Vegetation Enhancement via Species and Cultivar Selection: A Perspective

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Roadside maintenance personnel are limited, in large part, in what they can do with a roadside condition by the type of vegetation that was sown there originally. The grasses and legumes that were initially sown as cover along the roadsides may not have persisted. Their place may have been taken by weeds, or the intended balance of sown species may have shifted. Species persistence in a region and their roles in mixtures are generally understood in agronomic circles, but cultivars (cultivated varieties) are a newer concept and not sufficiently appreciated by many who deal with establishing vegetative covers to allay erosion and to beautify and protect our environment. Cultivar selection may be as important to the maintenance and acceptability of roadsides as the selection of species in a mixture. Seed of any species labeled as "common" is often seed of a cultivar that did not meet certification standards, and may not be appropriate for a given roadside. Older "standard" varieties such as "Kentucky 31" tall fescue and "Pennlawn" red fescue, even if certified, are now variable commodities, and some may not be appropriate. Expanded lists of cultivars of several important species and their characteristics are available. Cultivars of proven performance may be selected from lists of data generated from widespread testing under intensive management. Much less testing of cultivars of promising species has been done under extensive management, such as roadsides. The rewards of superior turf with less maintenance costs are available for those who select appropriate combinations of superior cultivars for roadside mixtures.

A landscape architect's legacy is a reflection of the species and cultivars (cultivated varieties) that he or she specifies, or fails to specify, in a roadside seed mixture. Grass mixtures, alone or in combination with legumes, cover most roadsides and are the focus of maintenance activities on the 25 to 30 acres per mile of Interstate roadside. Experience has taught that grass serves best in these various habitats, hence grasses are the focus of this paper, with special emphasis on experiences in the Middle Atlantic states, particularly New Jersey.

UTILITY, SAFETY, ECONOMY, AND BEAUTY

According to Federick (*1*), four basic elements are to be incorporated into the design of a modern highway: utility, safety, economy, and beauty. Although originally aimed at highway construction per se, these points are also pertinent to roadside vegetation.

The "utility" of vegetative cover refers primarily to its erosion control in protecting the roadbed and its appurtenances. It also extends to minimizing transport of sediment off site and subsequent problems.

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A good roadside turf contributes to "safety" by providing support for vehicles leaving the paved surface and by enabling them to reenter the highway in a controlled fashion. Vegetation should not grow so tall that it causes snowdrifts to build on road surfaces, nor should it decrease line of sight.

"Economy" of roadside vegetation maintenance was emphasized most stringently following the fuel crisis of 1973, when mowing was drastically curtailed. Interest in "no mow" or minimum maintenance vegetation increased. Opportunities for reduced mowing (and lower maintenance costs) are greater now with the use of various plant growth regulators (PGRs) and herbicides. Responses to questionnaires distributed by the Committee on Roadside Maintenance in 1986 indicated that there has been a decrease in roadside mowing over the last 10 years (*2*). The reasons cited were the increased use of herbicides and PGRs on roadsides. The increase in use of herbicides appeared to be greater than the increase in use of PGRs.

Emphasis on "beautification" increased during the presidency of Lyndon B. Johnson, particularly through the interest of the President's wife, Lady Bird. The pressure of economy on maintenance temporarily suppressed interest in wildflowers for roadsides, but recent interest in this topic is at an all-time high.

Wildflower plantings are strategically located for maximum visual impact at sites where erosion potential is minimal. With few exceptions, notably bluebonnets (*Lupinus texensis*) in Texas, the modes of establishment and range of adaptation of the large number of wildflower species is very poorly understood.

THE UNMOWED ROADSIDE

The process of "naturalization" is largely dependent on the availability of seeds nearby, and these may or may not be desirable species. Attempts at seeding selected woody species to roadsides were pursued by Thornton (*3*), with successes largely limited to the sumac species, some of which appeared to be quite attractive and appropriate.

