Shrubs and Vines

Shrubs can effectively block early morning and late afternoon sunlight on eastern and western exposures, respectively. Small-leaved, open-branched shrubs provide shade without unduly restricting air movement for passive cooling in the spring and fall. Vegetation close to the residence also lowers the air temperature near the home, reducing the heat conducted through the walls. Espaliered shrubs (shrubs trained to grow horizontally against a wall), can block a great deal of sunlight before it strikes and heats up the wall.

Vines are especially useful for shading homes when small lot size restricts the use of shade trees. Vines are either self-supporting or twining. Self-supporting vines cling to a surface by either padlike "holdfasts" (e.g., Virginia creeper. Parthenocissus quinquefolia) or aerial roots (e.g., trumpet vine: campsis radicans). Self-supporting vines are not recommended for wood structures because they may trap moisture, which can lead to wood decay. On brick or concrete block homes, a fast growing, self-supporting vine can effectively prevent the sun from heating a wall. Twining vines climb by means of stems or tendrils and require some form of support. By providing a lattice-type support or a trellis, twining vines can be used to shade walls, windows, and outdoor living spaces. As with shade trees, only deciduous vines are recommended for southern exposures in Southern Nevada to allow winter sun to passively heat the home.

References


Shade Factors in Southern Nevada Using Trees and Shrubs for Shading Outdoor Spaces

M.L. Robinson and Carole Eddington

Introduction

In urban areas, shading artificial surfaces with trees and shrubs is beneficial because less radiant heat is emitted to people, ground plants, and building walls. The south side of structures receive direct solar radiation most of the day, while the north face is in the shade. The south side of a building is also warmed by heat energy radiated from the south walls and paving materials on the ground. The combination of higher temperatures and lower humidity in these "hot pockets" can increase heat stress on vegetation. Choice and placement of plant materials in these areas must be carefully considered in the design process. Vegetative cover has the effect of reducing maximum and raising minimum daily temperatures.

Discomfort created by heat and low humidity can be countered by good air circulation, shade, and the cooling effects of moisture retained and released by plant materials (evapotranspiration). Trees, shrubs, and ground covers are valuable tools for moderating the effects of outdoor temperatures on the home because they provide shade and effectively modify air movement and humidity. How well a particular tree species performs depends on how tall it grows, whether or not its leaves remain all year, and the shape and density of its canopy (Meerow & Black, 1993). Once established, most landscape trees require only periodic maintenance and represent an appreciating investment in the home’s value up to 10 - 12%. The correct placement of trees chosen to shade the home involves consideration of the angle of the sun’s rays, the mature height and width of the tree canopy, and the height of the structure to be shaded.

Conserving Energy

Summer shade on residences may reduce energy used for cooling noticeably. Shrubs, short trees, and slower growing trees should generally be exposed to the sun to allow for adequate light and growth. Trees can be planted (for shading) a distance of three to seven times the average height of the tree. They can be closer as long as they do not shade the house in winter.

The term heat load is often used to describe the total heat accumulated by a structure over the course of the day. The heat load begins to build when the morning sun strikes the east walls of a house, and usually peaks in the afternoon, the maximum temperature occurring four hours before sunset, sometime between 2 p.m. and 4 p.m. in Southern Nevada. Not surprisingly, this is also the peak time of energy demands for air conditioning. The times of sunrise and sunset change with the season.
For effective shade, the major factor to consider in tree placement is the position of the sun. The sun is not in the same place in the sky day after day, or even during the day. Once the sun’s position is known, a few calculations will determine the proper placement of trees for maximum shade on the structure during the hottest time of the day and year.

The farther away from the equator (a factor of geographic location), the more angle of the sun (angle of incidence) and the less solar radiation. The intensity of solar radiation is affected by humidity (moisture), dust, pollution, the month/season (orientation), and time of day. Some radiation is reflected by the clouds back to the surface. Some radiation is absorbed by air impurities. Some is reflected back by water on the earth’s surface. Part of radiation reflected back is evaporated, part reradiated, and some scattered and diffused.

