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Mulches: Durability, Aesthetic Value, Weed Control, and Temperature[1]

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Abstract

Five organic mulches (pine bark, hardwood bark, cedar chips, longleaf pine needles, shortleaf pine needles), used alone or in combination with two inorganic mulches (black polyethylene, woven polypropylene), were evaluated over two years for weed control, durability, aesthetic value, and influence upon soil temperature. Organic mulches reduced total weed counts by 50% compared to control plots, and underlaying organic mulches with polyethylene resulted in complete control. Polypropylene, used in combination with organic mulch, was ineffective in controlling perennial weed species. Pine bark was the most durable organic mulch, requiring the least replenishment (70% initial volume) after 630 days. Durability of organic mulches increased when underlaid with polyethylene. Longleaf pine needles were rated most attractive, and underlying organic materials with either polyethylene or polypropylene enhanced appearance. Organic mulches reduced maximum daily temperatures at the soil surface by 2.2–3.3°C (4–6°F) and increased minimum daily temperatures by 1.1–2.2°C (2–4°F). However, the type of organic mulch did not affect temperatures at the soil surface.

Index words: Geotextiles, landscape fabrics, polyethylene, polypropylene, weed barriers

Significance to the Nursery Industry

Although both organic and inorganic mulches are commonly used within the landscaping and grounds maintenance industries, characteristics of specific mulches are poorly defined. Research within shows that optimal weed control is obtained when organic mulches are underlaid with a layer of polyethylene. Use of woven polypropylene as a foundation material is less effective, particularly in the control of perennial bermudagrass and yellow nutsedge.

Pine bark is the most durable organic mulch, and longleaf pine needles are significantly longer lasting than shortleaf. Durability of organic mulches increases when underlaid with polyethylene. Longleaf pine needles are the most attractive organic mulch, and pine bark rates higher than either hardwood bark or cedar chips. Underlying organic mulches with either polyethylene or polypropylene enhances appearance.

Introduction

Mulch application to landscape plantings is a common practice within the landscaping and grounds maintenance industries. Mulches enhance plant growth by reducing moisture evaporation from the soil and increasing water infiltration (2, 6). Additionally, mulches suppress weeds, thereby reducing costs of landscape maintenance.

Selection of a mulch depends on more than its potential to enhance plant growth. Mulches must also be durable and aesthetically pleasing since, when used over large areas to define turf interfaces or prevent soil compaction, they comprise a highly visible component of the landscape.

Mulches are classified as organic (naturally occurring) and inorganic (synthetic). Most common mulches are organic, with selection based upon cost, appearance, and local availability. Synthetic mulches, such as plastic (polyethylene) and more recently developed "fabrics" (woven polypropylene), reportedly restrict weed growth more effectively than organic mulches (1, 2, 3). However, these materials are unattractive in the landscape and are commonly overlaid with one of the more aesthetic organic mulches.

There is little information on characteristics of different organic mulches, or how characteristics are altered when organic mulches are used in conjunction with synthetic materials. Therefore, the objective of this study was to evaluate several organic mulches, used alone or with synthetic mulches, for durability, aesthetic value, weed control, and influence upon soil temperature.

Materials and Methods

A series of 1.2 × 1.2 m (4 × 4 ft) plots were established October 1, 1987 by tilling to a depth of 15 cm (6 in). The experimental design was a randomized complete block with

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4 replications; the treatment set was factorial, with five organic mulches (pine bark, hardwood bark, cedar chips, longleaf pine needles, shortleaf pine needles) applied to a depth of 9.0 cm (3.5 in) over soil, black polyethylene (6 mm plastic), or woven polypropylene (Dewitt Weed Barrier, Dewitt Company, Inc., Sikeston, Missouri). Each block included a control of soil without mulch. After installation, blocks were covered with thin wire mesh to prevent disturbance by wind. Roundup (1% v/v) was used to prevent weed encroachment from outside plots; herbicides were not used within plots.

Weed counts were recorded after 230 (May 1988), 325 (Aug. 1988), and 630 (June 1989) days. In May 1988, counts were recorded for tall fescue (*Festuca arundinacea* Schreb.), vetch (*Vicia* spp.), common blue violet (*Viola papilionacea* Pursh), wild garlic (*Allium vineale* L.), bermudagrass [*Cynodon dactylon* (L.) Pers.], and yellow nutsedge (*Cyperus esculentus* L.). Subsequent counts included data only for bermudagrass and yellow nutsedge. At each date, plots were weeded following counts.

Durability of organic mulches, determined after 230 (May 1988) and 630 (June 1989) days, was recorded as percent initial volume required to refill plots to the initial 9.0 cm (3.5 in) depth. The total amount added during the study was calculated by summing amounts added at each date.

Aesthetic value of organic mulches was rated after 210 days (May 1988), using a visual scale of 0 (poor) to 10 (excellent). Primary emphasis was given to texture, color, and presence of debris within plots. Weeds within plots were disregarded in aesthetic evaluations.

Soil temperature was monitored by inserting thermocouple probes beneath organic mulches at ground surface. Maximum, minimum, and average daily temperatures were recorded over four months (March–June 1989) with a Campbell Scientific Micrologger.

