Effective Use of Living Shade

studies show how selection and location of trees and shrubs can reduce extremes of summer temperatures in living areas

Robert B. Deering

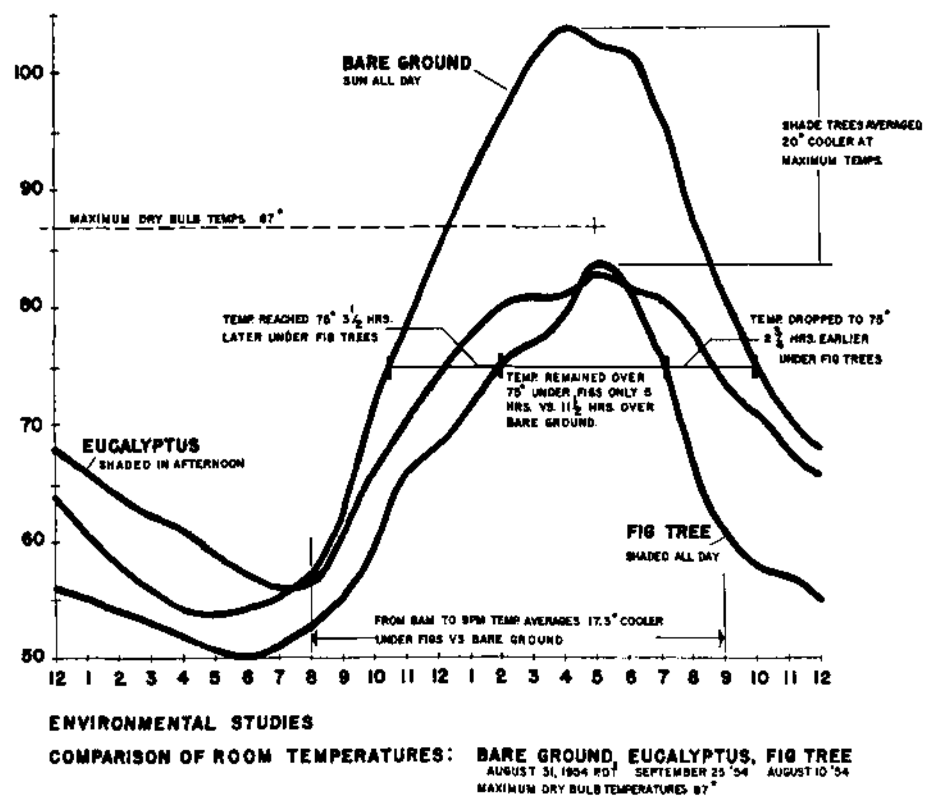
Dense shade from trees can reduce room temperature in houses as much as 20F.

Studies conducted during the summer of 1954 showed that the cooling influence of well-placed shade trees of moderately dense foliage can materially affect both exterior and interior living areas, even in hot regions where temperatures reach above 100F.

To carry out the experiments, a 20′ × 8′ house trailer was selected because of its adaptability to changes in site and orientation. The trailer simulated—as nearly as possible—a typical low-cost frame house. Construction included 2″ × 3″ studs with the clapboard siding painted white and the roof covered with asphalt shingles. There was so little insulation in walls and roof that it had slight effect. The window area of the interior space used in testing totaled 576 square inches of glass on the right side, 0 on the left side where the instrument room shut off the test room, 899 on the front, and 1,152 square inches on the rear. Roof overhang was negligible and offered little shading.

The results obtained from the trailer experiments can be applied only to small wood houses with wood floors over a crawl space. Houses built on slab floors have a very different heat capacity than those not directly connected with the ground. Because the ground is a large thermal source or sink, it has a great bearing on room temperatures. Heavy materials take longer to warm up and consequently longer to cool off. For that reason, a wood-type structure heats up and also cools off more rapidly than masonry or stone. The square footage of the slab and cubic volume of a house are also important. Furnishings—5,000 pounds for the average home—add considerably to the heat capacity of a house. The removal of a small amount of heat from a small house may have a great deal of effect upon the cooling, but in a large house it may be unnoticeable.