The sun is directly over the equator in March and September, after which it moves northward until June 21. The sun then begins moving on a more southerly track, reaching its southern-most position about December 21. The angle of the sun from due south is called an azimuth. From sunrise to noon, the azimuth is measured in negative degrees. From noon to sunset, the azimuth is measured in positive degrees.

A sun path diagram shows the path of the sun over a particular site. The time of the day, the season, and the latitude of the site determine this path. The altitude of the sun is the angle between the rays of the sun and the horizon. The altitude of the sun changes with the time of day, the seasons, and also with latitude.

Trees and Plant Materials for Shading

Trees and plant materials are some of the most valuable landscaping tools for passively increasing the interior comfort of a home. Once established, most trees require little maintenance and represent an appreciating investment in the home’s value. Trees and plant materials are effective providers of shade as well as modifiers of air movement. How a particular tree species performs these functions depends on how tall it grows, whether or not the leaves stay on the tree all year, and the shape and density of the canopy.

Trees that grow thirty or more feet tall are capable of casting shadows over the roof of a typical single family house. Unfortunately, new plantings of most large growing trees require twenty or more years to reach full size. The homeowner is probably better off investing in quality ceiling insulation, attic ventilation, and construction of radiant barriers unless a preexisting tree canopy effectively shades the roof during the summer months.

Large trees overhanging the roof of a house do present the risk of damage from falling limbs as well as the nuisance of clogging rain gutters with leaf and twig litter. The planting sites of new trees must be carefully considered to optimize future shade benefits while minimizing these potential problems. If a solar water heating or electric system is on the roof, careful attention must be paid to positioning shade trees so that the efficiency of the system is not reduced.

The shadow of a tree planted 10 feet from the home moves across the target surface four times more slowly than a tree planted 20 feet away. With the small lot size in Southern Nevada, many walls and windows will also be shaded by adjacent homes and property line walls and fences.

The correct placement of trees chosen to shade the home involves consideration of the angle of the sun’s rays, the mature height and width of the tree canopy, and the height of the structure to be shaded. Precise guidelines on determining shade patterns can be found in diagram 1.
Growth rate and initial planting size will ultimately determine how quickly benefits will be derived from newly installed plantings. Generally, the largest affordable tree available to most homeowners is one with a stem caliper of 2-3", an overall height of 8-10', and spread of 3 - 4'. The lowest limbs are usually 3 - 4' from the soil surface. A tree with a fast growth rate generally produces over three feet of growth during one growing season; moderate 2 - 3'; and slow; less than 2' of annual growth.

Where and What to Shade

During Nevada summers, the sun rises in the northeast and casts shade towards the west. The sun sets west of northwest, shading the east sides of buildings in the evenings.

This factor, along with the high altitude of sun in summer causes southwest walls to have more exposure to the sun than walls facing north or east. Eastern and western wall exposures accumulate the most heat during the long days of summer. Tree shading should thus be maximized on these sides of the house.

To maximize shading from summer sunrise and morning sun, trees should be planted on the east side of the house. To deter the afternoon heat, trees should be planted on the west side of the house. Because the sun is at such a high angle (directly overhead) during the summer months from May to October, the south walls receive less direct heating than during the winter months when the sun is at a lower angle.

Therefore, planting deciduous trees on the south side of a building will benefit shading, cooling and heating effects in summer and winter. The southern exposures may be relatively free of direct radiation in May, June and July in Southern Nevada, but by August and September, the sun has dropped sufficiently in the sky to cause a significant heat load increase on a southern wall in the afternoon. (See diagrams 1 and 1 for tree height and distance from building.)

Windows and glass doors are the most direct routes for sunlight to enter the home. Trees and shrubs (or shading devices such as awnings) should be positioned to shade them in hot seasons throughout the day. (See diagram 3.) Trees can provide valuable shading of sidewalk, particularly in older homes where walls have little insulation and retrofitting is prohibitively expensive. Small (up to 25 ft.) or medium-size (25-40 ft) trees can perform this function well and won’t grow out of bounds. Fast growing trees can be planted at the same time as slower-growing species to provide a temporary solution to shading problems. Such trees can be removed later as the slower-growing, longer-lived trees approach their mature heights. Care must be taken that these vigorous, temporary trees do not shade or otherwise compete with the slower growing, more permanent landscape elements.

