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 20°F.

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 100°F.

To carry out the experiments, a 20' x 8' house trailer was selected because of its adaptability to changes in site and orientation. The trailer simulated—a nearly as possible—a typical low-cost frame house. Construction included 2" x 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.

Three experimental sites for the house trailer were selected for comparing the effectiveness of 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

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.

Environmental Studies

Comparison of Room Temperatures: Bare Ground, Eucalyptus, Fig Tree

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 well located east of and adjacent to eucalyptus grove which received morning sun and afternoon shade.

Site C. Southern exposure of left and rear sides of well located west 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 citiculture

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

Continued on next page

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 20°F 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 75°F, 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 75°F 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 35°F 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

Continued on page 15
SHADE
Continued from page 10

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 plant-
ings 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—broadleafed or conifer—on the west
have dropped the leaves. Evergreen trees—broadleafed or conifer—on the east
and south, the benefit of the sun would provide green foliage and protection from the
winter winds.

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iforniia, Davis.

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nomics and Agricultural Engineering, University of California, Davis, co-operating.

MILK
Continued from page 2

price must be high relative to a flat price to yield the same average returns. Practi-
cal considerations of public price admin-
istration preclude the use of a price considered too high—even though consist-
ent 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¢.

<table>
<thead>
<tr>
<th>Volume per delivery (labor units)</th>
<th>Percentage discount</th>
<th>Effective prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-74</td>
<td>0</td>
<td>$0.1900</td>
</tr>
<tr>
<td>75-324</td>
<td>6</td>
<td>$0.1748</td>
</tr>
<tr>
<td>325-649</td>
<td>10</td>
<td>$0.1710</td>
</tr>
<tr>
<td>650 or over</td>
<td>12</td>
<td>$0.1672</td>
</tr>
</tbody>
</table>

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 fol-
low 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 vol-
ume discount system which brackets sev-
eral 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 de-
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 dif-
fences would encourage both whole-
sale 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 re-
lected in lower average costs of distri-
bution 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 cus-
tomers 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 pur-
chases to a single distributor.

In the Los Angeles market, the exist-
ing 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, whole-
sale 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 dis-
tributor, 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% de-
crease in the number of routes, if it is
assumed that the total volume of whole-
sale 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 aver-
age 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 in-
crease of 25% in route volumes at a cor-
responding 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
Continued from page 8

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

Resistance

The Verticillium wilt resistant strawber-
ries 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 Verti-
cillium 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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search Project No. 981.

The U. C. soil mix was developed by K. F.
Baker, Professor of Plant Pathology, Univer-
sity of California, Los Angeles, and his cowor-
kers.