Plant succession usually starts with weedy species, which are often undesirable in roadside situations. Excessive amounts of ragweed (*Ambrosia* spp.), poison ivy (*Rhus radicans*), crabgrass (*Digitaria* spp.), and foxtail species (*Setaria* spp.) volunteer where sown species have failed. Annual weed species frequently give way to perennial grasses. In New Jersey this succession typically includes species such as the bluestems (*Andropogon* spp.), purpletop (*Tridens flavus*), and the paspalums (*Paspalum* spp.).

These persistent warm-season grasses are C_4 photosynthesizers, which operate more efficiently at high midsummer temperatures than the C_3 cool-season grasses (e.g., tall fescue and Kentucky bluegrass) that were sown on the roadsides. The sown species suffer in competition and their stands are further depleted. These warm-season perennial grasses cannot currently be selectively removed from a cool-season turf with herbicides. Weedy growth generally necessitates extra roadside mowings. The eventual ingress of woody species such as sumacs (*Rhus* spp.) and dogwood (*Cornus* spp.) may be acceptable, although taller-growing timber type trees such as oaks (*Quercus* spp.), maples (*Acer* spp.), and pines (*Pinus* spp.) may become hazardous to motorists and require expensive clearing operations.

Crown vetch (*Coronilla varia*) seedlings start so slowly that a grass associate is needed to allay erosion during the first 2 or 3 years. Subsequently, crown vetch typically becomes so vigorous (where adapted) as to eliminate the grass associate and (to a large extent) preempt the ingress of weeds and brushy species. Crown vetch is well adapted to northern New Jersey, Pennsylvania, and southern New England, where moisture is favorable. Even here, after a decade or two, perennial weeds and woody species may invade. Crown vetch adaptation extends appreciably beyond the above limits (from southern Canada to Alabama), but it is not adapted to droughty, sandy soils like those of southern New Jersey.

"MANAGED" ROADSIDE VEGETATION

Species shifts in sown mixtures are commonplace and can be expected to vary with the management imposed. Stand composition is also dependent upon the soil, moisture regime, and fertility of the specific roadside site. These factors are likely to vary along the road and up and down the slope, as well as within and beyond the mow or spray line.

Contractors generally like to have a lot of ryegrass (*Lolium multiflorum* or *L. perenne*) in a roadside turfgrass mixture because, in addition to being inexpensive (especially common types), they are particularly fast to emerge, quick to green up the newly sown area, and make rapid growth. The ryegrasses, however, are strongly competitive and are likely to be detrimental to the other species in the mixture, particularly if frequent close mowing (such as 1-½ in. at least once a week) is not practiced (*4*). As little as 10 percent ryegrass in a mixture that is unmowed until after heading may give the appearance of a solid ryegrass stand. Lawn mixtures generally have no more than 25 percent ryegrass. Contractors' "economy" mixes often exceed 25 percent ryegrass and may contain only ryegrass. This is false economy for any perennial low maintenance turf. Even improved, truly perennial ryegrasses, such as "Manhattan," fail to persist beyond the second or certainly the third year under roadside conditions. Rust diseases (*Puccinia* spp.) and *Anthracnose* build up when mowing is infrequent (more than 3 weeks between mowings during the growing season); they are the probable causes of the failure of "perennial" ryegrasses under roadside conditions. However, under modest home lawn conditions, Manhattan has maintained an attractive, complete turf for at least 14 years.

Tall fescue (*Festuca arundinacea*), particularly the cultivar "Kentucky 31," has been extensively sown on roadsides since the mid 1950s. Tall fescue commonly dominates turf at the toe of slopes and other productive roadside sites. Its persistence on the sandy acid soils of southern New Jersey, however, or on the difficult-to-vegetate shoulders or roadside banks on various soils throughout the state, falls far short of desirable. Where tall fescue is eliminated by such environmental stresses, fine fescues often persist.

Kentucky bluegrass (*Poa pratensis*) is commonly found along roadsides in productive sites, sometimes in association with tall fescue. Kentucky bluegrass is not as tall or coarse-textured as tall fescue. Various species of fine fescues are found throughout the area, persisting on roadsides sown prior to the popular use of tall fescue.

