

Landscaping for Summer Shade

good planning uses cooling influence of plants to reduce summer temperatures in living areas

R. B. Deering and F. A. Brooks

Over 40% of the sun's heat can enter uninsulated houses through the roof but as a shadow—from overhead foliage or cover—moves over an area, the speed of cooling makes the newly shaded area immediately useful.

Research workers in the Imperial Valley have found that bare ground surface temperatures ranging from 136° F to 152° F cooled on an average of 36° F in five minutes after the arrival of the shadow line. Other experiments have shown that tree foliage has stopped as much as 80% of the incident radiation in dense groves.

The body of air shaded by tree foliage has properties dependent upon the extent and species of trees.

Because most varieties of shade trees turn as great an absorbing surface as possible toward the sun for purposes of photosynthesis they produce great amounts of shade without the disadvantages of an extensive solid surface.

As soon as a shallow non-evaporating bare surface is covered with vegetation, the solar-energy absorbing area is transferred to a living thermal-absorbing surface which draws on soil moisture from a considerable depth to provide surface evaporation cooling.

The heat balance at foliage surfaces differs fundamentally from that of the bare-ground surface, because of lack of connection with a substantial heat reservoir. There is no appreciable heat-capacity term for the leaf which means that the outgoing heat rates from leaf surfaces are balanced all the time by the incoming heat rates so heat does not build up in the foliage. Air itself has very little heat capacity, and so it is readily cooled by evaporation; therefore the body of air lying beneath foliage can be maintained cooler than over bare ground.

In the daytime, the air is usually moving fast enough to cause forced convection. Most of the solar energy transformed to sensible heat by the foliage is carried away by the air—only a minor fraction being radiated. Most homeowners want their living and garden areas to face south to benefit from the warm winter sun. This orientation is best for the winter and spring months, but may require special planning for the hot summer months. During the summer the shade areas start on the west side of the house

in the morning, move to the north during mid-morning to mid-afternoon, and to the east in the afternoon. An exposed south-facing area remains hot from mid-morning to mid-afternoon until the sun moves to the northwest.

By orienting the house more toward the southeast, this area would receive earlier afternoon shade but the north side would have more hot afternoon sun. Properly located trees would be needed to provide the necessary shade.

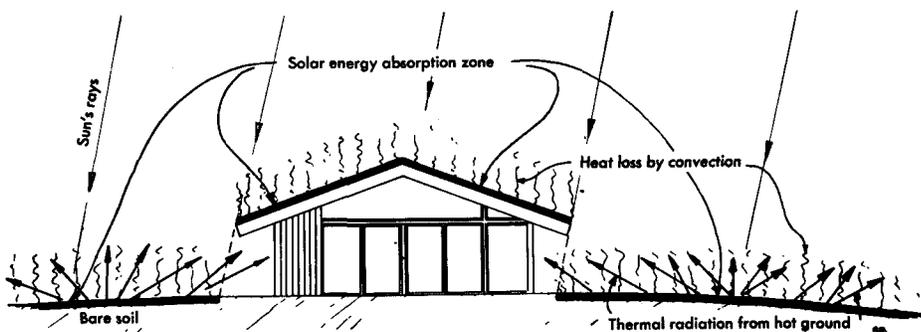
During the winter and early spring months direct solar energy is usually desired, so vines and trees planted on the south side should be deciduous. Evergreen trees always provide a cool atmosphere which in winter is generally undesirable. One of their greatest values is their usefulness for windbreaks.

Little is known as to the effect of shrubs on the micro-climate, except on their actions as windbreaks. High humidity and high temperature may persist in sun-

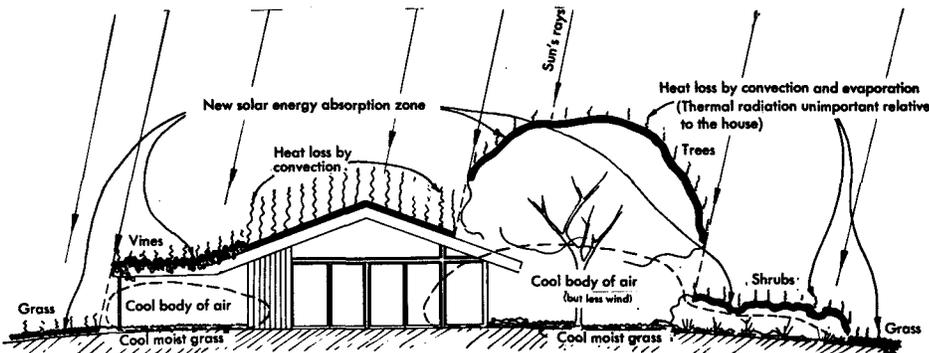
lit areas adjacent to shrubs mainly because the density of the foliage may prevent breezes from penetrating through them. Shrubs with an open structure, however, may assist in reducing the velocity of strong winds.

