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RESPONSE OF HIBISCUS TO ORGANIC MULCHES

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Abstract. **Five organic materials were evaluated during a 14-month period to determine their potential as landscape mulch. Using hibiscus (*Hibiscus rosa-sinensis* L.) as the test plant, the materials evaluated were melaleuca, municipal solid waste (MSW), eucalyptus, pine needles, and cypress. Particle sizes of the mulches were determined before application. Mulches were applied to a depth of four inches. During the evaluation period, the plants were grown without pruning, pesticide applications nor the use of additional mulch. Mulch subsidence and plant growth were measured. Phosphorus, K, Mg and pH analyses were performed on soil samples. Plant tissues were analyzed for N, P, K and Mg. A subjective evaluation of plant appearance was done at the end of 14 months. Cypress and pine needles lost 20% and 72% of total volume, respectively, and represent the extreme in losses. All mulches lowered pH. Nitrogen in plant tissue initially increased then decreased over time. Potassium concentration in soil and plant tissues decreased. The best plants were grown with cypress, eucalyptus, melaleuca, MSW, pine needles and control, respectively.**

The increased use of organic mulch is being driven by expanding suburbia and by laws restricting the dumping of organic waste in landfills. A mulch is any material applied to the soil surface for protection and improvement of the area covered. It enhances plant establishment by preventing water loss, suppressing weeds, modifying soil temperatures and improving soil structure and tilth (Ashworth and Harrison, 1983; Black et al., 1994).

Mulch can be used around individual trees, in entire beds of shrubs, trees, annuals, perennials and/or ground covers. The type of mulch used will largely depend on its cost, availability, effect on plant growth and durability. Nationally, the type of mulch used is largely dependent on local tree source. In southern Florida, cypress (*Taxodium distichum* (L.) L. Rich.), pine (*Pinus elliottii* Engelm.) and melaleuca (*Melaleuca quinquenervia* (Cav.) Blake) trees grow without cultivation and are popular sources of mulch. It is estimated that up to six billion non-native, invasive melaleuca trees exist in the Florida Everglades. This represents a perpetual source of mulch. Eucalyptus, originally cultivated as a pulp material, has largely been diverted for use as landscape mulch. Eucalyptus trees are cut to the stump and regrow to provide a continuous supply of mulch (Aaction Mulch, Fort Myers, FL, pers. comm.).

Cypress, pine, melaleuca and eucalyptus are available as mulches from most south Florida garden centers. Not available for retail sales but obtainable at county waste facilities and private mulching companies is municipal solid waste (MSW) compost. MSW compost includes curbside organic trash collected separately from the rest of the garbage and landscape refuse from professional landscapers. In 1992, Florida generated approximately 1/10 (20 million tons) of the nation's MSW. About three million tons were due to yard trimmings (Smith, 1994). Florida law prohibits the disposal of plant trimmings in lined landfills (Black et al., 1994) and so the quantity of MSW compost is expected to increase. MSW compost is often available free of charge to home gardeners and professional landscapers.

Organic mulches will gradually decompose and need replenishing over time. Some material might reduce plant nutrient availability and retard plant growth. Selecting the right type of mulch may reduce labor, fertilization and irrigation cost and add to the general appearance of plants.

The objective of this investigation was to determine the suitability of five organic mulches for landscape use and their effect on hibiscus plant growth.

Materials and Methods

Site preparation. In June of 1994, workers from Lee County Department of Parks and Recreation roto-tilled a field on soil of the Immokalee-Urban land complex series to a depth of six inches. The area was simultaneously leveled.The field is located at the Extension office in Terry Park, Fort Myers. Organo™ slow release fertilizer (5N-2.2P-1.7K [5-5-2]) was incorporated at the time of tilling at a rate of 30 lb/100 ft². The fertilizer is derived primarily from activated sludge. Master Gardeners placed 4 × 8-ft recycled plastic sidings to established three randomized complete blocks, each of which consisted of nine planting beds that measured 6 × 4-ft (24 ft²). Weeds left by the roto-tiller were removed by hand.

