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SYNTHETIC WEED BARRIER MULCHES FOR PROMOTING SURVIVAL AND GROWTH OF TREE SEEDLINGS

by

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Weed competition is a major problem when establishing tree seedlings. Strategies to improve survival and tree growth include cultivation, application of herbicides, ground covers, organic mulch, or synthetic mulches. Synthetic mulches include plastic sheets and woven geotextile fabrics.

Synthetic mulches have several advantages over herbicides and cultivation. They are generally less toxic than herbicides and do not require repeated application. Other benefits include conserving soil moisture and reducing soil erosion and nutrient leaching. Despite these advantages, synthetic mulches are not widely used in traditional forestry. However, synthetic mulches are frequently used in horticulture. Various new types of plastic and fiber mulches continue to appear on the market and are continually being evaluated.

The objective of this series of studies was to compare weed control effectiveness of weed barrier fabrics and plastic mulches versus conventional weed control methods, specifically herbicides and cultivation, in plantings of black walnut, Scotch pine, and cottonwood.

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Recommended publications

Additional information may be found in Kansas Forest Service publications *Weed Barrier Fabric Mulch for Tree & Shrub Planting*, MF-2216; *Tree Planting Guide*, L-596; and *Conservation Tree Planting Schedule*, L-871. All these are available through a local K-State Research and Extension office or on the Web at *http://www.oznet.ksu.edu* {select Publications from the menu near the top of the page, and then type in publication number in the appropriate space}.

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Summary and Conclusions

Survival and growth of both walnut and cottonwood were better with the synthetic weed barriers than for some of the herbicide treatments and were better than grass sod. Growth was best with cultivation and Oust herbicide. Synthetic barriers may be economically sound because they require less maintenance in the years following establishment. The only costs involved are those of initial ground preparation and laying of the material, whereas herbicides require ground preparation and herbicide application every year. Likewise, three to five cultivations are needed each growing season to adequately control weeds.

Synthetic weed barriers have many positive attributes. They increase soil temperatures in the spring, reduce evaporative soil moisture loss during dry periods, and control herbaceous competition, often for an extended period. The UV-resistant woven polypropylene fabrics initially can be expensive when establishing a stand and may present a problem later from girdling. Polyethylene plastics cost much less and no girdling problem was evident. Polypropylene fabrics appear to last much longer than is necessary for tree establishment. Negative effects, especially girdling, may result from the persistence of these materials, and trees should be checked to see if the tree stem is experiencing any constraint. If girdling is noticed, the material around the trees needs to be cut to prevent injury.

Synthetic mulches are practical to use under special conditions. For example, square blocks can be laid around individual trees when planting a limited number of seedlings (Figure 2). Also, strips of mulch (Figure 3) are practical when planting rows of trees for wind and snow barriers, for landscape plantings, riparian plantings along streams, or within tree rows that are widely spaced for production of agricultural crops as part of an alley cropping agroforestry practice.

Application of synthetic weed barriers may be a desirable and practical management tool for establishing tree stands in the Great Plains. They provide an effective and economical alternative to herbicides and cultivation. Problems with girdling are not likely, but follow up is needed and appropriate measures should be taken if the mulches appear to be restraining diameter growth of the trees.

Figure 2. Example of using plastic weed barriers around individual trees. In this example, the barrier has been cut in a 4 by 4 ft square, with a slit cut in the middle for planting the tree.

Figure 3. In this example, the weed barrier has been placed in strips, with trees planted in slits cut out of the center of the strip. Soil is tossed over the barrier at intervals to help hold it in place.

Procedures

Four studies were conducted near Manhattan, KS. Precipitation averages about 30 inches per year, with 75% of that coming during the growing season. The planting sites were on flat, alluvial, fine sandy loam and silty clay loam soil. In the first study, 1-0 (one-year-old) seedlings of black walnut (*Juglans nigra* L.) and Scotch pine (*Pinus sylvestris* L.) were hand-planted. Tree seedlings of each species were alternately planted 8-ft apart in ten 300-ft-long rows, with rows spaced 40-ft apart, for a total of 380 trees. The alleyways were planted with various agricultural crops for another study. Rows were divided into three treatment plots, each of which was 6-ft wide by 100-ft long with 12 or 13 trees per plot. Weed control treatments were either annual application of Surflan herbicide or strips of either Sunbelt or Earthmat woven polypropylene fabric (supplied by the DeWitt Company, Sikeston, MO). The area was cultivated before the weed barriers were laid. Seedlings were planted through small X-shaped slits cut in the fabrics. Surflan at commercial label rates was applied each spring over the top of dormant seedlings during the first and second year and along the side of seedlings in the third year. A randomized complete block design was used with weed barriers and herbicide treatments replicated once in each of the 10 rows or blocks.

