Weed Control with Landscape Fabrics[1]

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Abstract

Six polypropylene landscape fabrics were compared with black plastic and preemergence herbicides for weed control. Large crabgrass [*Digitaria sanguinalis* (L.) Scop.] shoots and roots and yellow nutsedge (*Cyperus esculentus* L.) shoots penetrated all of the fabrics tested and developed into large plants. In greenhouse studies, black plastic plus mulch, and pennant (metolachlor) [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(methoxy-1-methylethyl)acetamide] at 4.5 kg ai/ha (4.0 lb/A) plus mulch provided equal, or greater control of large crabgrass than the landscape fabrics. In the field study, more time was required to hand-weed landscape fabrics covered with mulch than uncovered fabrics. When covered with mulch, hand-weeding time and weed shoot fresh weights were similar for black plastic, surflan (oryzalin) [4-(dipropylamino)-3,5-dinitrobenzenesulfonamide] at 2.2 kg/ha (2.0 lb/A), and the landscape fabrics.

Index words: geotextiles, mulch, weed barriers, plastic

Species used in this study: large crabgrass (*Digitaria sanguinalis*); yellow nutsedge (*Cyperus esculentus*)
Herbicides used in this study: Pennant (metolachlor) 2-chloro-N-(2-ethyl-6-methylphenyl)-N-(methoxy-1-methylethyl)acetamide; Surflan (oryzalin) 3,5-dinitro-N^4,N^4-dipropylsulfanilamide

Introduction

A major component of landscape maintenance programs is the suppression or elimination of weed growth. Not only do weeds aesthetically detract from a landscape, they also compete with desired plants for space, light, water and nutrients (10, 11), serve as a habitat for insects and diseases and, in some cases, cause allelopathic growth suppression of desired plants (7).

Due to the reported adverse effects on landscape plant growth when plastic (black or clear) is used for weed control (5, 12, 15, 16, 17), and the increasing desire to reduce chemical use in the landscape, weed control alternatives are needed. One alternative is landscape fabrics (also referred to as geotextiles or weed barriers) (1, 2, 14). A major advantage of the fabrics over plastic is their porosity, which allows for the exchange of water and air. While some users of plastic cut large holes around landscape plants for water and air penetration prior to covering them with mulch, these openings are sites for weed growth.

Fabrics have been used in other applications (erosion control, soil separation, drainage installation), however, their use in the landscape has received only limited evaluation. Martin, Ponder and Gulliam (8) reported variable weed control from the use of nine polypropylene fabrics, with control dependent on the weed species and the particular fabric. McLean, Kobayashi and Defrank (9) noted mixed results using two organic mulches, one herbicide and one polyester fabric. Powell, Bilderback and Skroch (13) reported that a longleaf straw plus a fabric barrier was superior for weed control when compared to longleaf straw or pine bark mulch used alone.

The objective of this study was to compare several fabrics with other conventional weed control measures to determine their effectiveness in controlling landscape weeds.

[1]Received for publication March 22, 1989; in revised form May 17, 1989.

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Materials and Methods

Greenhouse studies. In the first greenhouse study, 15 cm diam (6 in) plastic containers were filled to within 2.5 cm (1 in) of the rim with commercial potting mix (60% peat moss, 20% vermiculite and 20% perlite (Promix BX) and sand (2:1 by vol). A slow release, 17N-2.6P-9.9K (Osmocote 17-6-12) fertilizer containing trace elements was added at 5 g (0.01 lb) per container. Large crabgrass seed was mixed with the potting medium at 1.5 cm^3 (0.3 teaspoons) per pot. One group of containers received no additional treatment and served as the control. One treatment received just mulch while another treatment received mulch plus a treatment of Pennant (metolachlor) at 4.5 kg ai/ha (4.0 lb/A). A 625 cm^2 ((0.69 ft^2) piece of fabric or black plastic was placed over the top of the remaining containers, with the edges stapled at the rims. The fabrics utilized were: DeWitt and Visqueen, both black, woven materials; Duon and Typar, both gray, spun-bonded fabrics; TEI, a woven, white fabric; and Exxon, a white, spun-bonded fabric[4]. All fabrics were composed of polypropylene. A 2.5 cm (1 in) deep layer of pine bark mulch was placed over all treatments, except the untreated control.