Treatments. Plants in each bed were mulched to a depth of four inches with pine needles, shredded cypress, melaleuca chips, eucalyptus shreds or MSW compost. The mulches were supplied by Forestry Resources, Inc. of Fort Myers. One bed in each block was left untreated as a control. During the 14-month trial, no additional mulch was added to replenish that lost to decomposition. Cypress and eucalyptus were shredded in the same manner and had an average size of 1/8 × 1/2 inches. Melaleuca chips averaged 1 × 1/2 inches. MSW was composted for 120 days and screened to contain particles no larger than 2 1/2 inches.

Plant maintenance. Three days after site preparation, hibiscus plants were taken from one gallon containers and planted two

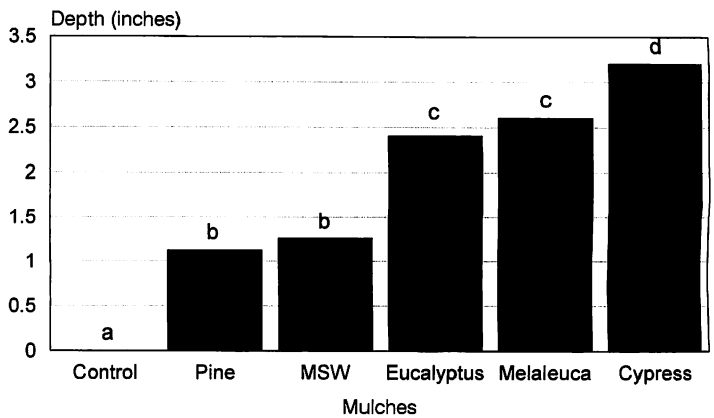

Figure 1. Depth remaining of 4" of organic mulches after 14 months of hibiscus plant growth. Bars with the same letter are not significantly different due to treatment at the 5% level as determined by Fisher's LSD.