Because houses offer such a great barrier against the wind, low plants located adjacent to them generally interfere very little with the breezes. The main advantages of plants used in this situation lie in the fact that they keep the soil cooler near the house, reduce radiation, glare, and reflection, and should provide an attractive setting. One distinct advantage in the use of high shrub masses is their ability to act as a horizontal thermal-radiation absorption barrier against heat from adjoining dry-ground areas. Thick foliage may be desirable when used as windbreaks or dust and noise filters; therefore the optimum plantings need to be considered with relation to lawn and trees.

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Typical situation before planting or site without trees.



As soon as a bare surface is covered with vegetation, the heat absorbing surface which was previously held by the soil and roof is then transferred to the upper layers of foliage, in trees, shrubs, vines and turf, and a cool body of air is then produced by evaporation in the shade.



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LANDSCAPING

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A good turf sod creates a sunshine-absorption layer on top and a moist shaded surface beneath. This shading prevents large amounts of heat absorption by the soil and thus keeps the ground from getting hot. Because the maximum temperatures at noon are held down close to wet-bulb temperature, the net thermal radiation that would come from bare hot dry ground to the house can be reversed so that the cool grass will act as an absorber of heat radiated from the house.

Conduction takes place through the ground horizontally depending upon the temperature differences. There is a significant advantage in having the ground as cool as possible surrounding the house because of this horizontal conduction of heat in the deep soil. In addition there is a cool moist layer of air lying above a turf cover, whereas a dry warm one lies above dry soil, asphalt, or concrete. The placement of trees and especially the use of grass near the house allows the heavier cool air to flow inside, when low openings are provided for through circulation.

The sun's heat entering a house through the roof can be reduced greatly by properly insulating the ceilings and by the use of white reflectant materials on the roof surface. In addition, the location of trees close to the house can materially restrict the area of the roof exposed to the sun's rays.

An effective way of reducing the heat inflow through walls, when not shaded by trees, is to cover them with vines. This has two advantages: shading the wall and cooling the air next to the wall surface by evaporation of moisture from the living plants.

East or west walls receive much more heat in summer than south walls. The heat problem on east walls is less troublesome than west walls since the soil, wall, and the air temperatures inside and outside have cooled greatly during the night. The heat absorption for areas on the south can be considerably reduced and

delayed by the use of roof overhang, trees and vines.

With proper landscaping the house walls, soil, and paving will not be warmed to high temperatures until the sun is moving away in the late afternoon. As the sun moves toward the west, its angle becomes lower, and therefore groups of tall, vertically growing shrubs and small trees can be effective in providing shade on the west and north walls. By this shading the sun is cut off and the air temperatures will begin to drop early.

Paved surfaces generally absorb and release more heat than bare ground and therefore have less temperature change day to night. If kept wet they can serve in place of grass turf, but in most cases this is inconvenient and impractical. Dark pavements are usually hotter than grass in the daytime and light-colored pavements usually have objectionable glare. In hot regions, it is well to keep all dry paving to a minimum and to have as much shading as possible. The coldest exposure is toward the north sky, so the vertical shading by trees and vines is more effective than horizontal shading providing the same interception of absorption and radiation.

As much as one tenth of the total heat entering an ordinary house comes through the windows. Every attempt should be made, therefore, to keep the sun's rays from penetrating glassed areas.

Living areas facing south can be made more comfortable in summer by providing dense tree or vine shade overhead, using as much moist turf as possible beneath and providing adequate overhang to keep the sun off walls, paving, and glass. Tall deciduous shrubs planted so one looks into their shaded and cooler north sides, greatly reduce glare and the shimmering view of hot dry areas. Careful selection of plants and their placement should be made to prevent any interference with cooling breezes or winter sun.

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MITE

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Two nozzles per row were used for plants up to 30" in height and four per row for plants of greater height. This resulted in applying 10 and 20 gallons per acre. When using four nozzles per row, the two nozzles on either side of the plant were placed 18" apart on a boom-drop.

This adjustment of flat fan nozzles showed a good deposit of spray on the underleaf as well as on the upper surfaces of the leaves.

During the tests it was soon evident that sprays of very fine droplets from the cone type nozzle could be driven only a very short distance onto the underleaf surfaces. If cone nozzles giving larger droplets were used, the gallonage would be increased and higher pressure would be required. This would defeat the objective of low gallonage and low pressure spraying.

Consequently the flat fan type of nozzle was used for further work. The pressure was kept at 60 psi throughout the experiments. The gallons applied per acre therefore varied with the size of orifice, the speed of the tractor and the number of nozzles per row.

Spraying late in the season in rank cotton is generally possible with standard tractors when properly shielded. However, tractors with a higher—36"—than normal axle clearance are more desirable for late season spraying.

Sprayers mounted on such tractors and with an extra extension for nozzles on the boom-drop, may be used for late season spraying—until the cotton begins to close-in in the middles.

Tall, rank, closed-in cotton requires a reinforced—or shielded—boom-drop to spread the foliage ahead of the nozzles, however, the types of shields have not been tested sufficiently to permit specific recommendations.

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