Another set of containers was prepared as described above except that the large crabgrass seed was placed in the mulch layer above the fabrics and plastic. These methods were used to determine if large crabgrass shoots and roots could grow through the fabrics.

Large crabgrass plants were counted 4 weeks after planting and shoot fresh weight recorded for containers seeded with large crabgrass below the fabric. Large crabgrass shoot fresh weight was determined 5 weeks after planting for pots seeded above the fabric. The design used for all studies was

[4]DeWitt (5 oz.), DeWitt Company Inc., HWY 61 South, Sikeston, MO 63801; Duon (5.3 oz.), Blunks Wholesale Supply Inc., 8923 South Octavia, Bridgeview, IL 60455; Typar, Reemay, Inc., P.O. Box 511, Old Hickory, TN 37138; Visqueen, Visqueen Film Products, P. O. Box 2448, Richmond, VA 23218; TEI (DuPont 3.5 oz.), TEI, P. O. Box 9652, Baltimore, MD 21237; Exxon (125 D, 4 oz.), Landscape Supply, Inc., P.O. Box 12706, Roanoke, VA 24027.

a randomized complete block with 4 single pot replications. Data were subjected to analysis of variance, with mean separation using the Least Significant Difference Test at the 0.05 level.

A second greenhouse study was conducted using the methods described above. For one set of containers, 10 yellow nutsedge tubers per pot were planted below the fabrics. Yellow nutsedge plants that had penetrated the fabrics were counted and weighed 6 weeks after planting. Large crabgrass was seeded either below or above the fabrics in another set of containers and harvested 6 weeks after planting. A longer time period was utilized in the second study to determine if large crabgrass plants that had penetrated the fabrics could develop into mature plants. Both the yellow nutsedge and large crabgrass tests were repeated, with the reported results an average of the 2 trials.

Field study. Roundup (glyphosate) [N-(phosphonomethyl)glycine] was applied twice in August, 1987, to kill existing vegetation. Individual plots measured 1.8 m (6 ft) by 6.0 m (20 ft). Sixteen treatments were used: Bare ground, with and without mulch; Surflan (oryzalin) at 2.2 kg/ha (2.0 lb/A) with and without mulch; black plastic, with and without mulch; fabrics—Typar, Duon, DeWitt, VisQueen and Exxon—with and without mulch. Fabrics were placed on the soil in November, 1987, with the edges and seams pinned down using U-shaped nails. The mulch layer, which was 7.6 cm (3 in) deep, contained partially-composted, chipped hardwood and softwood bark and wood. The design was a randomized complete block with 4 replications.

Hand-weeding time per plot and total weed shoot fresh weight per plot were recorded on July 15, 1988. On September 9, 1988, the % cover by yellow nutsedge, bermudagrass [*Cynodon dactylon* (L.) Pers.] and annual grasses (a mixture of large crabgrass, goosegrass [*Eleusine indica* (L.) Gaertn.] and yellow foxtail (*Setaria glauca* (L.) Beauv.] was recorded. Data were subjected to factorial analysis of variance.

Results and Discussion

Greenhouse studies. All fabrics reduced the number of large crabgrass plants compared to the check when seeded below the fabric (Table 1). Only the DeWitt and TEI fabrics significantly suppressed crabgrass plants below that of the containers receiving only mulch. Black plastic provided greater control of large crabgrass than the Duon or Exxon fabrics. Large crabgrass shoots penetrated all fabrics, and similar control occurred with metolachlor and most of the fabrics. Large crabgrass shoot weights were lower in the DeWitt and TEI fabrics than in the Exxon fabric.