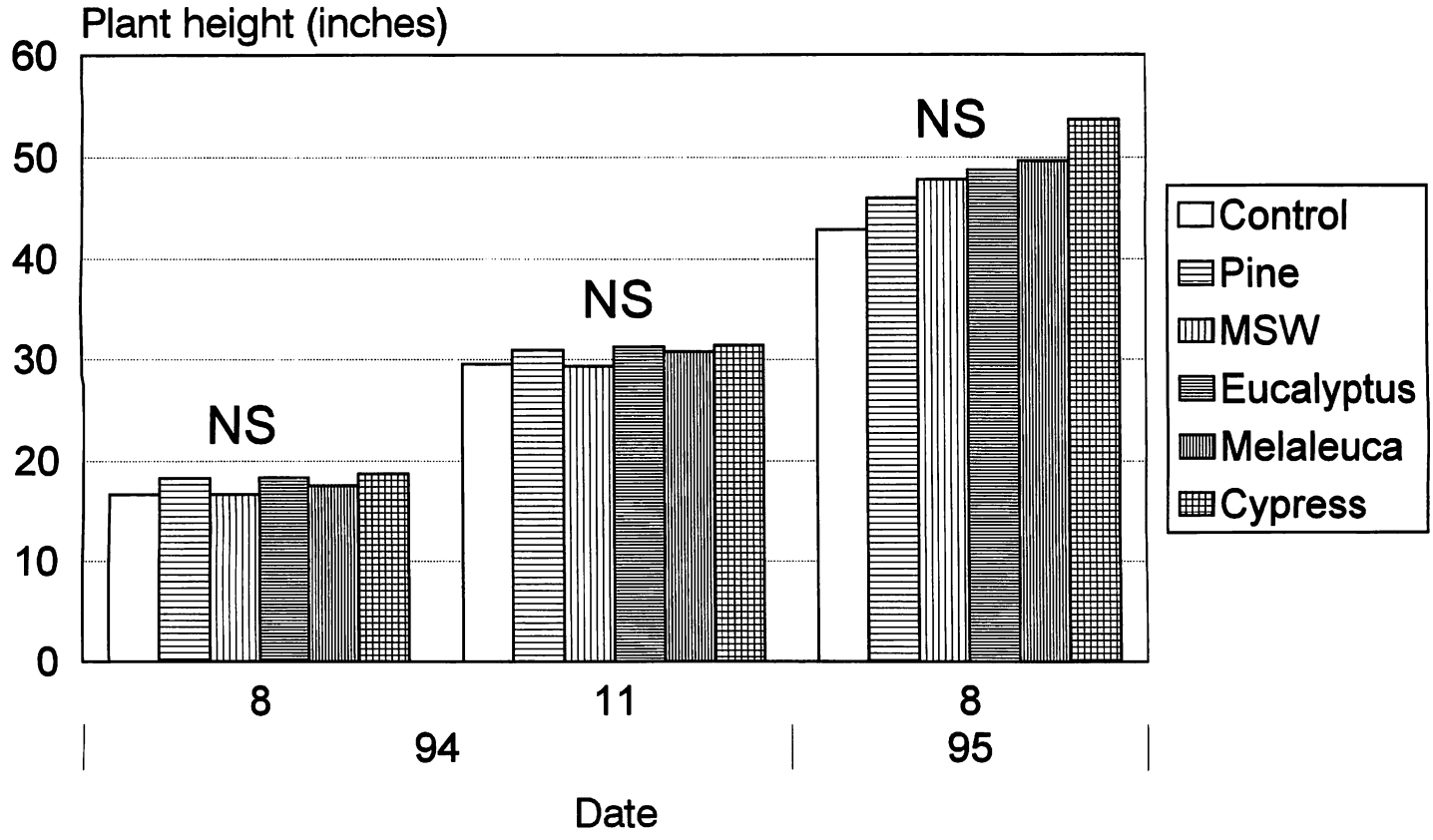

Figure 2. Height of hibiscus plants grown with various mulches. NS = no significant differences on indicated date due to treatment at the 5% level as determined by Fisher's LSD.

