Mulch Effects on Crown Growth of Five Southwestern Shrub Species[1]

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Abstract

Effects of pine bark mulch on crown growth of cliffrose (*Cowania mexicana var. stansburiana* Torr.), curlleaf mahogany (*Cercocarpus ledifolius* Nutt.), desert olive (*Forestiera neomexicana* Gray), Apache plume (*Fallugia paradoxa* D.Don), and winterfat (*Ceratoides lanata* Pursh.) were examined. Three depths of mulch 0, 7.5, and 15 cm (0, 3, and 6 in), were applied to 3.8 liter (1 gal) plants at time of planting (April, 1989). Height, width, stem diameter and foliage fill were recorded for each plant after 18 months. Foliage fill was obtained by digital image analysis of 35 mm photographic slides. Mortality was recorded at the conclusion of the study. Results indicated no treatment differences within species in their growth or mortality after 18 months. Soils were examined within three soil layers (0–5 cm, 5–15 cm and 15–30 cm depths) for electroconductivity and pH. Soil pH was not affected throughout the profile but was lower in the surface soil layers under mulch. Soil EC in the top soil layer was reduced under mulching depending on species. The benefit of pine bark mulching is not apparent in the crown growth of these species. Growth form and native environment of individual species should be considered in mulching recommendations.

Index words: native plants, mulch, digital imaging, pine bark

Significance to the Nursery Industry

Mulches are widely recommended for newly planted landscapes to improve weed control, increase water conservation, and moderate change in soil temperatures. Effectiveness of mulch may depend on site conditions and plant species used. Our purpose was to determine the effects of mulching on crown growth of arid land species. Our results indicate that mulching did not significantly benefit height, width, basal diameter, or crown foliage fill of newly established plants.

Introduction

Benefits of mulching have been widely reported (1, 4, 8, 13, 14). Green and Watson (7) have shown increased crown development, stem diameter and root development on bare-root sugar maples (*Acer saccharum*) under a mulch/till factorial treatment. Litzow and Pellett (11) documented stem diameter increase from hay and black plastic mulches. Hensley (8) found that 7.5 cm (3 in) of hardwood bark mulch increased height and stem diameter of *Magnolia grandiflora*. Mulching to improve survival of tree seedlings has been well documented in forestry (3, 5, 10, 12). Borland (2) suggested that investigations of mulched native plants should be initiated concurrently with the horticultural industry's present interest in "low water use" species.

Our purpose was to examine the effects of pine bark mulch on the growth of semi-arid shrub species in an irrigated landscape. This study compared three mulch depths on five species of woody shrubs which are currently marketed for ornamental use in the semi-arid regions of western Texas, eastern and central New Mexico.

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Materials and Methods

This study was conducted in a fenced research area on the Texas Tech University campus. The Lubbock area is in the southern High Plains grassland, USDA hardiness zone 7a, and receives an average of 45.7 cm (18 in) of precipitation annually. The soil in the research units was a sandy loam urban soil underlain by a caliche layer at approximately 1m (3 ft). Plants were obtained as 3.8 l (1 gal) container stock from commercial growers in the Albuquerque area in March, 1989. Species used include Mexican cliffrose (*Cowania mexicana* var. *stansburiana* Torr.), curlleaf mahogany (*Cercocarpus ledifolius* Nutt.), desert olive (*Forestiera neomexicana* Gray), Apache plume (*Fallugia paradoxa* D.Don), and winterfat (*Ceratoides lanata* Pursh.); (Nomenclature follows Correll and Johnston, 1979). Mulch used was large pine bark nuggets, ranging in size from 7.5 to 15 cm (3 to 6 in). Mulch treatments were held in place by use of pine lumber frames constructed around experimental plots. Drip irrigation was installed to improve chances of plant survival. Emitters supplied 3.8 l per hour (1 gph) to each experimental unit, including controls. Watering was uniform throughout the study area. Weeds were controlled manually throughout the duration of the study.

The experimental design for this study was a split-plot arrangement of a completely randomized design. Three mulch treatments, 0, 7.5, and 15 cm (0, 3 and 6 in) depths of mulch, were applied to each main plot. Main plots were divided into six 75 cm (30 in) square areas, to form sub-plots. Sub-plots were randomly assigned species treatments (consisting of five plant species and a control (no plant)) and re-randomized between main plots. There were eight replications of each species at each level of mulch, totaling 24 plants of each species and 144 individual sub-plots.

Height, width, and stem diameter were recorded in September 1989, May 1990 and September 1990. Heights were measured from the soil surface to the highest point in the crown. Width measures were taken by averaging the greatest horizontal width of the crown with a second width measurement taken at right angles to the first. Stem diameter was recorded for cliffrose, desert olive, and curlleaf mahogany at 1.3 cm (0.5 in) above ground level. Apache plume and winterfat are multi-stemmed and were not measured for stem diameter. Digital image processing of 35mm photographic slides was used to obtain repeated measures of crown fill of each plant (9).