No large crabgrass plants were observed when large crabgrass seed was placed above black plastic (Table 1). Large crabgrass roots were able to penetrate all fabrics, with no apparent differences in penetration among the fabrics. These results support a similar report by Klett (6) using several grass species.

Yellow nutsedge shoots were able to penetrate all of the fabrics, with no difference in shoot number between any fabric and the untreated containers (Table 2). Lower yellow nutsedge shoot fresh weights were observed in the metolachlor and black plastic treatments than in any of the fabrics. More yellow nutsedge plants were found in the Exxon-covered containers than in the TEI or Typar treatments (Fig. 1).

Table 1. Large crabgrass control with landscape fabrics, greenhouse study.

	Seeded below the fabric barrier		Seeded above the fabric barrier
Treatment	Plants (No.)	Shoot fresh wgt (g)	Shoot fresh wgt (g)
Untreated	131.8	24.3	30.0
Mulch	33.0	14.2	6.8
Pennant + mulch	18.3	3.9	0.1
Black plastic + mulch	0.3	0.1	0.0
DeWitt + mulch	4.5	1.3	2.0
Duon + mulch	40.0	5.7	5.1
Typar + mulch	11.8	1.7	6.2
Visqueen + mulch	17.5	4.5	2.5
TEI + mulch	0.3	0.2	3.7
Exxon + mulch	33.0	7.8	3.3
LSD (0.05)	20.1	4.3	4.3

Large crabgrass plants penetrated the fabrics, either by sending shoots up or by sending roots down through the fabrics, and developed into large plants (Table 2). Although fewer plants were present in the fabric-covered containers (data not shown), shoot fresh weight was generally similar to the untreated containers, demonstrating the rapid growth that can occur after fabric penetration. Lower large crabgrass

Table 2. Control of yellow nutsedge and large crabgrass with landscape fabrics, greenhouse study.

	Yellow nutsedge		Large crabgrass: Seeded below the fabric barrier	Large crabgrass: Seeded above the fabric barrier
Treatment	Plants (No.)	Shoot fresh wgt (g)	Shoot fresh wgt (g)	Shoot fresh wgt (g)
Untreated	3.8	29.8	57.4	48.2
Mulch	4.5	33.3	21.6	47.7
Pennant + mulch	1.9	1.9	5.0	2.1
Black plastic + mulch	0.0	0.0	0.0	1.3
DeWitt + mulch	3.6	28.1	41.8	26.2
Duon + mulch	3.3	23.4	32.6	22.2
Typar + mulch	2.5	18.3	8.1	57.3
Visqueen + mulch	4.3	21.9	24.6	34.6
TEI + mulch	2.8	24.1	17.5	22.3
Exxon + mulch	4.6	35.5	35.0	42.5
LSD (0.05)	1.4	11.4	30.4	21.1

Fig. 1. Yellow nutsedge shoots that penetrated the Exxon fabric in the greenhouse studies.

shoot fresh weight was found in the metolachlor and black plastic treatments than any of the fabrics.

Field study. Presence of mulch affected weed control with the various treatments (F value for interaction significant at the 5% level for both hand-weeding time and weed weights), therefore results are reported by treatment and presence or absence of mulch (Table 3). Interaction means were separated using LSD.

When no mulch was added to the plots, less time was required for hand-weeding the fabric-covered plots than for the untreated or the Surflan (oryzalin) treatments. A similar pattern was observed for weed weights. Numerically lower weed weights and hand-weeding times were observed in the black plastic and DeWitt fabric treatments, although no statistically significant differences were detected among the fabrics.

When no mulch was added, lower cover of yellow nutsedge was recorded in the black plastic and the DeWitt, Typar, Visqueen and Exxon fabrics than either the Surflan (oryzalin) or the untreated plots. All fabrics and the black plastic-covered plots contained less bermudagrass than the untreated or oryzalin-treated plots. A greater amount of annual grass was present in the Duon and Typar treatments than in the black plastic, DeWitt or Visqueen treatments. Cook (4) reported similar grass control, noting that the rigid fabrics (such as DeWitt) were more effective than the flexible and more porous ones (such as Duon).