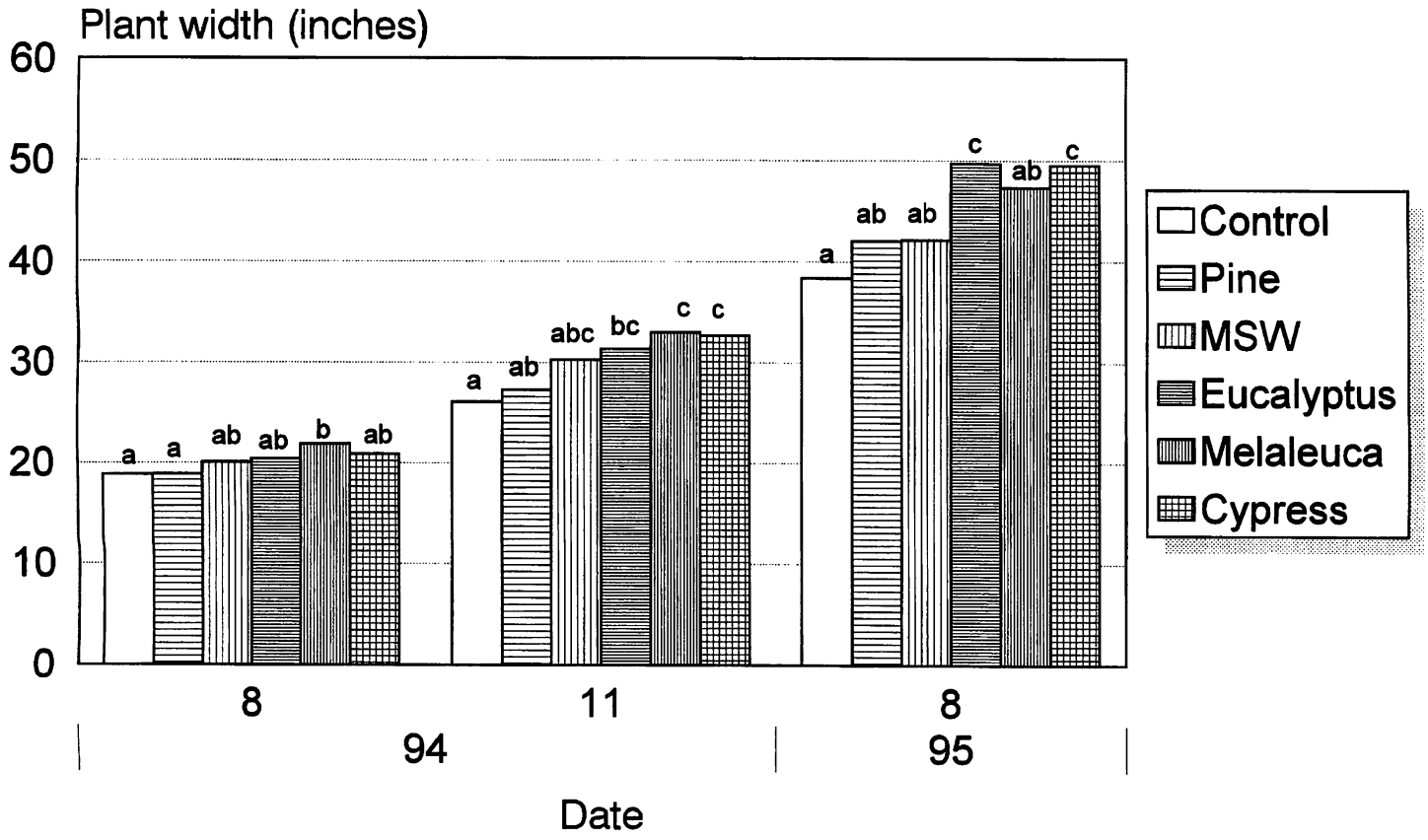

Figure 3. Width of hibiscus plants grown with various mulches. Bars with the same letter, on the indicated date, are not significantly different due to treatment at the 5% level as determined by Fisher's LSD.

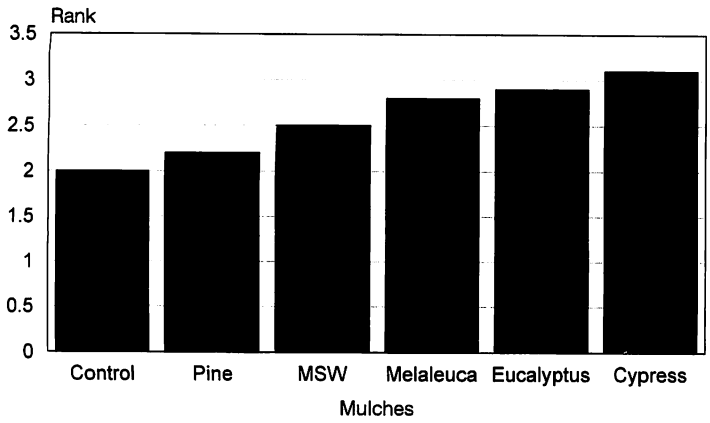

Figure 4. Appearance of hibiscus plants after 14 months of growth with various organic mulches. Rank represents the following: 1 = unacceptable; 2 = barely acceptable; 3 = acceptable; 4 = excellent appearance; 5 = superior appearance.

per 6 × 4-ft bed for a total of 54 planted. Plants were thoroughly watered in upon planting and then watered every day for three weeks until establishment. After establishment the plants were maintained by normal precipitation. After the initial incorporation of fertilizer into the soil, plants were grown for 14 months without further fertilization. During this time they were neither pruned nor treated with any pesticides. Extension Master Gardeners hand-weeded the test plots as needed.

