or white, are highly attractive to butterflies. Grow Pentas in full sun or shifting shade.

VERBENA (*Verbena* x *hybrida*) This sprawling perennial makes a beautiful flowering ground cover or hanging basket. Perennial (not annual) verbena blooms prolifically from March through October. Flowers are red, pink, white or lavendar. Verbena will tolerate full sun or partial shade. It should be lightly pruned occasionally to promote flowers and to curb its growth. This plant is easily propagated from cuttings.

The perennials discusssed her are ones which, in my opinion, are proven performers in central Florida and can be used as long-lasting, colorful additions to traditional landscapes or as foundation plants for an herbaceous perennial garden.

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LANDSCAPING TO CONSERVE ENERGY

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Abstract. **The best use of structural and landscape design elements to maximize or moderate sunlight, shade and air movement can reduce the cost of keeping a home comfortable as much as 30%. A house will be more energy efficient if 1) oriented with its long axis running east-west, 2) the roof and walls are light-colored, 3) roof overhangs shade windows and walls, 4) arbors and trellises shade nearby walls, 5) wooden decks are used instead of concrete patios, and 6) the driveway is located on the east or north side of the house. Summertime heat gain in a home can be reduced by using plants in the lanscape to 1) shade the residence from direct solar radiation, 2) divert air movement away from the house when air-conditioning is the sole source of cooling, 3) channel air movement towards the house when air-condidtioning will be used only minimally, and 4) create cooler ambient temperatures near the home as moisture is evaporated from plant leaves. Heating costs in winter can be reduced by selecting and properly locating plants so that the amount of direct solar radiation received by the home is maximized and the effects of cold winter winds are minimized.**

Florida's long, hot summers create a high demand for air conditioning. As much as 30% of the cost of keeping a home comfortable could be saved by effective management of the microclimate which surrounds it. Microclimate is the term used to define any small, local area within which the effects of weather are easily controlled.

One way to control microclimate is through structural modifications involving the design of a house. They may include orientation of a house on the site and associated construction such as patios, decks, fences, and driveways. A house is more energy efficient if it is oriented with the long axis running east-west. With this orientation, the short walls of the house will receive most to the direct morning and afternoon sun, thereby reducing the total heat load on the structure. In the winter, when the sun is lower in the sky, the south-facing long wall will receive the heating benefits of solar radiation.

Light-colored materials reflect sunlight; dark materials absorb radiation. A house with dark walls and roof will be less expensive to heat in winter, but more costly to cool in summer. Light-colored walls and roofs will lower cooling cost but increases the need for winter heating. In Florida, the use of light-colored materials is more cost effective and energy efficient, since the cooling season is considerable longer than the heating season.

Fencing can influence the patterns of air circulation depending on the season of the year, direction of prevailing winds, and degree of dependence on air-conditioning for home cooling. This can affect energy efficiency of a home. Air movement around the home may raise energy consumption by increasing conductive heat loss (in winter) and heat gain (in summer) through walls and windows, and infiltration of outside air through cracks and around edges of windows and doors.

In Florida, winter's prevailing winds are from the north or northwest. Thus, a solid fence on the north side of a house can provide a barrier against cold winter winds. In the summer, southerly winds predominate and open fencing on the south side of a house, especially with bottom clearance, will maximize air flow and reduce reliance on air-conditioning for cooling. However, if air-conditioning rather than natural cooling will be used to cool the home, prevailing summer winds should be blocked or diverted away from the house to reduce warm air infiltration.

Roof overhang is the most common method of architectural shading of windows and walls. A properly designed roof overhang will provide shade from the summer's sun and admit winter sun for warmth. Other shading devices which are attractive as well as energy conserving include horizontal projections such as awnings and extended porches.

Arbors or trellises over patios, decks and terraces will increase comfort and shade nearby walls. Many outdoor living areas are made of concrete, but a raised wooden deck is cooler. Air circulation underneath the structure discourages heat buildup. In addition, wood conducts heat poorly, so it heats up less than concrete and because of its dark color, it will not create a glare. If possible, driveways should be located on the east or north side of the house to

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reduce heat buildup during warm afternoons. Solid surfaces such as concrete and asphalt, which transfer a great deal of heat, should be kept to minimum, and wood chip, bark, or pine straw mulch used instead.