Comparisons of room temperatures of the three situations. Bare Ground, August 31, 1954, P.D.T.; Eucalyptus, September 25, 1954; and Fig Tree, August 10, 1954.



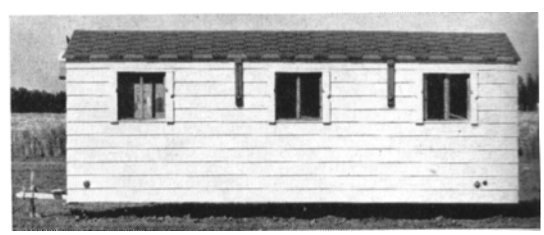
Three experimental sites for the house trailer were selected for comparing the effectiveness of the different types of shaded situations with bare, unlandscaped ground. At each site, the trailer was located with its long axis running east and west. Half-hour readings were taken of wet and dry bulb thermometers, and recordings of temperatures were made from thermocouples located at the following points: on the roof, ceiling, floor inside and out; east wall outside, south wall inside and out, west wall inside and out, and the north side inside and out.

Site *A*—a bare dry ground area devoid of all vegetation and shade during the day—was selected as the check site because it was typical of many locations of small homes.

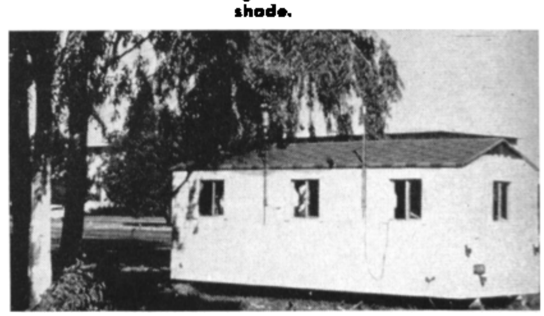
Site *B*—east of and adjacent to a large grove of eucalyptus trees—was chosen because it provided afternoon shade only. A good cover of turf was present on all sides.

Site *C*—beneath a group of large fig trees—was selected because the foliage completely covered the trailer with the exception of the north side, yet no direct

Site A. Rear—south, in this location—of the experimental, mobile house unit on check site, where no shade or vegetation was present during entire day.



Site B. Southern exposure of left and rear sides of unit located east of and adjacent to eucalyptus grove which received morning sun and afternoon shade.



Citrus Collection for Research

citrus relatives, species, varieties, strains, and hybrids provide materials for research on problems of citriculture

W. P. Bitters

Plant source materials for research on citrus problems are available—in one of the world's most extensive citrus variety collections—at the Citrus Experiment Station at Riverside.

In the collection, there are citrus fruits—including relatives—of unusual shapes, sizes, colors, and tastes, growing on trees with varying heights, forms, and foliage characters.

As shown in the lower illustration on the next page, citrus fruit ranges in size from the shaddock—*Citrus grandis*—which may be as large as a person's head and weigh many pounds, to the Chinese box orange—*Severinia*—as small as a pea and weighing only a fraction of an ounce.

Most citrus fruits are round or slightly flattened or elongated in shape, but those of the orange jessamine—*Murraya*—and the finger limes — *Microcitrus* — are greatly elongated and banana-shaped in appearance. Others—such as *C. macroptera*—are conspicuously necked at the stem end and shaped like pears. Some are prominently creased and wrinkled like *C. hystrix* and the Moroccan rough lemon. Fruits of most citrus occur as a single specimen, but that of the Wampee grows in a cymose cluster like a bunch of grapes.

Peel colors range from the bright red of the *Murraya*, through the orange and yellow colors of the standard orange and lemon varieties, to the greenish yellow of the limes, the brown of the Wampee, and the dark blue of the *Severinia*.