At the conclusion of the study, soil samples were retrieved from each plot in each of three soil depths layers (0–5 cm, 5–15 cm, 15–30 cm). Soil samples were individually analyzed for electroconductivity and pH. The soil study design was a split-split-plot with 432 samples taken (mulch treatments applied to main plots, species treatment to sub-plots and soil depth layers in sub-sub-plots).

Results and Discussion

Treatments did not affect ($p > 0.05$) plant height, width, stem diameter, or canopy fill (Table 1). Plant mortality during the study was limited to Mexican cliffrose and winterfat; mortality of mulched and unmulched plants did not differ ($P > 0.05$) in either species. Although half of the Mexican cliffrose died, losses were not obviously related to mulching treatments.

Although crown growth did not appear to respond to mulch treatments, soils did have some pH and conductivity (EC) differences at the conclusion of the 18 month study (Tables 2 and 3). Results of soil measures were examined through an analysis of variance for a split-split-plot design.

For three species (Mexican cliffrose, curlleaf mahogany, and Apache plume), the pH was significantly ($P > 0.05$) lower under a mulch treatment than under no mulch. The pH in the surface layer of soil under curlleaf mahogany was significantly lower than the 15 cm mulch depth treatment. Apache plume surface soil pH was significantly lower under the 7.5 cm mulch treatment only; while cliffrose surface soil tested significantly lower in pH under both 7.5 and 15 cm mulch depths. Soil pH under winterfat, desert olive, and control (no species) did not differ in any soil layer as a result of mulching treatments.

Soil electroconductivity (EC) differed significantly ($P < .05$) overall between mulch treatments, across all species and soil layers. There were expected overall significant dif-

Table 1. Crown growth of five Southwestern shrub species 18 months after planting under three depths of pine bark mulch.

Plant	Measure	Mulch depth (cm) 0	7.5	15	Prob > F[z]
Mexican Cliffrose	height (cm)	59.6	62.9	52.6	0.572
	width (cm)	50.8	63.4	42.4	0.312
	stem diameter (mm)	21.2	21.2	13.7	0.102
	foliage fill (%)	34.7	34.2	25.4	0.103
Curlleaf Mahogany	height (cm)	78.7	63.3	75.1	0.225
	width (cm)	36.3	33.2	40.1	0.396
	stem diameter (mm)	21.3	16.9	19.6	0.090
	foliage fill (%)	21.2	25.5	29.5	0.052
Desert olive	height (cm)	121.1	130.7	119.7	0.279
	width (cm)	53.6	61.5	54.4	0.434
	stem diameter (mm)	22.8	26.0	25.1	0.754
	foilage fill (%)	24.8	26.4	26.7	0.373
Apache plume[y]	height (cm)	70.2	83.1	80.8	0.082
	width (cm)	91.8	107.7	95.9	0.188
	foliage fill (%)	39.1	42.8	42.6	0.495
Winterfat[y]	height (cm)	49.2	60.4	52.6	0.255
	width (cm)	65.4	79.3	65.2	0.536
	foliage fill (%)	39.8	40.6	41.0	0.939

[z]Stem diameter was not taken.

[y]Probability of obtaining greater F value for 3 mulch treatments, given treatment equality.

Table 2. Mean soil pH values at three depths for five species and a control under three depths of mulch (n=8).

Species	Soil depth[z]	Mulch depth (cm) 0	7.5	15
Control	1	8.59 a[y]	8.34 a	8.33 a
	2	8.55 a	8.55 a	8.56 a
	3	8.47 a	8.39 a	8.48 a
Desert olive	1	8.50 a	8.34 a	8.29 a
	2	8.38 a	8.51 a	8.47 a
	3	8.39 a	8.50 a	8.45 a
Curlleaf mahogany	1	8.48 a	8.28 ab	8.12 b
	2	8.47 a	8.40 a	8.48 a
	3	8.47 a	8.39 a	8.49 a
Mexican cliffrose	1	8.66 a	8.18 b	8.35 b
	2	8.54 a	8.39 a	8.61 a
	3	8.48 a	8.36 a	8.50 a
Apache plume	1	8.52 a	8.09 b	8.34 ab
	2	8.60 a	8.46 a	8.55 a
	3	8.52 a	8.36 a	8.54 a
Winterfat	1	8.47 a	8.32 a	8.34 a
	2	8.43 a	8.53 a	8.57 a
	3	8.44 a	8.55 a	8.54 a

[z]Soil depths 1 = 0-5 cm, 2 = 5-15 cm, 3 = 15-30 cm.

[y]Means within a single row with the same letter are not significantly different (LSD; $P > 0.05$).