Data collection. This trial consisted of three replications in a completely randomized design and 18 plants per replication. In Aug. and Nov., 1994 and again in Aug., 1995, the depth of mulch in each planting bed was measured for subsidence. (Only the latter measurement is presented here.) On the same days, the width and height of each plant were recorded. Leaves were taken from each plants and analyzed for N, P, K and Mg. Soil samples were taken from a depth of 3 to 6 inches and analyzed for pH and plant available P, K and Mg. The standard soil fertility and plant tissue analyses were performed at the IFAS Soil Testing Laboratory in Gainesville. Plant appearance was observed throughout the trial and ranked numerically in Aug., 1995. The rankings were 1 = unacceptable; 2 = barely acceptable; 3 = acceptable; 4 = excellent appearance; 5 = superior appearance. Data within a given month were analyzed using Least Significant Difference (LSD) at the 5% level of confidence. No data was analyzed over time.

Results and Discussion

Subsidence rate. After 14 months cypress mulch was the most stable of the five mulches tested (Fig. 1). As much as 80% of the original quantity (3.2 inches) remained. In contrast, pinestraw lost 72% of total volume or 2.9 inches. MSW compost, eucalyptus and melaleuca lost 69%, 41%, and 35% of volume, respectively. In Florida, cypress sawdust is preferred as a container medium because it is slower to decay than most other wood particles (Henley and Ingram, 1989). However, in a central Florida study (Stinson et al., 1990) subsidence rate of cypress mulch did not differ significantly from pine needle and other organic mulches. There was no significant difference in subsidence between eucalyptus and melaleuca even though melaleuca was applied as larger chips of mulch. Henley and Ingram (1989) reported that a desirable characteristic of melaleuca for container media is its resistance to decay providing particle size stability.

Height and width. Mulch treatments did not significantly affect height of hibiscus (Fig. 2). However, at the end of the trial, trends in plant height were observed with respect to treatments. Plants grown with cypress mulch were on average 11 inches taller than those grown in bare soil. Heights of cypress, melaleuca, eucalyptus, MSW compost, pine needle and control grown plants decreased respectively. Significant differences between plant width occurred on all dates growth was recorded (Fig. 3). After 14 months, plants grown with cypress and eucalyptus mulches had significantly greater width than plants grown with the other mulches or without mulch.

Appearance. After 14 months, cypress grown plants had the best appearance compared to plants of other treatments (Fig. 4). Plant appearance was progressively worse in the order of cypress, eucalyptus, melaleuca, MSW compost, pine and control grown plants. Control grown plants were judged barely acceptable for landscape purpose. Only cypress grown plants were considered fully acceptable for landscape use. This is not surprising since no additional fertilizer application was made after an initial quantity was roto-tilled into the soil. Soil analysis determined the need for K applications (Table 1).

pH analysis. All treatments lowered soil pH but there was no significant difference between treatments (Table 1). Contrary to popular belief (Ball, J., 1988), pine needles did not significantly lower pH relevant to other treatments. After 14 months, the pH in each plot was slightly acidic and reflected the range recommended for optimum plant growth of most cultivated plant species.

P, K and Mg soil analyses. With the exception of MSW treated plots, soil phosphorus decreased over time for all treatments (Table 1). By Aug., 1995, cypress treatments had significantly less P (26 ppm) than other treatments. Phosphorus in MSW compost treatments (50 ppm) exceeded that of all other treatments. Soil K concentrations tended to decrease over time for all treatments and strongly point to significant differences in many cases if statistically analyzed.

Table 1. Effect of five organic mulches on soil pH, P, K and Mg concentrations sampled at a depth of 3 to 6 inches.

	pH			P (ppm)			K (ppm)			Mg (ppm)		
Treatment	8/94	11/94	8/95	8/94	11/94	8/95	8/94	11/94	8/95	8/94	11/94	8/95
Control	7.56a[z]	6.97a	6.8a	40.67a	42.67a	39.00abc	24.00b	17.67a	14.33ab	221.33a	172.00a	174.67a
Pine needle	7.47a	7.23a	6.7a	53.00a	46.33a	40.67ab	15.33b	14.67b	13.00bc	180.00a	156.99a	136.00a
MSW	7.63a	7.03a	6.67a	49.00a	52.33a	49.67a	62.00a	19.00a	15.00a	221.33a	185.33a	202.67a
Eucalyptus	7.47a	7.20a	6.67a	41.67a	39.67a	32.33bcd	15.00b	12.67b	12.00c	140.00a	132.00a	108.00a
Melaleuca	7.57a	7.07a	6.4a	35.67a	30.00a	28.00dc	17.00b	12.67b	9.67d	177.77a	125.33a	104.00a
Cypress	7.37a	7.17a	6.47a	47.67a	33.67a	26.00d	18.33b	12.00b	10.33d	181.33a	141.33a	101.33a