The color of the pulp varies as well, and there are several selections of pink-pulped lemons. One of these has in addition a variegated—mottled green and yellow—fruit and attractive green and white variegated leaves, as illustrated in the upper photograph on the next page.

There are many pink-pulped grapefruit and shaddocks. While most fruits

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sunlight struck any part of the structure. A good turf was located adjacent to the north.

Comparisons of the temperatures recorded at Site *A*, on August 31; Site *B*, on September 25; and Site *C*, on August 10 are given in the graph on page 10 because conditions of wind, temperatures, and humidity were approximately equal. However, the summer of 1954 was unusually cool and maximum temperatures were considerably below those of normal years.

More important than the 20F temperature differential between bare ground and shade is the resulting delaying action of the morning heating and hastening of the afternoon cooling. Under the fig trees—Site *C*—the morning temperature reached 75F, three and one-half hours later than when the trailer was located in the sun—Site *A*. It cooled down to 75 F in the afternoon, two and three-quarters hours earlier than in the open. In addition, the temperature remained over 75F during the hot noon period only five hours in comparison to the eleven and one-half hours at Site *A*—the bare ground check location.

The effect of afternoon shade from the eucalyptus trees—Site *B*—was striking, as indicated by the readings of roof temperatures. The trailer received direct sun until 12 noon; then as the shade began to cover the roof, a 35F drop in roof temperatures occurred in an hour's time after arrival of the shadow. The interior heating continued to rise but began to level off two hours later.

Although the coolest condition existed beneath the fig tree foliage—Site *C*—there was inadequate light inside for reading and close work. However, this is attributed largely to the smallness of window area.

From the results of these tests, it would appear that the best planting for living shade would be high-branching deciduous trees—relatively close to the house

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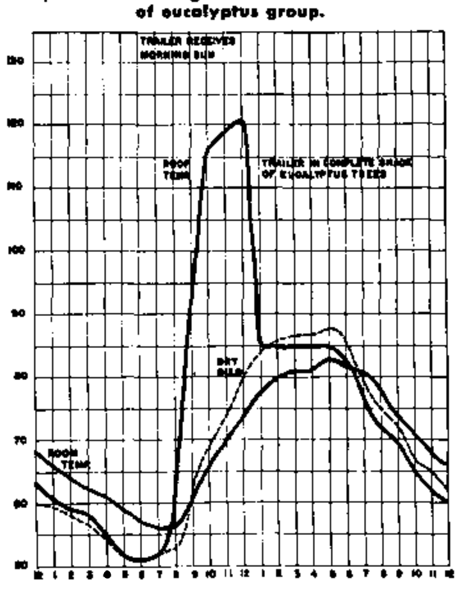
Site C. Northern exposure of front of unit under fig tree where foliage provided shade during entire day.

Effect of afternoon shade is shown in the roof temperature readings where unit is located east of eucalyptus group.



SHADE

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on the east and south—because vertical shade control is necessary during the morning and afternoon. Low-branching trees planted on the west and northwest would provide horizontal shade in late afternoon and early evening. Such plantings would provide good cooling shade during the entire day.

By planting deciduous trees on the east and south, the benefit of the sun could be had in winter when the trees have dropped the leaves. Evergreen trees —broadleafed or conifer—on the west or northwest would not interfere with the winter sun but would provide green foliage and protection from the winter winds.

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MILK

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price must be high relative to a flat price to yield the same average returns. Practical considerations of public price administration preclude the use of a price considered too high—even though consistent with costs for very small volume deliveries. Such plans would probably underprice milk for small serves and, to average out, would require overpricing certain volume groups near the end of the discount bracket.

One discount schedule for wholesale sales has been arbitrarily selected for four classes with a base price of 19¢.