Infrequent mowing of roadsides allows the ingress of various broadleaf weeds, brushy species, tree seedlings, and certain grass species. The latter include the bluestems, paspalums, and purpletop, none of which can be readily controlled with herbicides. These are warm-season species that compete severely with the sown cool-season species when the latter are at their low ebb of growth during summer.

Excessively close mowing, particularly in late spring, favors the ingress of warm-season annual grasses such as the crabgrasses (*Digitaria* spp.) and foxtails (*Setaria* spp.). Tall growth of these species necessitates more summer mowing than the originally sown turfgrasses. Low mowing also generates larger quantities of unsightly clippings that are more apt to smother remaining cool-season grasses. Warm-season annual grasses are prolific producers of seeds, which assures the continuation and aggravation of these problems.

Excessive application of certain PGRs may also suppress sown species and promote dramatic shifts toward the above grassy weeds. Figures 1 and 2 illustrate the severe retardation of tall fescue following PGR treatment and a subsequent shift to foxtail.

Damage through mismanagement, errors, or poor initial choice of turf species frequently necessitates roadside renovation. Currently there are extensive lists of cool-season grass cultivars from which to choose more appropriate grasses for better roadside mixtures.

FIGURE 1 Excessive PGR and herbicide have retarded roadside growth dominated by tall fescue (May 15, 1987).

SOLUTION

Vegetation that is poorly adapted to a site or management situation will give way to better-adapted plants that may or may not be desirable roadside vegetation. By selecting appropriate vegetation, however, it is possible to build in minimum maintenance.

Improved cool-season turfgrasses began with the selection of "Merion" Kentucky bluegrass in 1936. The next major step occurred with the release of Manhattan ryegrass in 1967. Since that time, a host of improved turfgrass cultivars of these species, plus tall fescue and various species of fine fescues, have continued to emerge. Most of these cultivars have been bred and tested primarily for fine turf use. Only "Fortress" (*Festuca rubra* subsp. *rubra*, a strong creeping red fescue), "Banner" Chewings fescue (*F. rubra* subsp. *comutata*), and "Wabash" Kentucky bluegrass (*Poa pratensis*) were bred and tested specifically for use on roadsides. Fortress and Banner were developed in New Jersey and are being used on its roadsides (*5,6*). Wabash was developed in Indiana and has not been promising in low maintenance testing in New Jersey.

FIGURE 2 Roadside is dominated by foxtail (*Setaria* spp.), a summer annual grassy weed; surviving tall fescue will probably succumb to competition from the foxtail (September 15, 1987).

Uniform trials of the performance of the major cool-season turfgrass species are conducted in many states, with the results compiled and published every few years by the U.S. Department of Agriculture (USDA). The extent of testing and the proliferation of cultivars over time is shown by the data presented in Table 1. The number of fine fescue entries, for example, doubled between 1983 and 1989. This testing is conducted primarily under lawn-type management.

The Variety Review Board of the Lawn Institute has also published a list of cultivars of lawn grasses recognized for excellence (*7*). Their criteria included vigor as well as insect and disease resistance. The list includes the names of 18 Kentucky bluegrass cultivars, 11 turf-type perennial ryegrasses, 5 fine fescues, 6 tall fescues, 2 bentgrasses (*Agrostis* spp.), and 3 specialty grasses. Cultivars of all but the last two categories are evaluated largely from data derived from the USDA National Turfgrass Evaluation Trials described above. Unfortunately, this list makes no reference to suitability for low maintenance use, nor does it specify area of adaptation.

Fine turfgrasses and roadside grasses should be evaluated on quite different parameters. One of the criteria of quality for roadside grasses, for example, involves their appearance when unmowed. An abundance of seed stalks indicates partitioning of photosynthates away from attractive green foliage. Seedheads are therefore undesirable along roadsides and become aesthetically unattractive as they senesce. Figures 3 and 4 show marked differences in seedhead development between two cultivars of Kentucky bluegrass and between two fine fescues.

Major seed companies want proprietary rights over the various cultivars of these species in order to offer customers their own full line of improved grasses for blends (two or more cultivars of a species, particularly important with Kentucky bluegrasses) or mixtures (two or more species). This competition stimulates development of new cultivars, but the proliferation causes some concern over finding appropriate names. At least one company resolved this by developing an alphanumeric code to identify new cultivars.

