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 individuals recorded these parameters and their scores were averaged. Shoot growth was measured on the same 4 shoots per plant monthly from April through October. Trunk diameter was measured at ground level once in April and again in October, at the end of the study.

Results and Discussion

Turf competed with hibiscus plants. Stem diameter, leaf color, plant quality and shoot growth for hibiscus growing in turf were significantly less than for those in the mulched or bare-ground plots (Table 1). There was no difference in hibiscus response between the mulched and bare-ground plots. Turf may have competed for both water and nutrients (1); however, soil moisture was relatively constant as the water table was regulated at 18" below soil surface by pumping water from the area. Without pumping, the site would have been under water. Assuming that there were no allelopathic effects, nutrient competition limited hibiscus growth in the St. Augustine sod. However, turf roots may compete with woody plant roots for water under less optimum soil moisture conditions.

Hibiscus growing in mulch or bare grount without fertilizer had better quality, leaf color and stem diameter growth than plants growing in fertilized turf (Table 1). In the sodded plots, only hibiscus plant quality responded to soil injected fertilizer. Plants did not respond to surface fertilization in the sodded plots. Compared to the unfertilized check, injecting fertilizer had no effect on plant response in the mulched or bare ground plots. Only plant quality was increased by surface fertilization in the bare ground plots compared to the unfertilized checks. Surface fertilization had no effect on hibiscus in the mulched plots.

Table 1. Stem diameter increase, leaf color, plant quality and shoot growth during 1983 of hibiscus shrubs planted in bare ground, mulched and sodded turf plots receiving no fertilizer, broadcast or subsurface injected fertilizer.

Treatment	Stem diameter increase (cm)	Leaf Color[x]	Plant Quality[y]	Shoot growth[x] (cm)
No Fertilizer				
Bare ground	1.1[w]	6.0	5.8	21.6
Mulched	1.3	6.4	6.2	20.9
Turf	0.2	4.5	3.6	11.0
Surface Fertilized				
Bare ground	1.5	6.8	6.9	24.4
Mulched	1.6	7.0	6.9	34.4
Turf	0.3	4.9	4.4	10.3
Injected Fertilizer				
Bare ground	1.6	6.7	6.6	29.4
Mulched	1.4	6.7	6.4	27.8
Turf	0.7	5.1	4.8	12.9
LSD 10%	0.6	0.8	1.0	13.7

[z]Measured on a 9-1 visual scale (9 = dark green color, 6 = marginally acceptable green color, 1 = all leaves bright yellow or brown).
[y]Measured on a 9-1 scale (9 = best quality 6 = marginally acceptable quality, 1 = poor quality).
[x]Measured on 4 shoots per plant.
[w]Mean of 5 shrubs.

Harris (3) with fescue (*Festuca*) and Richardson (4) with ryegrass (*Lolium perenne*) found that competition for nitrogen was a major factor in the detrimental effect of turf on trees. In contrast, Dean and Whitcomb (2) found that broadcasting nitrogen over bermuda grass did not increase the ability of trees or shrubs to compete with the turf. In an earlier study bermuda (*Cynodon dactylon*) and centipede (Eremochloa ophiuroides) grasses were found to be the most competitive with woody plants, bahia (*Paspalum notatum*) intermediate and St. Augustine the least competitive turf (6). Hibiscus grown in St. Augustine turf in this study did not respond to surface or injected fertilization. Woody plants growing in the other turf grasses common in Florida may not respond to fertilizer since they are even more competitive than St. Augustine. Competitiveness between turf and woody plants may be related to root morphology, root depth, growth rate or allelopathic substances released by the turf or woody plant leaves, stems or roots.

There appears to be no advantage to injecting fertilizer into the soil at the 6" depth when fertilizing young hibiscus growing in St. Augustine turf, bare-ground or in a mulched bed since surface fertilizer application gave the same growth response as soil injection. Maintaining the area around hibiscus in mulch or bare-ground, even without fertilizer, corresponded to better hibiscus growth compared to keeping the turf and fertilizing. This shows the importance of preventing turf growth within the root zone of recently planted landscape trees or shrubs. Hibiscus did not respond to fertilizer applied during the first 16 months following planting.

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