Weeds were able to germinate below the Exxon and Typar fabrics when they were not covered by mulch, since sunlight was able to penetrate these fabrics. The Duon fabric, when uncovered, exhibited considerable breakdown during the growing season. Little deterioration was present in the DeWitt, Visqueen and black plastic materials one year after establishment.

All fabric manufacturers recommend that mulch be put atop the fabrics. With fabrics that lack ultra-violet light inhibitors, this mulch layer is important to prevent photodecomposition that leads to fabric deterioration and subsequent weed seed germination (Duon in this study) (Figure 2). With fabrics that are either white in color or light-weight, light passes through the fabrics and weeds grow beneath them, again showing the necessity of the mulch layer (Exxon spun-bonded, Typar in this study).

The problem with covering the fabrics with mulch is the increased weed growth that frequently occurs. In this study weed weights and hand-weeding times were numerically greater for the mulch-covered fabrics than for the unmulched fabrics (Table 3). Weed seeds either blew in or were carried in via irrigation water, or may have been contaminants of the mulch itself. Annual weeds were able to germinate and develop in the mulch layer above the fabrics, as observed

Table 3. Time required for hand-weeding, weed shoot fresh weight, and percent weed cover per plot in field study.

	No mulch					With mulch				
Treatment	Hand weed (min)	Weed wgt (g)	Yellow nutsedge	Bermuda grass	Annual grass	Hand weed (min)	Weed wgt (g)	Yellow nutsedge	Bermuda grass	Annual grass
			----------% cover---------					----------% cover----------		
Untreated	39.5	14706	10	18	38	7.7	2303	14	25	5
Surflan	11.8	3350	18	19	5	3.5	690	9	21	8
Black plastic	0.1	45	0	0	1	3.5	1065	9	5	10
DeWitt (w)[z]	0.6	16	0	4	1	2.8	800	15	6	6
Duon (sb)	1.7	357	9	5	18	4.6	1478	9	21	9
Typar (sb)	3.0	758	0	0	15	7.2	2388	13	10	8
Visqueen (w)	0.2	129	0	4	0	2.5	1079	4	13	8
Exxon (sb)	1.8	405	1	3	9	2.9	1496	11	11	9

LSD (0.05) for comparing hand weed time within columns = 6.4

LSD (0.05) for comparing weed weights within columns = 1920

LSD (0.05) for comparing % cover of yellow nutsedge within columns = 9. LSD (0.05) for comparing % cover of bermudagrass within columns = 13. LSD (0.05) for comparing % annual grass cover within columns = 11

[z]w = woven fabric, sb = spunbonded fabric

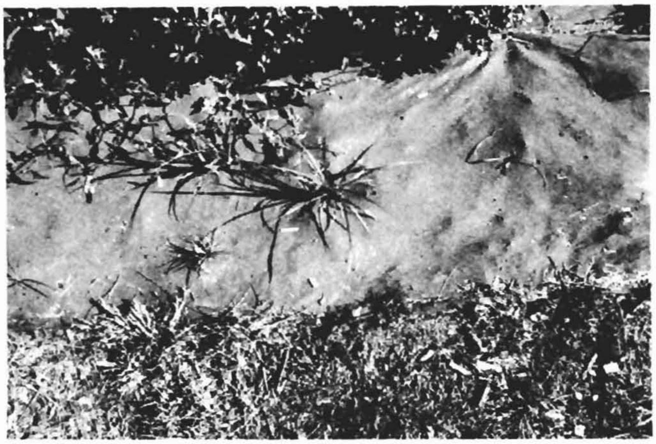

Fig. 2. Fabrics that lack ultra-violet light inhibitors begin to photodecompose when not covered with mulch, allowing weeds to grow (Duon in this photo).

in the greenhouse studies and as reported by Cook (4) and Klett (6) for grasses. Once the weeds penetrated the fabrics, rapid growth occurred, showing the need for timely hand-weeding or herbicide application.