The outdoor compressor/condenser unit of the air conditioning system uses less energy when it and surrounding areas are shaded from direct sun during the entire day which is difficult to shade when on the roof. A tree can shade the unit when the sun is overhead, while nearby shrubs can provide protection during the early morning and late afternoon hours. Care must be taken, however, not to block the conditioner's air flow (short-circuiting). If the warm discharge air is prevented from escaping, the intake air temperature is raised, causing the unit to operate less efficiently. A plant must have a mature width of 6 feet, then plant it 3 feet (half of its mature width) plus 2 feet from the air conditioner unit (compressor).

In winter, the sun is low in the southern sky. Southern exposures of a home can receive the cost-free, energy-saving benefits of passive solar heating, when deciduous trees are used along the southern exposures. In Southern Nevada, where winters are mild compared to the rest of the state, benefit may be realized by using deciduous trees along southern exposures to maximize warming from the sun (passive solar heating) and lower heating costs.

Trees planted fairly close to the home provide shade sooner than those planted at greater distances. (See diagrams 1 and 2). The benefits of new shade trees should be obtained within 5-10 years, depending on the specific species and elevation of the building. To accomplish this goal, a distance of 7 to 20 feet from tree to wall is recommended for most medium-sized trees (10-30 feet high). Lot sizes and mature tree heights directly influence this distance. Trees planted closer will shade for a longer period of time during the day, and over a greater part of the hot season. The shadow of a tree planted 10 feet from the home moves across the target surface four times more slowly than a tree planted 20 feet away. With the small size of lots in Southern Nevada, many walls and windows will also be shaded by adjacent homes and property line walls and fences.
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attention must be paid to positioning shade trees so that the efficiency of the system is not
reduced.

Types of Shade Trees

Evergreen trees maintain their leaves throughout the year. There are two types of evergreen
trees. Broad-leaved evergreens include oaks, mesquites, sycamores, palms, and elms, and
are to be planted on the south side of buildings. Needle-leaved trees to be planted on the
north side of buildings are pines, cedars and junipers. Broad-leaved evergreen trees provide
dense shade year-round. The shade cast by needle-leaved trees is sparse and more open,
though pruning can, in some cases, stimulate a denser canopy. In the winter, temperatures
are cooler in Southern Nevada, averaging sixty degrees Fahrenheit. Deciduous trees shed
their leaves in the fall and are bare during the coldest months of the year, which allows the
sun to come through and warm the buildings from November to March. Tree shape also influ-
ences the amount of shade cast on buildings.

Three size classifications of trees have been used: small (less than 25 feet), medium (25 - 40
feet), and large (more than 40 feet). Small trees are best used as patio trees or can be plant-
ed relatively close to the house to directly block morning and afternoon sun. Medium trees,
because of their canopy and size, provide extensive shade on lawns and patios. They limit
solar radiation by directly blocking or casting shadows on wall surfaces. Generally, medium
trees should be planted 10 to 15 feet away from the house. Trees larger than forty feet and
those with wide spreading canopies should be restricted to perimeters of most residential lots.

Tree form is quite variable and accordingly shade patterns vary with each form. The forms
used are horizontal spreading, rounded, vase, pyramidal, and oval. Maximum shading is pro-
vided by horizontal spreading forms, but unfortunately, not many small or medium trees exist
in this form. Rounded or oval forms can be just as effective if multiple plantings are used.
Pyramidal forms are least effective. Remember that the shadow of a broad tree with a low
canopy moves much slower than the shadow of a tall slender tree.

Density of tree canopies can have as much effect as tree form on solar reduction. Density of
shade is related to the size of the foliage and the general compactness of the crown as influ-
enced by branching habit, number of leaves, and internode length. Trees have been classified
according to light, moderate, or heavy shading, but even these are approximations since cul-
tural practices can have a major influence on the density of a tree’s growth.