In the other three studies, 1-0 seedlings of cottonwood (*Populus deltoides* Bartr. Ex Marsh.) were hand planted 2- or 4-ft apart in four 400-ft-long rows, with rows spaced 12-ft apart. Each row was divided into eight plots, which were 6-ft wide and 50-ft long with 12 trees each. A randomized complete block planting design was used with each row considered a block. Weed control treatments in these three studies were:

- Solid and punctured 3-mil black plastic polyethylene mulch
- Solid and punctured 3-mil gray/black plastic polyethylene mulch
- Yellow 3-mil plastic polyethylene mulch
- Blue 3-mil plastic polyethylene mulch
- Clear 3-mil plastic polyethylene mulch
- Sunbelt woven polypropylene fabric
- Earthmat woven polypropylene fabric
- Tall fescue sod
- Monthly cultivation
- Ground preparation to deaden the sod and postplanting application of Gallery (2 lb ai/a) and Surflan (0.75 lb ai/a)
- Ground preparation to deaden the sod and application of Oust herbicide at 1 oz ai/a.
- Brown 2-mil plastic polyethylene mulch

Percent survival, height (ft), and groundline stem diameter (in.) were recorded at the end of the third growing season for all three species planted. A biomass index for each tree was calculated using D^2H (D=diameter in inches and H=height in ft) and converted to oven-dried pounds of wood per tree. All data were analyzed by standard statistical procedures.

Results

Other research has shown that synthetic weed barriers improve the soil environment, resulting in better plant growth and survival. Polyethylene plastic weed barriers increase soil temperatures during the growing season and preserve soil moisture at depths of 6 and 10 inches. Models from other data suggest that plastic mulches increase early spring soil temperature. Presumably, these warmer soil temperatures, combined with soil moisture at or near field capacity, improve tree growth.

In the first study, both Scotch pine and walnut survival were significantly improved with plastic mulches versus the herbicide treatment (Table 1). Heights after 3 years were greater with plastic mulches for walnut, but were not significantly different for Scotch pine.

Table 1. Third-year survival and growth in a walnut/pine planting using three weed control methods.

Species / Treatment	Survival	Height
Walnut	%	ft
Surflan	81 b	3.4 b
Sunbelt	95 a	5.5 a
Earthmat	92 a	5.3 a
Scotch Pine		
Surflan	62 b	1.7 a
Sunbelt	87 a	1.8 a
Earthmat	83 a	1.7 a

Values followed by the same letter within column and species are not significantly different at P=0.05.

Current results with cottonwood showed significant differences among weed control treatments in survival, height, and stem diameter after three growing seasons (Table 2). Survival of cottonwood seedlings was very poor in the sod (28 percent), but was good with either synthetic plastics or cultivation (70 and 84%, respectively). Survival varied with the type of herbicide (28% with Gallery/Surflan, and 84% with

Table 2. Third-year mean survival and growth in all three cottonwood planting using 11 weed control methods.

Treatment	Survival[1]	Height	Stem diameter
	%	ft	in.
Gallery and Surflan	27.8 (33)	8.0 (44)	0.8 (26)
Tall fescue Sod	27.8 (33)	8.0 (44)	0.6 (20)
Yellow Plastic	80.7 (96)	15.6 (86)	1.6 (51)
Clear Plastic	69.8 (83)	14.2 (79)	2.6 (82)
Gray/black Plastic	69.8 (83)	16.1(89)	2.6 (80)
Blue Plastic	74.0 (88)	16.3 (90)	2.7 (86)
Sunbelt Fabric	71.4 (85)	16.3 (90)	2.8 (88)
Brown Plastic	64.8 (77)	16.7 (90)	2.5 (79)
Black Plastic	71.4 (85)	16.8 (93)	2.9 (90)
Monthly Cultivation	84.1 (100)	18.1 (100)	3.2 (100)
Oust	77.3 (92)	19.7 (109)	3.6 (112)

[1] Values in parentheses are percent of the Monthly Cultivation treatment.

Oust), confirming previous research showing that different types of herbicide used for weed control have different effects on seedling survival.

Overall, cottonwood saplings had the best growth with Oust herbicide applied to control herbaceous competition (Table 2). Average cottonwood height for the polyethylene or polypropylene mulches was about 88% the height of the saplings in the cultivated treatment, and these height differences were not significant. No difference was noted between use of solid and punctured black or gray-on-black plastic sheets. Sapling height was less than half the height of cultivated controls when tall fescue sod was used as a mulch, and also for saplings treated with Gallery/Surflan herbicides for weed control (Table 2). Cottonwood stem diameter followed a similar pattern as height; however, diameter for saplings grown with the seven polyethylene or polypropylene mulches were 51 to 90% of the diameter of the saplings in the cultivated treatment.

Using oven-dried weight as a biomass index, cottonwood grown with plastic mulches had about 63% of the biomass of the saplings in the cultivated treatment. In contrast, the cottonwood saplings in the tall fescue sod and Gallery/Surflan herbicide weed control treatments were less than 5% of the biomass of those grown under the cultivated treatment. Oust herbicide produced cottonwood biomass that was 140% of the cultivated treatment (Figure 1).

