SOD PRODUCTION AND TRANSPLANTING FOR SHADED AREAS

Dr. James B. Beard, Professor
Department of Crop and Soil Sciences
Michigan State University

Good landscaping calls for the utilization of trees and turfgrasses in association. It is estimated that more than 20 percent of the existing turfgrass areas in the United States are maintained under some degree of shade. Thus, the speciality production of sod for shaded sites is substantial. Before the specific considerations involved in sod production for shaded sites can be discussed, it is important to first understand the limiting factors associated with turfgrass growth under shaded conditions.

Shade Microenvironment

Shade adversely alters the turfgrass microenvironment. The most obvious change is the reduction in light intensity. A dense tree canopy can screen out as much as 98 percentof the incoming solar radiation. Such a dense canopy can be alleviated if there is a substantial amount of sunflecking. Light quality is also affected in comparison to the normal distribution within the visible spectrum. The light quality under a canopy of trees has a spectrum low in blue and red wavelengths, and a predominance of green and far-red wavelengths. The blue and red wavelengths are required for photosynthesis and are also the wavelengths screened out to the greatest extent.

Poor turfgrass quality under shaded conditions is frequently attributed to a lack of light. However, a number of other important environmental factors must be considered in shade ecology. Included are:

1. A moderation of diurnal and seasonal temperatures, both air and soil.
2. Increased relative humidity.
3. Restricted air movement.
4. Increased intensity and duration of dews.
5. Reduced atmospheric carbon dioxide levels.
6. Tree root competition for water and nutrients.

Turfgrass adaptation to shade does not involve any single factor, but is the result of a complex microclimatic regime. The increase in relative humidity plus the reduction in wind movement under shaded conditions, enhances disease development. The more favorable microclimate for disease and the lack of disease resistant cultivars has been shown to be the key factor in shade adaptation of cool season turfgrasses.

Plant Response to Shade

The low light intensities that occur under shaded conditions limit the amount of carbohydrate a plant can synthesize. As a result, carbohydrate deficiencies cause a decrease in shoot, root, rhizomes, and stolon growth. In general, the growth reduction of roots under shade is greater than the shoots, and the root to shoot ratio is lowered. The root system of shaded turfgrass plants is also shorter, thinner, wiry, and less branched. A substantial reduction in shoot density will normally occur for a period of time after a sod is transplanted into a shade environment. One should not be overly concerned and attempt to prevent this reduction by increased fertilization and irrigation.

Plants respond morphologically to shaded conditions. Typically observed under shade are the following characteristics: (1) thinner leaves, (2) larger leaf area, (3) thinner stems, (4) longer internodes, and (5) reduced tillering.

Turfgrass density in terms of shoot numbers and rhizome numbers are reduced significantly under shade. On the other hand, shading increases plant height and leaf length. Shade stimulates emergence and upright growth of rhizomes and stolons. A more upright growth habit causes a greater percentage of the plant to be removed during the mowing process as well as development of a more open turf.

Physiologically shaded plants exhibit the following characteristics: (1) higher chlorophyll content, (2) lower photosynthetic rate, (3) lower respiration rate, (4) lower compensation point, (5) lower carbohydrate to nitrogen ratio, (6) reduced respiration rate, (7) higher tissue moisture content, and (8) lower osmotic pressure. In general, these morphological and physiological changes cause an over-all deterioration in plant vigor resulting in reduced tolerance to heat, cold, drought, disease, and wear.

Turfgrass Shade Adaptation

Based on the limited data available concerning turfgrass species tolerance to shade, the fine leafed fescues are the preferred grasses to be utilized (Table 1). The Kentucky bluegrasses possess poor shade adaptation due to a high susceptibility to powdery mildew. No comparisons between bentgrass and red fescue have been reported. However, assuming that disease control practices are utilized, the bentgrasses should provide adequate turf under shaded conditions, although lower in quality compared to full sunlight.

In order for cool-season turfgrass cultivars to perform well under shaded conditions, they must possess improved disease tolerance. Characteristics such as growth habit and ability to capture and convert light energy into chemical energy at various wavelengths are also involved in shade adaptation. However, disease resistance is the key limiting factor.

Table 1. Relative shade adaptation of eleven cool season turfgrasses.

