the frequency of irrigations when soils are used in containers.

The consumptive use of water by greenhouse crops varies within wide limits depending on climatic conditions, but many crops consume substantial quantities of water. Carnations, for example, will consume about 0.20" per day or more on clear days. A crop of chrysan-

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Perforated plastic tubing used to distribute water to ornamentals grown in shallow containers supplies water with good uniformity in runs up to 100'.



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showed that maintaining readily available moisture in the soil up to and including harvest time did not injure either the shipping or canning quality. Lack of readily available moisture for several weeks before harvest produced peaches of tough, leathery texture.

Quality in prunes, as measured by the specific gravity, is not greatly affected by the irrigation treatment. It seems to be associated with climatic conditions during the summer. The drying ratios of prunes are not materially affected by the irrigation treatment. They are chiefly dependent on the amount of fruit on the trees. Years of large crops have high drying ratios while those of light crops have low ratios.

Irrigation did not affect the keeping quality, flavor or drying ratio of table and raisin varieties of grapes. Wines produced from the grapes under different irrigation treatments were remarkably similar when the fruit was allowed to reach maturity.

Quality is an intangible characteristic not well adapted to precise measurements but where analyses such as sugar, acid, firmness and storage life can be made, the results have indicated that quality can not be affected by irrigating but it may be adversely affected by withholding water.

Amount of Water Used

Experience with orchards and vineyards in California illustrates the irrigation requirements for these crops.

The maximum use of water per day varies from about 0.1" in the coastal areas with mild climates to 0.4", or higher, in the hot portions of the interior valleys.

The actual use of water by the trees or vines will not be increased by increasing the number of applications. Plants can not be made to transpire more water because of high soil moisture conditions than they transpire under lesser amounts of readily available soil moisture. When more irrigations are given than are necessary to assure a continuous supply of readily available moisture, waste occurs by surface evaporation and deep percolation. Where water supplies are cheap, there is a tendency to overirrigate by giving too heavy rather than too light irrigations. Under pumping conditions there is a more conservative practice.

For mature orchards maximum water extraction from the soil may be as high as 36 acre-inches per acre per season. For the average orchard 18-24 acre-inches of irrigation water per acre may meet the demands of the trees in years of normal rainfall. On loamy soils, this

amount can be applied in three irrigations. Where the ground water is 12' or less from the surface, deciduous orchards are able to get a part of their water from that source. The need for winter irrigation should be gauged by soil moisture conditions near the end of the winter season.

Determination of the seasonal water requirements for an orchard or vineyard is only one consideration necessary for successful irrigation. If a grower knows his soil, its field capacity and permanent wilting percentage, he will be able to time his irrigations correctly.

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themums may consume as much as 0.35" of water per day as it reaches maturity.

When water consumption is so great and root systems are limited by the confines of the container, the interval between the time when water is adequately available and severe water stress can be as short as two hours. To avoid any possibility of a water stress developing, ornamental growers usually irrigate when water suction may be relatively low—0.5 atmosphere or less. The tensiometer could serve as a guide to the irrigation of container grown ornamental crops, but it is not widely used. The interval between irrigations under container conditions is likely to be about the same or longer for a sandy soil as for a loam or clay.

Volume Proportion of Water and Air Space in Certain Soils

The volume proportions of air space and available water obtaining when drainage essentially ceases following a thorough wetting in soils of various texture with and without being amended by the incorporation of 50% sphagnum peat moss—volume basis—under both deep and shallow soil conditions. The shallow soil is approximately 8" deep.

	Available water as percentage of total volume		Percentage of free air space	
	Deep soil	Shallow soil	Deep soil	Shallow soil
Marina loamy sand	6	31	26*	32
Marina l.s. + 50% peat	11	48	46	50
Diablo clay	17.5	31.5	...	20
Diablo clay + 50% peat	15.5	52	...	49
Pleasanton silt loam	15.5	25	12	11.5
Pleasanton s.l. + 50% peat	13.5	45.5	33	38.5
Pleasanton s.l. + Krillium	12	28.5	17.5	22

* Volume percentage of water released in range from .01-0.5 atmosphere suction. This is approximately the quantity of water available under shallow soil conditions—soils in a container—if irrigation is effected at a moisture content of 0.5 atmosphere suction.

Because water-holding capacities of shallow soils may be unusually high, there has been considerable apprehension among ornamental growers regarding possible inadequate aeration. To date, research has failed to demonstrate inadequate aeration in container grown carnations or chrysanthemums even when using fine textured soils which would remain approximately saturated after an irrigation. It appears that transpiration losses may induce adequate aeration conditions within a day or two under these conditions. Aeration might become limiting, however, should soils be used in which infiltration was so poor that water stood on the soil surface for prolonged periods.

To assure a free porosity of about 6% or more under container conditions it is the practice for growers to include a coarse organic amendment in a soil mix. Chemical aggregate stabilizers such as krillium are also effective.

One of the significant developments in the use of amendments in recent years has been the use of low-cost bark or wood fragments in place of peat. The use of pine, fir or redwood materials has been quite satisfactory when adequate nitrogen fertilizer has been supplied. These materials may be obtained at about one half or less of the cost of an equivalent volume of peat. Thus the cost of preparing special soil mixes in most cases has declined in recent years.

Irrigation Techniques

Inasmuch as equipment is available to automatically turn on water when needed, the biggest irrigation problem facing the ornamental growers is distribution of water from the supply source to pots, cans or benches. The use of perforated, flexible plastic tubing appears to be a satisfactory solution for irrigation of bench crops. Hand irrigation with a hose costs about 10¢ per square foot per year. At this cost for hand irrigation, plastic tubing approximately pays for its installation in the first year.

The irrigation of potted plants is a more difficult problem. Hand irrigation here costs about 75¢ per square foot per year. Subirrigation appears to be the most satisfactory solution to this problem, although problems of disease control with this cultural practice have yet to be thoroughly evaluated. Plastics are also playing a part in this development by making possible lightweight, economical watertight benches.

The accumulation of salts in pots due to capillary conduction to the surface presents a problem, but it is one which can readily be dealt with if the grower is cognizant of the hazard.

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