Table 3. Mean soil EC (dS/1) values at three soil depths for five species and a control under three depths of mulch (n=8).

Species	Soil depth[z]	Mulch depth (cm) 0	7.5	15
Control	1	0.32 a[y]	0.10 b	0.10 b
	2	0.23 a	0.10 b	0.11 b
	3	0.26 a	0.15 ab	0.10 b
Desert olive	1	0.40 a	0.10 b	0.10 b
	2	0.37 a	0.10 b	0.13 b
	3	0.30 a	0.19 ab	0.16 b
Curlleaf mahogany	1	0.37 a	0.11 b	0.11 b
	2	0.30 a	0.12 b	0.11 b
	3	0.30 a	0.15 b	0.13 b
Mexican cliffrose	1	0.27 a	0.12 b	0.12 b
	2	0.19 a	0.14 a	0.10 a
	3	0.23 a	0.18 a	0.18 a
Apache plume	1	0.12 a	0.11 a	0.12 b
	2	0.13 a	0.10 a	0.12 a
	3	0.19 a	0.15 a	0.18 a
Winterfat	1	0.12 a	0.10 a	0.10 a
	2	0.13 a	0.12 a	0.14 a
	3	0.16 a	0.17 a	0.18 a

[z]Soil depth; 1 = 0-5 cm, 2 = 5-15 cm, 3 = 15-30 cm.

[y]Means within a single row with the same letter are not significantly different (LSD; $P > 0.05$).

ferences in E.C. between soil layers. There was also a significant ($P < .05$) species by mulch interaction. The interaction indicates that the effect of mulch on EC differs between species.

Soil electroconductivity in the surface soil layer (0–5 cm) was significantly ($P < 0.05$) lower under both 7.5 cm and 15 cm of mulch than under no mulch for three species and the control (desert olive, curlleaf mahogany, Mexican cliffrose and control). For curlleaf mahogany, all soil depths revealed a significantly lower EC in mulched than in unmulched soils. This difference was restricted to the soil surface layer for Mexican cliffrose, but extended to the next soil layer (5–15 cm) for both desert olive and the control. Apache plume and winterfat revealed no significant differences in EC in any soil layer as a result of mulch treatments.

It appears that in spite of the short time of the study, and the lack of crown growth differences, that mulching did significantly alter the soil chemistry in the surface layers. This result may be viewed either as benefit or hazard depending on the soil qualities of a particular location. In winterfat and Apache plume, the low EC values for unmulched plants might be attributed to the growth forms of these plants which contrasts with the forms of desert olive, curlleaf mahogany, and cliffrose. The low, spreading, branching patterns of winterfat and Apache plume apparently act in much the same way as mulching in reducing evaporation of moisture from the soil surface, thus reducing the accumulation of soluble salts in the soil surface. In effect, these species differ from the others in their evaporation inhibiting growth form. Consequently, these plants can be regarded as evaporation moderating plants. Evapomoderating plant growth form is one example of the species influence on the effects of mulch application.

It must be recognized that the results of this study are not universally applicable for several reasons. First, the study assessed mulch treatments where moisture was not limiting. Drip irrigation supplemented moisture during dry times to reflect urban landscape site conditions. For that reason, the results are not applicable to dryland sites where it would be expected that mulch could be advantageous. Secondly, the study was conducted on a study site where the environment did not contribute to rapid decomposition of mulch materials. Watson (15) indicated that decomposition of mulch provided additional medium for root growth under seven tree species. Finally, weeds were mechanically controlled in this study. Any benefits that the mulch could provide in controlling competition were not assessed. Green and Watson (7) have shown improved establishment of maples under mulching combined with minimal maintenance. That mulching can minimize competition from weeds and grasses has been documented in several studies (3, 5, 11). In areas where factors that are necessary for plant growth are limiting, reduced competition from weeds should be advantageous. It is also expected that crown growth of the plants would eventually be altered by the mulch treatments, since soil surface layers were affected by mulching.

Although this study does not preclude the potential long term effects mulching may have, it does suggest limits to the applicability of mulch for short-term crown growth benefits to these five species. Given the results of this study, it appears doubtful that species native to semi-arid lands will benefit from mulching when placed in an irrigated landscape setting. Yet, it should be recognized that the effects of mulch on revegetation of harsh, dryland sites is not comparable to the use of the same mulch in an urban landscape setting. Benefits in dryland and harsh or low maintenance sites have been documented in prior work (1, 3, 5, 7, 8, 10, 11, 12, and 15). Site conditions and species tolerance should be considered in recommending mulch application. Mulching effects should be examined for several other semiarid land species currently in use as ornamentals. This study suggests that mulch trials on ''native'' plants should include irrigation treatments, should be species specific, and should consider site conditions.

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