Shade adaptation	Turfgrass species
Excellent	Chewings fescue Red fescue Velvet bentgrass
Good	Rough bluegrass Creeping bentgrass Tall fescue
Medium	Colonial bentgrass Redtop Perennial ryegrass Meadow fescue
Poor	Kentucky bluegrass

A Kentucky bluegrass cultivar shade adaptation study was initiated in 1971 at Michigan State University. During July and August of 1971 an irrigation system was installed in the woodland shade plot area at the MSU Crop Science Field Laboratory, East Lansing, Michigan. Technical assistance and contributions provided by A. J. Miller and Jim Vince during this project are gratefully acknowledged. Subsequent to the installation of the irrigation system, the tree canopy was selectively pruned to provide a light intensity equivalent to approximately 5 percent of normal sunlight.

A seedbed was prepared and the experimental area sodded on August 25, 1971. The sods were lifted from the MSU Muck Farm experimental plots which were 18 months old at the time of harvest. Three replications of each of the cultivars were transplanted into a uniformly shaded area in a randomized block design. The plot size was 3 x 6 feet. Subsequent to transplanting, the area was irrigated as needed to prevent wilt and mowed weekly at a cutting height of 2.5 inches. In addition, Dr. Vargas is cooperating in the application of a preventive fungicide program over one-half of each of the individual cultivar plots. This is being done with the objective of separating those cultivar responses associated with disease effects from those responses associated with the lack of light and associated shading effects on the turfgrass environment.

Table 2. The relative degree of thinning of twelve Kentucky bluegrass cultivars transplanted into the shade experimental area at East Lansing, Michigan

Cultivar	Percent Thinning*
A-34	20
Nugget	32
Merion	35
Windsor	37
Newport	40
Fylking	42
Galaxy	42
Pennstar	45
Cougar	57
Kenblue	65
Prato	67
Park	69

*Average of three reps and two ratings made in the fall of 1972.

Results to date indicate that A-34 Kentucky bluegrass ranks superior in shade adaptation followed by Nugget, Merion, and Windsor. Those cultivars ranking lowest in shade adaptation include Park, Prato, Kenblue, and Cougar. These evaluations during the initial year reflect primarily the effect of leaf spot damage. The influence of powdery mildew was minimal since the incidence of this disease was rare during the 1972 growing season in the shade experimental area. A substantial change in the ranking of some of these cultivars is anticipated during 1973 when the powdery mildew severity will have a greater effect. These data are presented as a preliminary report which will be updated at next year's Michigan Turfgrass Conference. It is apparent though that progress is being made in the development of shade adapted Kentucky bluegrass cultivars.

Sod Production for Shaded Areas

Red fescue is the preferred species for use in shaded areas. However, all the available cultivars lack leaf spot resistance and thus are seriously thinned during the late July-August period. As a result, it is very difficult to harvest, handle and transplant red fescue sods during this period of time. Consequently, a mixture of Kentucky bluegrass-red fescue and/or chewings fescue is used when producing sod especially for shaded environments. Hopefully we will have some detailed information within the next year regarding the preferred Kentucky bluegrass cultivars to utilize in this seed mixture. From the standpoint of the red or chewings fescue cultivars, a reliable comparative evaluation of leaf spot disease incidence on three fescues was obtained during 1972. These are the first significant differentials observed at the MSU Muck Experimental Farm. The fine leaf fescue cultivars were planted on August 25, 1971. The disease occurred one year later during the mid-summer heat stress period under conditions of excessive rainfall and soil moisture. The comparative incidence of leaf spot was fairly uniform across all three reps. The results are summarized in Table 3. Jamestown chewings fescue was the most resistant followed by Wintergreen chewings fescue. Pennlawn red fescue, which has been the standard cultivar utilized in sod production for shaded areas, was by far the most severely thinned.

Table 3. Incidence of leaf spot disease on three fine leaf fescues under muck sod production conditions.

Cultivar	Percent leafspot* Thinning (Aug. 20, 1972)
Jamestown chewings	46
Wintergreen chewings	65
Pennlawn red	95

*Average of 3 reps.