Arbitrary Volume Discount Schedule

Volume per delivery (labor units)	Percentage discount	Effective prices
0–74	0	$0.1900
75–224	8	.1748
225–449	10	.1710
450 and over	12	.1672

With a base price of 19¢, the schedule must fail to reflect completely the actual costs involved in servicing very small volumes per delivery, but the general nature of the price changes tends to follow costs. This type of a schedule is not very complicated nor does it involve radical departures in billing methods.

Some of the major limitations of a volume discount system which brackets several delivery volumes are made clearer in the case of retail deliveries. Costs for a one-unit retail delivery are about 28.5¢ while for two units, the unit cost is about 5¢ lower. If, for example, one- and two-unit deliveries are bracketed at 26¢ per unit, the price would more closely reflect costs for these small deliveries than does the present uniform price system which involves a 21.5¢ price for all delivery sizes. However, there would be the obvious disadvantage of underpricing one-quart serves by 2.5¢ while overpricing the two-quart serves by slightly more than 2.5¢. Furthermore, it would provide no price incentive for one-quart customers to increase their volume per serve through a reduction in the number of deliveries or by consolidating store and home-delivered purchases.

Reducing Costs of Distribution

Pricing plans which reflect cost differences would encourage both wholesale and retail customers—by the lower net prices—to consolidate their orders and to limit the number of distributors from which they purchase milk.

Such consolidations would increase the efficiency of the market as a whole. That increased efficiency would be reflected in lower average costs of distribution and in correspondingly lower average gross incomes for distributors. These changes would affect individual distributors according to the changes in the number and average size of their customers which, in turn, would require immediate route reorganization and would permit route consolidations to take advantage of the increased load sizes possible with larger customers.

Wholesale Distribution

Volume pricing systems provide the customer with an incentive to limit purchases to a single distributor.

In the Los Angeles market, the existing duplication is the smallest and the average volume per customer is the largest of all California markets studied. Therefore, estimates based on the Los Angeles market conditions will be the most conservative. In this area, wholesale customers received dairy products from an average of 1.71 distributors and the average volume per delivery was 77 labor units. Under conditions where each customer is supplied by a single distributor, the average size of delivery would be increased to 132 units. On the basis of the developed cost relationships, this would mean that a 26% increase could be made in route volumes which would result in a 19% saving in unit delivery costs. This 26% increase in route volume would permit a 20% decrease in the number of routes, if it is assumed that the total volume of wholesale sales remains constant.

In other markets, such as Fresno, a complete reorganization based on one distributor serving each customer would permit increases in load sizes of as high as 65%.

Retail Distribution

There is no currently available data that would indicate the probable effects of a volume pricing system on the average volume per serve and therefore on the costs of retail delivery. If the average volume per customer was increased by one labor unit per serve—an increase from three to four units—that increase in average deliveries would allow an increase of 25% in route volumes at a corresponding reduction of about 20% in the number of routes operated and in the unit costs of retail delivery. In such a case, under current cost levels, the saving would amount to nearly 1¢ per quart.

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STRAWBERRIES

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years duration in the probable presence of strains of Verticillium different from the one used in the greenhouse tests. They also, with few exceptions, withstood the combined inoculations of fifty different clonal lines of the Verticillium fungus isolated from diseased strawberries from the major strawberry growing areas of California.

Resistance

The Verticillium wilt resistant strawberries obtained in these studies with few exceptions have glossy, dark green leaves and are also highly resistant to powdery mildew. Not all of the mildew resistant seedlings proved to be resistant to Verticillium wilt, but approximately 95% of the Verticillium resistant seedlings have proved to be also resistant to mildew. Since powdery mildew is a troublesome disease of strawberry in California, this may prove to be an exceedingly useful genetical linkage and may enable the plant breeder to develop a variety of strawberry completely resistant to both diseases.

There is no indication thus far in this work that any desirable qualities are lost in this rigorous selection for resistance to Verticillium wilt.

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The U. C. soil mix was developed by K. F. Baker, Professor of Plant Pathology, University of California, Los Angeles, and his coworkers.