Microclimate Modification with Plants

Using trees for shade. Trees are both effecive providers of shade and modifiers of air movement. How a particular tree species will perform 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 grown 60 feet or more are capable of casting shadows over the roof of a typical family house. Unfortunately, new plantings of most large-growing trees will require 20 or more years to reach full size. Also, large trees overhanging the roof of a house drop limbs and leaves, and can shade solar collectors, reducing their efficiency. Unless a preexisting tree canopy effectively shades the roof, a homeowner is probably better off investing in quality ceiling insulation, attic ventilation, and radiant barriers (a layer of aluminum foil situated in the air space between the roof and the attic insulation) (2, 3). Small (up to 25 ft) or medium-size (25-40 ft) trees will provide valuable shading of sidewalls and windows and will not grow out of bounds.

In north Florida, deciduous trees can be used effectively to conserve energy. Properly placed, they provide shade in the summer, drop their leaves in the fall, and allow the sun to warm the home in winter. However, in south Florida, where winters are short and mild, evergreen trees are a better choice to reduce heat build-up and lower air-conditioning costs.

Tree shape will influence the amount of shade casted. Broad spreading trees like live oak (*Quercus virginiana* Mill.), dogwood (*Cornus florida* L.), and crape myrtle (*Lagerstroemia indica* L.) will provide the longest periods of shade over the course of the day than trees like the column shaped Italian cypress (*Cupressus sempervirens* L.) and the pyramidal shaped American holly.

Eastern and western exposures accumulate the most heat during the long days of summer. Trees should be planted to shade these sides. South-facing walls will also benefit from tree shade. Although southern exposures may be relatively free of direct radiation in June, by August the sun has dropped sufficiently in the sky to cause significant heat load increase in the afternoon (4, 6, 7).

Trees planted close to the home will begin to provide shade sooner than those planted at greater distances. The benefits of new shade trees should be obtained within 5 years. To accomplish this goal, a distance of 7 to 20 feet from tree to sidewall is recommended. The shadow of a tree planted 10 feet from the home will move across the target surface 4 times slower than a tree planted 20 feet away (4, 6, 7). 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. Several publications and an interactive computer program are available at Florida's County Cooperative Extension offices for determining proper shade tree position.

The outdoor compressor/condenser unit of the air conditioning system will use less energy if it and the surrounding area are shaded from direct sun during the entire day. 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. However, care must be taken not to block the conditioner's air flow. If the warm discharge air is prevented from escaping, the intake air temperature will be raised, causing the unit to operate less efficiently.

Shrubs and vines. Shrubs can provide effective barriers to early morning and late afternoon sun. Espaliered shrubs—shrubs trained to grow flat against a wall—will block a great deal of sunlight before it strikes and heats up the wall.

Vines are specially useful for shading homes when small lot size restricts use of shade trees. Vines are either self-supporting or twining. Self-supporting vines cling to a surface by either pad-like holdfast (e.g., Virginia creeper: *Parthenocissus quinquefolia* L.) or aerial roots (e.g., trumpet vine: *Campsis radicans* L.) Self-supporting vines are not recommended for wood structures because they may trap moisture which can lead to decay of the wood. On brick or concrete block homes, a fast-growing, self-supporting vine can effectively prevent the sun from heating a wall (5). Twining vines (e.g., Confederate jasmine: *Trachelospermum jasminoides* Lem.; painted trumpet: *Clytostoma callistegioides* Bur.) climb by means of stems or tendrils that require some form of support. By providing 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, to allow winter sun to passively heat the home, except in south Florida.

Wind control. In Florida, trees and shrubs situated on the north, northwest and, to a lesser extent, northeast exposures of the home can provide significant energy savings during the winter heating season. Acting as a wind break, they reduce heat loss from the home. A multi-layered canopy of shrubs and trees of moderate density planted in one or more rows is the most effecive windbreak design, but even a single row of trees will provide some windbreak action. Windbreaks significantly reduce wind velocity for a distance equal to 10 times the height of the trees, less significantly to 20 times the height. The greatest amount of protection occurs within a distance of five times the height of the windbreak.

In Florida, summer breezes prevail from the south and southeast. In north Florida, breezes during July and August originate from the south or southwest; in south Florida they largely remain southeasterly (1). How best to use plant to interact with summer air movement is largely determined by the means with which the home will be cooled.