In terms of sod handling, Jamestown, Wintergreen, and Pennlawn all provide sod strength comparable to Kentucky bluegrass during the spring and early summer period. It is only when the leaf spot attacks occur that the sod strength problem develops.

From the standpoint of Kentucky bluegrass-red fescue mixture composition, it has been reported at earlier turfgrass conferences that as little as 10 percent Kentucky bluegrass on a seed number basis has provided adequate sod strength. However, a minimum of 30 percent Kentucky bluegrass is needed in order to have sufficient uniformity of stand to be acceptable from the appearance standpoint. The primary cultural practice of concern during sod formation is nitrogen nutrition. Excessive levels of nitrogen nutrition will greatly increase the incidence of leaf spot disease on the red fescues. Data collected at the MSU Muck Experimental Farm show that red fescue maintained at nitrogen levels comparable to that required for Merion Kentucky bluegrass will result in a three fold increase in disease incidence over those plots maintained at very minimal nitrogen fertility levels. Another cultural factor of concern involves the irrigation practice. Preferably the red fescue sod should be maintained at minimal but nonlimiting moisture conditions. Where possible, ti should be planted on fields that tend to be better drained and drier so that disease problems can be minimized. Finally, the cutting height and frequency for red fescue sod should be comparable to that commonly used on Kentucky bluegrass.

Transplanting Sods to Shaded Areas

The cutting height of sod just prior to harvest for transplanting onto shaded sites should be farily high, preferably around 2 to 2.5 inches. This ensures the maximum amount of leaf area available to capture light for conversion to carbohydrates. This will also provide a more optimum rate of sod rooting. Presodding nitrogen fertilization should be minimal. A complete analysis fertilizer of the appropriate ratio should be incorporated into the soil in order to provide the needed phosphorus and potassium levels. Desiccation of sods in shaded areas is less likely to be a problem than in open areas. Thus, the frequency and quantity of water application should be less than in open sites. Preferably the irrigation should be deep and infrequent in order to minimize disease problems. Since we do not have the ultimate in terms of disease resistant Kentucky bluegrass and fine leaf fescue cultivars for shade adaptation, one of the best ways to ensure adequate performance of sods in shaded areas is to follow the correct post-transplant cultural practices. These include both modification of the shade environment to favor grass growth and also manipulation of the trufgrass cultural practices to favor survival and adequate performance in shaded conditions. These factors will be summarized in the following section.

Shade Grass Culture

Culture of turfs under individual trees is no great problem when the limbs below 8 to 10 feed are pruned. Shade turf difficulties are generally encountered under a grouping of trees having an extensive, dense canopy.

The first step in proper culture of shade grasses is to modify the microenvironment as much as possible to favor proper conditions for grass growth. Included are (a) selective thinning of the tree canopy to improve light penetration to the grass, (b) deep fertilization of tree roots through injection procedures, and (c) some root pruning at intervals, especially with shallow rooted tree species. The trimming of lower limbs and the thinning of dense barriers of low shrubs or young trees will also improve air movement, reduce the relative humidity, and prevent stratification of air temperatures. The end result is less turfgrass disease problems.

Three basic practices are involved in the culture of turfgrasses under shade. The cutting height should be high, preferably 2 to 2.5 inches for cool season turfgrasses. The high cutting height provides greater leaf area for the synthesis of carbohydrates that are required to maintain shoot and root growth. Fertilization should be according to the specific needs of the grass. For example, red fescue is impaired when over-fertilized with nitrogen. Excessive nitrogen fertilization will also tend to produce a more succulent tissue that is more prone to disease and wear injury. The third practice involves judicious irrigation. Irrigate infrequently and deeply to minimize disease problems as much as possible. It would be preferred if irrigation were practiced in early morning. The microenvironmental conditions favorable for fungal activity will be reduced if water is present on the leaves for the least length of time.

A final factor which should be kept in mind is that turfgrasses growing in the shade are in a succulent condition with a reduced tolerance to wear. Therefore, traffic patterns should be controlled to minimize traffic effects over shaded turfs as much as possible. Shaded turfs are more susceptible to wear injury and have a reduced capability for recovery from traffic. This is a particularly important consideration during the sod rooting period following transplanting.

Reference

Beard, J. B. 1973. Turfgrass: Science and Culture. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 658 pp.