All data were subjected to analysis of variance. There were no significant interactions between organic and inorganic mulch types for any parameter. Therefore, main effect means (organic and inorganic mulch types) were averaged over levels of the other factor and, if significantly different, separated by the LSD test ($P = 0.05$).

Results and Discussion

Weed control. Organic mulch significantly ($P = 0.01$) reduced total weed counts by 50% compared to control plots. There were no differences between organic mulch types except in May 1988, when hardwood bark contained more vetch than other mulches (data not presented).

The predominant factor affecting weed counts was the presence of an inorganic mulch (Table 1). After 230 days (May 1988), both synthetic materials significantly reduced populations of all species. Yellow nutsedge, the predominant species after 325 days (Aug. 1988), was present in greatest numbers when organic mulches were applied alone or over polypropylene; polyethylene prevented development. After 630 days (June 1989), yellow nutsedge counts were greatest when organic mulches were applied alone. Bermudagrass counts were greatest when organic mulches were applied alone or over polypropylene; polyethylene prevented development.

Polypropylene appears to be a less effective barrier against perennial weeds than polyethylene (Table 1), as yellow nutsedge and bermudagrass were able to penetrate the material (3, 4). Although polyethylene prevents establishment of perennial species, its lack of porosity has been associated with reduced plant growth (2, 5, 7). Therefore, it may be most useful in situations where weed control is the primary concern.

Durability. After 230 days (May 1988), longleaf pine needles were significantly more durable than other mulches (Table 2), requiring 37% initial volume to replenish plots; pine bark was next most durable (52%). After 630 days (June 1989), pine bark had the least loss (17%); greatest loss was observed with shortleaf (54%) and longleaf (58%) pine needles. Summing over dates, pine bark was significantly more durable than other mulches, requiring 68% replacement of initial volume. Cedar chips and longleaf pine needles were second best, requiring 88% and 94%, respectively. Polyethylene underneath plots enhanced total durability, compared to plots containing just organic mulch.

In summary mulch durability must be considered within a specific time frame. Longleaf pine needles were most durable over the first season (230 days) but, with limited renewal, decayed rapidly afterwards. After 630 days, pine bark was significantly more durable than other organic mulches.

Aesthetic value. Organic and inorganic mulch types affected plot appearance (Table 3). Longleaf pine needles were rated most attractive; pine bark and shortleaf pine needles rated second best. Shortleaf pine was downgraded because of numerous pine cones. Cedar chips had poor color

Table 1. Effect of underlying organic mulches with synthetic materials to control weed species.

Date[z]	Species[y]	Material underlying organic mulch		
		None	Polypropylene	Polyethylene
May 1988	Fescue	7.5 a[x]	0.0 b	0.0 b
	Vetch	23.5 a	0.2 b	0.0 b
	Violet	8.5 a	0.1 b	0.0 b
	Garlic	6.1 a	0.5 b	0.1 b
	Bermudagrass	24.3 a	1.8 b	0.1 b
Aug 1988	Nutsedge	14.3 a	24.2 a	0.0 b
June 1989	Bermudagrass	31.0 a	33.9 a	0.0 b
	Nutsedge	22.7 a	7.5 b	0.1 b

[z]At each date, plots were weeded following counts.

[y]For species not listed, material underlying organic mulch did not significantly affect weed counts.

[x]Row means separated by LSD test ($P = 0.05$).

Table 2. Mulch durability as affected by organic mulch type and underlying synthetic materials.

Treatment	Percent (%) initial volume required to replenish mulch to 9.0 cm (3.5 in) depth		
	May 1988	June 1989	Total
Organic mulch type			
Pine bark	51.5 b[z]	17.2 a	68.7 a
Hardwood bark	64.4 c	38.6 b	103.0 c
Cedar chips	66.5 c	21.5 a	88.0 b
Longleaf pine needles	36.5 a	57.9 c	94.4 b
Shortleaf pine needles	70.8 c	53.7 c	124.5 d
Material underlying organic mulch			
None	62.2 b	38.6 a	100.8 b
Polypropylene	57.9 ab	36.5 a	94.4 ab
Polyethylene	53.7 a	36.5 a	90.2 a

[z]Column means within categories separated by LSD test (P = 0.05).

Table 3. Aesthetic value of plots as influenced by organic mulch type and underlying synthetic materials.

Treatment	Rating[z]
Organic mulch type	
Longleaf pine needles	8.9 a[y]
Shortleaf pine needles	7.5 b
Pine bark	6.8 b
Cedar chips	5.7 c
Hardwood bark	4.8 c
Material underlying organic mulch	
Polyethylene	8.2 a
Polypropylene	7.9 a
None	4.2 b

[z]Visual scale ranging from 0 (poor) to 10 (excellent).

[y]Column means within categories separated by LSD test (P = 0.05).

retention and hardwood bark was non-uniform. Polyethylene and polypropylene enhanced appearance of organic mulches.

Soil temperature. Organic mulches stabilized daily temperature fluctuations compared to control plots (data not presented). Maximum temperatures were reduced by 2.2–3.3°C (4–6°F), and minimum temperatures elevated by 1.1–2.2°C (2–4°F). Maximum, minimum, and average temperatures did not vary among organic mulch types. Polyethylene underneath plots significantly increased maximum temperatures by approximately 0.8°C (1.4°F).

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