Yellow nutsedge and bermudagrass were present in fabric plots covered with mulch, whereas no yellow nutsedge plants and few to no bermudagrass plants were present when DeWitt, Typar, Visqueen or Exxon fabrics were not covered by mulch. Two possible explanations exist. First, weeds may have been able to germinate in the mulch layer and either grow roots down through the fabrics or throughout the mulch layer. Secondly, the temperature of the black fabrics and/or the soil below the fabrics may have increased to high levels during sunny days when the fabrics were not covered by mulch. Weeds may not have been able to tolerate these higher temperatures.

No difference in the time required for hand-weeding or in weed weights were observed among the mulched, oryzalin plus mulch, black plastic plus mulch or any of the fabrics plus mulch. Percent cover by yellow nutsedge, bermudagrass and the annual grasses were generally similar among all mulched treatments. Data presented by Billeaud and Zajicek (3) showed that where mulch was not used the fabrics were very effective for weed control, but that as the depth of the mulch increased, the need for a fabric decreased to the point that at a 15 cm (6 in) mulch depth (which is at least double what is generally recommended, but often seen in landscape situations), no improvement in weed control was observed when a fabric was added.

Total weed control costs were lowest in the treatments lacking a mulch layer (Table 4). However, these treatments could not be used in a landscape for aesthetic reasons. Among the mulch treatments, the lowest cost treatments were mulch and mulch plus Surflan (oryzalin). If a mulch layer less than 7.6 cm (3 in) deep could be used, a lower total cost than that shown in Table 4 would be seen with the landscape fabric plus mulch treatments.

To the costs for the fabrics must be added the time and materials needed to rid an area of any existing vegetation since the manufacturers' recommend that all existing vegetation be removed or killed prior to fabric installation. In addition, the fabrics can be cumbersome to position around the landscape plants by manufacturer-recommended application methods. If fabric sections are not adequately overlapped and securely pinned to the ground, or around the landscape plants, weeds will grow in the seamed and open areas.

Table 4. Estimated total weed control costs for the field study.

Treatment	Materials Cost[z]/plot ($)	Hand-weeding[y] cost/plot ($)	Total cost
Untreated	0	3.28	3.28
Mulch	26.67	0.64	27.31
Surflan	0.08	0.98	1.06
Surflan + mulch	26.75	0.29	27.04
Black plastic	3.33	0.01	3.34
Black plastic + mulch	30.00	0.29	30.29
DeWitt	8.00	0.05	8.05
DeWitt + mulch	34.67	0.24	34.91
Duon	10.66	0.14	10.80
Duon + mulch	37.33	0.38	37.72
Typar	10.66	0.25	10.91
Typar plus mulch	37.33	0.60	37.93
Visqueen	8.00	0.02	8.02
Visqueen + mulch	34.67	0.21	34.88
Exxon	10.66	0.15	10.81
Exxon + mulch	37.33	0.24	37.57

[z]Material costs are based on: plot size 13.5 m^2 (120 ft^2); mulch $2.00 per 0.8 m^2 (1 $yard^2$), 7.6 cm deep (3 inches); Surflan—$60.00 per 3.785 l (1 gallon), 4.7 L/ha (0.5 gallons/A); black plastic—$0.25 per 0.8 m^2; woven fabrics—$0.60 per 0.8 m^2; spun-bonded fabrics—$0.80 per 0.8 m^2. Material costs do not include planting bed preparation and establishment costs.

[y]Hand-weeding cost based on $5.00 per hour.