For a home in which air-conditioning will be used only minimally, trees and shrubs should be strategically situated to channel cooling breezes toward the windows. Low-branching trees should be avoided on the southeastern and/or southwestern exposure, or the low branches removed. Plants used to shade windows from the sun should be far enough away to not restrict air movement. Winter wind barriers on the north and northwest sides of the home will also deflect cooling breezes from the south back toward the house in the summer.

During the 5 to 7 months of Florida's uncomfortably warm temperatures, some residents find it impossible to stay cool without air-conditioning, regardless of the cost.

Wind movement around the home during the cooling season will substantially raise the energy cost of air-conditioning by increasing the infiltration of hot, humid outside air around windows, doors, and through cracks. Studies of air-conditioned homes in Florida have determined that heat gain by infiltration is actually greater than gain by conduction and radiation through walls and windows (8).

Shrubs and trees should be positioned around the air-conditioned home to divert the prevailing southern breezes away from the house. A multi-layered summer windbreak should be designed along the southern exposures and away from the home. Along and close to the walls that face the direction of summer winds, a foundation planting of shrubs should be used to create a dead air space that will reduce warm air infiltration.

Cooling effects of plants. As hot air passes over the surface of leaves, moisture absorbs some of the heat as it evaporates. The air surrounding the leaf surface is cooled by this process. This interaction is called evaporative cooling, and air temperatures surrounding vegetation can be lowered by as much as 9°F by its effects. To maximize the effects of evaporative cooling, increase the amount of plant cover around the home.

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EFFECTS OF INJECTED AND SURFACE FERTILITY ON HIBISCUS GROWTH IN BARE GROUND, MULCH AND TURF

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Abstract. **One-gallon container sized *Hibiscus* X rosa-sinensis planted in June 1982 were either treated with a surface application or subsurface injection application of fertilizer, beginning in the Spring of 1983. Treatments were applied to 8 ft. X 8 ft. bare-ground, mulch and turf plots, each containing one hibiscus plant. By the winter of 1983, after four fertilizer applications, hibiscus stem diameter, leaf color, plant quality and shoot growth in the bare ground was similar to growth in the mulched plots. Hibiscus growth and plant quality ratings in both treatments were better than in the sodded plots. There were no significant growth, color or quality differeneces between plants receiving injected or surface-applied fertilizer. Maintaining the area around hibiscus in mulch or bare ground, even without fertilizer, promoted better hibiscus growth than keeping the turf and fertilizing. Hibiscus did not respond to fertilizer applied during the first 16 months following planting.**

The traditional method of tree and shrub liquid fertilizing was to inject the material into the soil at prescribed depths. This concept has been challenged by van de Werkin (7) who reported that trees receiving fertilizer as a surface application grew as well or better than those receiving fertilizer from a subsurface injection. Since recent studies show that much of a plants' root length is just below the soil surface (5), subsurface injection would place most fertilizer below the roots. Excess leaching could cause unnecessary ground water contamination and poor plant response to the appled fertilizer.

Surface fertilization certainly reduces labor cost compared to the injection mehtod but data supporting the horticultural soundness of surface application is incomplete. This study was designed to determine how woody plants growing in turf, bare ground and mulch respond to surface and subsurface fertilization.

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Materials and Methods

Forty-five 1-gallon container size hibiscus were planted on 8′ centers in June 1982 in a Boca fine sand (pH=7.6) in Boynton Beach, FL. A square 64 ft² area around fifteen plants was sodded with St. Augustine (*Stenotaphrum secundatum* 'Floratam') turf in Jan. 1983. A 64 ft² area around fifteen plants was mulched with a 3″ thick layer of cypress mulch. The ground around the remaining fifteen plants was maintained with glyphosate as bare soil. Nine treatments (surface fertilized, injected and not fertilized for turf, bare ground and mulched plots) were replicated 5 times in a randomized complete block design. Plots were either surface liquid fertilized or injected with 1 lb nitrogen (from urea), 0.5 lb potassium (from KCL), 0.01 lb manganese (from MnS) and 0.03 lb iron (from EDTA chelate) per 1000 ft². Injections were made at 75 PSI at a depth of 6″ below the soil surface in an 18″ grid. Fertilizer was applied on 7 April, 23 June, 23 Aug. and 18 October, 1983.

Hibiscus color and plant quality were recorded at 2-week intervals on a 1-9 scale with 1 representing poor color or quality and 9 dark green color or excellent quality. Two