Too little testing of these cultivars has been done on roadsides and other minimum maintenance situations. The performance of improved turf-type tall fescues under such conditions is unknown. Some of these new tall fescues produce

TABLE 1 NATIONAL TURFGRASS EVALUATION TRIALS (INCLUDING CANADA)

Turf species	Year begun	No. of* locations	States/ provinces	Cultivars or selections
Ryegrass	1982	28	21	47
Tall fescues	1983	37	19	30
Fine fescues	1983	20	14	47
Kentucky bluegrass	1985	27	20	72
Bermudagrass	1985	10	7	28
Fine fescues	1989	-	-	94

*Some states tested at multiple locations

FIGURE 3 Cultivars of Kentucky bluegrass "Newport," in the rear, consistently produces more seed stalks (which mask foliage) than "Kenblue."

FIGURE 4 Cultivars of fine fescue "Highlight," in the rear, consistently produces more seed stalks (which mask foliage) than "Ruby."

more seed per acre than Kentucky 31 and have been sown on roadsides.

Improved turf-type Kentucky bluegrasses, including Merion, have high maintenance requirements and will not persist under typical roadside conditions. Kentucky bluegrass cultivars such as "Kenblue," "Park," "Troy," "Delta," "Arboretum," and "South Dakota" have tolerated the stresses of low maintenance and persisted better than the low growing, dense, and compact types developed for fine turf use. The six cultivars mentioned above are characterized as "common types" in that they are taller and less dense than other cultivars of the species.

The brightest development presently available for roadside mixtures are the hard fescues (*F. longifola*). They are newer and less well known than the creeping red fescues, Chewings fescues, and sheeps fescues. Hard fescue cultivars include the older "Biljart" and "Scaldis" and the newer "Reliant" and "Spartan." They are fine leafed and low growing. Of all the cool-season utility grasses, the hard fescues are the densest and have the best summer green color, particularly under low maintenance. Once established, their dense turf effectively excludes most weed encroachment. The weed-free aspect, low growth, plus rich green summer color provides quality roadside turf. The hard fescues also require minimum mowing and tolerate low fertility and low soil moisture.

IMPROVED GRASSES WITH ENDOPHYTES

Endophytes are certain types of fungi living inside grasses and other plants (Figure 5). This relationship has been known for over a hundred years but has only recently become of interest to turf scientists. They knew of the seed-born form of *Epichloe typhina*, for example, but only in the early 1980s did they discover that the association provides pest resistance to the turfgrass (*8*). Figure 6 shows that grasses containing an *Acremonium* endophyte were protected from attacks by bluegrass billbugs (*Sphenophorus parvulus*) and show superior recovery in spite of prevailing dry conditions. Major turfgrass species, excepting Kentucky bluegrass and bentgrasses, have been reported by others to have enhanced pest tolerance, resistance to weed invasion, and recovery from summer stresses.

Plant breeders are top-crossing their best genetic materials onto plants of the species that have passed microscopic examination for endophytes. After several generations of selecting and top-crossing, commercial quantities of seed having certain insect protection will be available.

CONCLUSION

Improved cultivars for fine turf abound. There is a need for more testing of these grasses under roadside conditions. There very likely are combinations of species and improved cultivars

FIGURE 5 White stroma atop stems of strong creeping red fescue are the outward manifestation of an endophyte (*Epichloe typhina*).

FIGURE 6 Presence of endophyte (*Acremonium* spp.) gives turfgrass resistance to insect attack and enhances recovery from drought.

that will maintain a more attractive appearance, exclude weeds, and resist drought. It would be unwise to buy "common" seed of any species as long as there are cultivars that would better suit specific roadside needs. For example, buyers should not accept seed whose label says simply "Kentucky bluegrass" or "perennial ryegrass" or "tall fescue" without a cultivar name that denotes superior characteristics for the site, use, and management to which it will be subjected.

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Publication of this paper sponsored by Committee on Roadside Maintenance.