Significance to the Nursery Industry

The new landscape fabrics have both positive and negative attributes. Certain landscape fabrics can effectively reduce annual broadleaf and grassy weed growth; however, most are far less effective against perennial weeds which are capable of growing through several inches of mulch, and then thrive in the absence of annual weed competition. Even when fabrics are used, some hand weeding or herbicide application will still be necessary. A desirable weed control alternative would appear to be a UV-resistant fabric, through which light could not pass, that could be aesthetically enhanced so that no mulch cover would be necessary. At this point the effects of the fabrics on the growth of desired landscape plants is still being determined.

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Propagation of *Osmanthus heterophyllus* 'Ilicifolius' and 'Rotundifolius' by Stem Cuttings[1]

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Abstract

Nontreated semihardwood and hardwood cuttings of *Osmanthus heterophyllus* 'Ilicifolius' rooted in high percentages (>80%) while comparable results for 'Rotundifolius' were only noted for hardwood cuttings. Response of both cultivars to indolebutyric acid (IBA) treatment [2500 to 10,000 ppm (0.25 to 1.0%)] was variable and often resulted in inhibition rather than stimulation of rooting.

Index words: rooting, auxin, indolebutyric acid, holly osmanthus, false holly, Oleaceae

Introduction

The genus *Osmanthus* Lour. (Oleaceae) comprises 30 to 40 species of evergreen shrubs and trees occurring primarily in eastern Asia with a few species in North America, Hawaii and New Caledonia (5). The most widely cultivated species is *Osmanthus heterophyllus* (G. Don) P.S. Green. The specific epithet *heterophyllus* is appropriate because it alludes to the variable morphology of the leaves. Leaves are opposite, simple, evergreen, coriaceous, lustrous, glabrous, dark green above, yellowish-green beneath, elliptic to ovate to elliptic-oblong to occasionally obovate, 2.5 to 6.4 cm (1 to 2.5 in) long, 2.5 to 3.8 cm (1 to 1.5 in) wide, cuneate to broad cuneate, and entire or spinose with 1 to 4 pairs of prominent spiny teeth (1).

Cutting material selected for having a predominance of one leaf type can be perpetuated by asexual propagation. Thus, rooting of stem cuttings consisting of holly-like leaves results in plants generally exhibiting this type of foliage. The same holds true for cuttings rooted from myrtle-like growth. The holly type of foliage has been reported to be juvenile and the myrtle-like foliage to be adult (1).

Fixation of leaf morphology by vegetative propagation was reflected in a key to cultivars of *Osmanthus heterophyllus* published in 1959 by Green and Keenan (3). Their key, based on leaf morphology and color, listed six cultivars: 'Aureus', 'Ilicifolius', [*O. ilicifolius* (Haask.) Hort. ex Carriere, *pro sp.*], 'Myrtifolius', 'Purpureus', 'Rotundifolius', and 'Variegatus'. One form of leaf is basically holly-like (i.e. 'Ilicifolius') with margins bearing spiny teeth. Another form of leaf is oval to ovate and entire with a spinescent apex (i.e. 'Myrtifolius'). A less common, third form of leaf is obovate, spineless, yet bearing blunt angled projections along the margins, remnants of locations for spiny teeth, with a rounded apex (i.e. 'Rotundifolius'). Since publication of the key, additional cultivars have been introduced (1). Landscape use of these newer cultivars has been limited similar to the six described by Green and Keenan (3).

The most often observed cultivar is 'Ilicifolius'. Although common in southern landscapes, specific propagation information is lacking. Those references available simply note that the species and related cultivars can be propagated by rooting stem cuttings and describe procedures which have proven successful (2, 4, 6). No information has been reported regarding importance of the time of year cuttings are taken (timing) or influence of auxin treatment on rooting. Rooting information for various cultivars of *Osmanthus heterophyllus* is apparently nonexistent. Therefore, the objec-

[1]Received for publication March 16, 1989; in revised form May 18, 1989. Paper No. 12093 of the Journal Series of the North Carolina Agricultural Research Service, Raleigh, NC 27695-7643.

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