[z]Means within columns followed by the same letter are not significantly different due to treatment at the 5% level as determine by Fisher's LSD.

Table 2. Effect of five organic mulches on hibiscus leaf concentration of N, P, K and Mg.

Treatment	N (%)			P (%)			K (%)			Mg (%)		
	8/94	11/94	8/95	8/94	11/94	8/95	8/94	11/94	8/95	8/94	11/94	8/95
Control	1.92b[z]	3.23a	2.44ab	0.48b	0.83a	0.58a	1.41c	0.90b	0.74a	0.45a	0.41ab	0.40a
Pine needle	3.08ab	3.41a	2.56a	0.51ab	0.55c	0.52a	1.39c	0.57b	0.60a	0.46a	0.44a	0.40a
MSW	3.07ab	3.35a	2.23b	0.57ab	0.59bc	0.63a	2.57a	1.48a	0.69a	0.40a	0.40abc	0.45a
Eucalyptus	3.00ab	3.45a	2.31ab	0.66a	0.77ab	0.56a	1.52c	0.78b	0.70a	0.38a	0.35c	0.42a
Melaleuca	2.87ab	3.43a	2.23b	0.52ab	0.54c	0.50a	1.47c	0.73b	0.56a	0.40a	0.37bc	0.48a
Cypress	3.20a	3.53a	2.37ab	0.57ab	0.66abc	0.49a	1.83b	0.84b	0.65a	0.44a	0.41ab	0.42a

[z]Means within columns followed by the same letter are not significantly different due to treatment at the 5% level as determine by Fisher's LSD.

Magnesium concentration decreased over time for all treatments. Between Aug., 1994 and Aug., 1995, Mg concentration decreased from a low of 8% to a high of 44% from MSW compost and cypress treated areas, respectively. At the end of the trial, P, K and Mg in MSW compost treatments exceeded that of all other treatments. Over time, plots treated with cypress mulch exhibited low retention of plant available P, K and Mg relative to other treatments. All treatments exhibited a trend toward lower pH, P, K and Mg concentrations.

N, P, K and Mg leaf analyses. For all treatments, N concentration in plant tissue increased (Nov., 1994) then decreased (Aug., 1995) over time (Table 2). Plants grown with pine needles had the highest leaf N concentration but were not significantly different than plants grown with bare ground, cypress and eucalyptus mulch. Leaf N concentration had no correlation with plant appearance (Table 2, Fig. 4.) With the exception of MSW compost grown plants, P leaf concentration decreased over time and by Aug., 1995, there was no significant difference in P concentration among treatments. Potassium in plant tissue decreased for all treatments over the 12-month period sampled. Potassium in soil also decreased over the same period for all treatments (Table 1). Analyses of plant Mg concentrations showed no definable trend. There was no significant difference in Mg concentrations among treatments at the end of 14 months.

Conclusions. The best plants were grown with cypress, eucalyptus, melaleuca, MSW compost, pine needles, and bare ground, respectively. After 14 months, the mulches retaining the greatest depth were cypress, melaleuca, eucalyptus, MSW compost, pine needles and control, respectively. All mulches lowered pH. Plots covered with pine needles did not significantly lower pH below that of other treatments. Soil and tissue analyses showed no apparent correlation with plant growth. The results indicated that because of better plant appearance and the slowest mulch subsidence rate, cypress mulch is the best material for landscape use. All materials evaluated had qualities which made them more valuable for hibiscus plant growth than control areas.

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