Use of herbicides to control herbaceous competition produced variable results. As is often the case with field application, herbicides were applied later in the spring than desired. Late spring application to dry soils in this study resulted in heavy weed competition and reduced height of both walnut and cottonwood seedlings. Fabric weed barriers and black plastic produced better results than some herbicides.

Weed barriers, both plastic and fabric, can be installed over weeds that have already germinated and the opaque fabrics will exclude light, killing existing vegetation and minimizing further germination of weed seeds. However, with the use of synthetic weed barriers, some weeding may be necessary within the planting hole. Weed barrier mulches also resulted in continuous weed control over several seasons, while herbicides controlled weeds for one season or less.

Durability of the synthetic mulches in the cottonwood study exceeded life expectancy normally seen under full sunlight because tree leaf litter and grassy vegetation at the barrier edge covered them. Rodents did not appear to damage the tree trunk nor did the plastic girdle the base of the tree. The problem of girdling may occur with the woven fabric, which would not expand as easily as the tree grew.

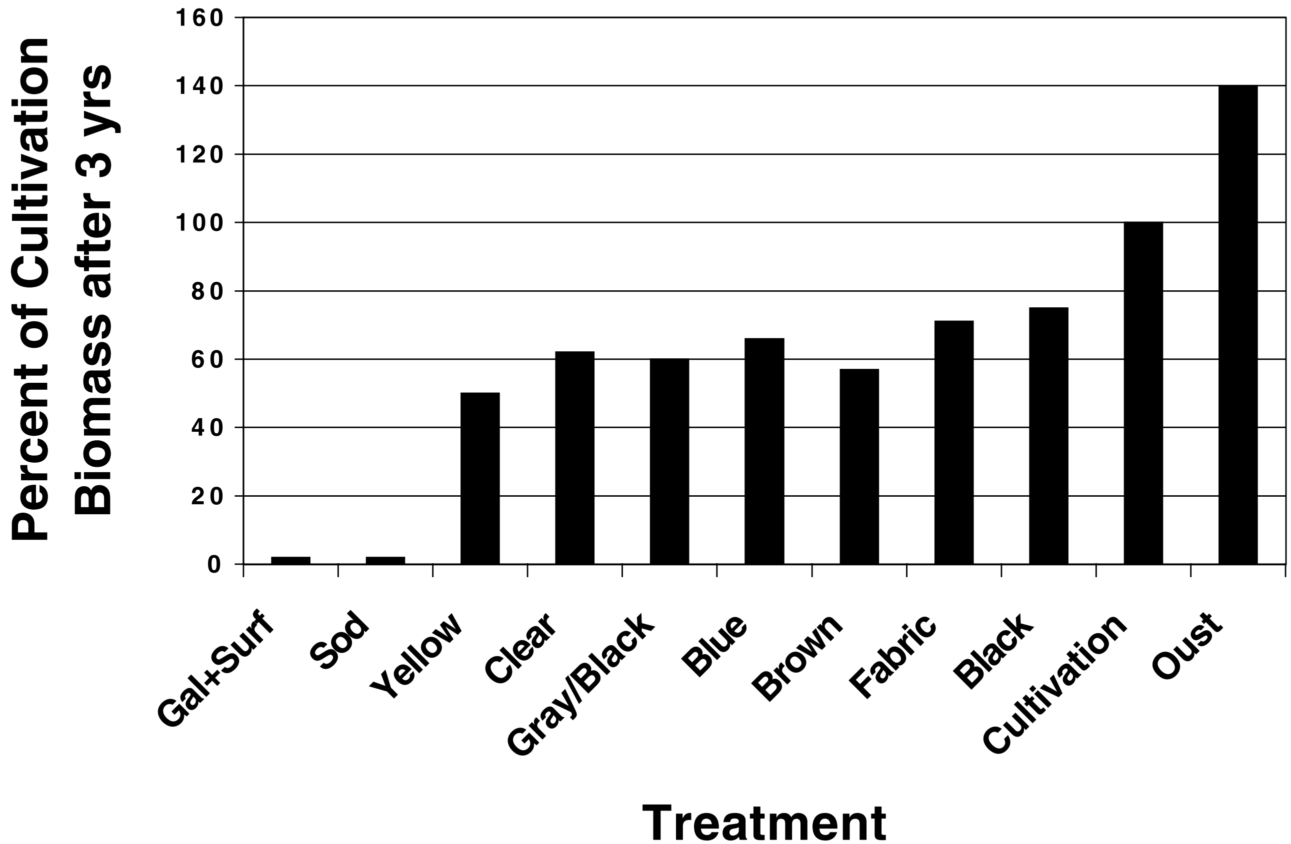

Figure 1. Cottonwood biomass index. Percentages are relative to the Monthly Cultivation Treatment.