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A Case for Direct Seeding of Woody Species on Highway Roadsides[1]

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Abstract

The use of woody species on highway rights-of-way is a long standing practice which is coming under closer scrutiny as costs of landscape materials and maintenance increase. Direct-seeding of woody species may be an option to help control establishment costs. The use of native species may help to reduce maintenance costs as well as the mortality experienced with exotic landscape cultivars. Past experience has shown that successful direct-seeding can be accomplished with proper site preparation and planting techniques.

Index words: direct-seeding, native woody plants, seed dormancy, site preparation, mulches

Introduction

The Virginia Department of Highways and Transportation has a long-standing commitment to maintaining both a functional and attractive roadside. The innate beauty of Virginia combined with its historic appeal, make tourism an important segment of Virginia's economy. Highway beautification, attractive rest areas, and wildflower plantings are now accepted as routine and necessary parts of the highway system.

Highway officials are looking for ways to further enhance the appearance of Virginia roadsides, but at the same time desire to reduce maintenance costs. This dichotomy of goals is possible by allowing mowed areas to regenerate to natural vegetation. A working goal now assumes that highway construction is not complete until the construction area has been returned to a naturalized state. This concept is not revolutionary as evidenced by a 1938 quote of J.L. Gubbels of the Texas Highway Department, "Permanence and stability cannot be assured by steam shovel and grader. It can only be achieved by the growth of living things—grass, flowers, shrubbery and trees . . . Planting is, and should be considered, an insurance policy taken out on the stability and permanence of the roadside, and on the very foundation of the highway itself. It is to the road what paint is to the house, it preserves and at the same time improves the appearance. Planting differs from paint in this important way: it renews itself, improves and grows better and more beautiful with age . . ." (7). Another author wrote, "Regardness of how beautiful the highway may be, it cannot be considered aesthetically pleasing if the feeling of safety is not present. Aesthetics involves all of man's feelings and emotions" (1). Jens Jensen stated further, "A roadside that's so monotonous it puts the driver to sleep, or so fearsome it puts his nerves on edge, is a dangerous highway, no matter how good the road itself is" (10). Grasses and turf are planted on land adjacent to roads for aesthetic reasons, but more importantly for soil stabilization and erosion control. Trees and woody shrubs also serve as conservation plants, but more often this is secondary to aesthetics. Great sums of money and energy are expended in attempting to make our highways more attractive, more integrated into the surrounding landscape. The increased diversity that woody plants provide helps decrease the boredom of our highways and in turn the visual strain on motorists (4).

In the past, most of the stock used to establish desirable woody species along the highways of Virginia have been purchased from commercial nurseries, a practice that is fast becoming prohibitively expensive. In 1976, the Landscape and Design Section of the California Division of Highways estimated that a commercially produced plant in the 1-gal (#1) size, planted and maintained for one-year cost approximately $10.00. It was also noted that many of these plants required a high level of maintenance after the first year (8). Inflation alone (from 1976 to 1986) has certainly more than doubled the cost quoted above.

Past beautification projects have tended to give immediate but shortlived success. A variety of reasons have contributed to their demise. Design and choice of plants were handled in a traditional architectural fashion. These included a wide variety of cultivated plants in mulch beds. Such plantings had inherent built-in maintenance problems. They became labor intensive and often had individualized pest problems unique to the particular cultivar.

Failure to keep plantings in an orderly fashion created criticism from motorists. It also created morale problems within the Highway Department as equipment

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operators spent greater efforts on weeding and pruning activities.

Alternatives to establishment of landscape-sized nursery stock include: a) using bare root seedlings of nursery grown stock; b) direct seeding of desirable woody species; and, c) natural regeneration.

The use of nursery grown seedlings greatly reduces materials costs, but tends to lose this advantage because planting of seedlings is also labor intensive. Reduced numbers of highway employees discourages projects that increase labor. A recent trend toward contractual labor could possibly overcome this difficulty. Additionally, small seedlings are subject to several environmental hazards. Rodent damage in seedling plantings can be significant due to the inherent size and tenderness of the plants. Climatic stresses such as drought or unseasonal frost can be devastating due to the amount of time it takes for the seedling to adapt to its new habitat (8). Efforts to protect newly planted seedlings from such hazards could conceivably cost more than buying established nursery stock (5).

Present trends focus on naturalization of the highway roadside with desirable native species.

Natural regeneration is probably the least expensive method of establishing woody vegetation. Additionally, while also susceptible to rodent damage, seedlings which germinate naturally are not subject to transplant shock and are inevitably stronger and more capable of adapting to climatic changes. Hence, their success rate under stress would normally surpass that of transplanted seedlings. On the other hand, natural regeneration has the following inherent problems: a) site selection tends to be random and may detract from the highway as often as enhancing it; b) species selection is absent and even if some desirable plants are present the result can be a brush pile, unattractive at best; and, c) undesirable species such as locust, tree-of-heaven, and multiflora rose, all well known for their aggressive growth habits, tend to become the predominant species.

Direct Seeding

Direct seeding of desirable woody species utilizes some of the positive points of both previously mentioned methods while not being saddled with their more serious drawbacks. In this practice, only desired species are planted and the sites can be tailored to match the environmental requirements of a particular species. This should provide the newly germinated seedlings with a competitive advantage and help assure a predictable result. Additionally, newly emerged seedlings will have an environmental advantage such that they can adapt to climatic change more readily than bare root transplants which must overcome the initial shock of both the transplant operation and their new habitat. Further, initial cost as well as maintenance cost should be substantially lower than other planting methods because of the lower material costs (i.e. seed cost) and the inherent vigor of on site germinated seedlings. Savings of greater than 80% have been quoted (8). This method should also serve to reduce long term maintenance cost and reduce herbicide use as it would rapidly convert the disturbed area to a desirable natural habitat and reduce invasion of weedy species.

The use of direct seeding to establish trees and woody shrubs is a practice well known to nursery and forestry practitioners and publications concerning the practice are well-documented (9, 11, 12, 16). The use of this methodology for roadside development of woody species is limited.

The results of direct seeding projects in the past have ranged from failure (8, 14); to not very successful (6, 8); to very successful (11, 12, 14). Reasons for success and/or failure include site selection, species selection, seed source, seed treatment, planting time, nurse crop, soil characteristics, mulch methods and materials, and follow-up attention (14).

Site Selection

The choice of sites has a direct bearing on which species may be planted and their success. On established roadsides with stable soil a multitude of species may be considered, subject to their anticipated chance of survival (3). In such a situation, a variety of planting techniques are available and they may be used in the manner deemed most practical. On new construction sites, however, large areas may be subject to immediate erosion which may necessitate prompt seeding of vigorous herbaceous species (2). These sites would preclude the establishment of woody species by virtue of the competitive edge the herbaceous species would possess. After soil stabilization portions of such areas may be altered (by herbicides and cultural work) to accept the seeding of woody plants (3). With this in mind, the main criteria for selection of sites should be: a) the vegetation does not create a hazard; b) the vegetation helps the highway blend into the adjacent landscape; and, c) the results will be reasonably attractive (3, 14).

Species Selection

Species selection is based on a number of criteria. Generally, the selection should be of native flora and of desirable size and habit. Selected species should be relatively fast growing (but not necessarily fast spreading) and not normally considered a nuisance in low maintenance open land (6, 8, 14). Seeds should be readily available in sufficient quantities at a reasonable price (6, 14). Cost of establishing and maintaining plantings should be low and potential disease problems negligible (8). Finally, the resultant vegetation should help the roadside blend with the surrounding countryside as well as be attractive, perhaps colorful sometime during the year (1, 4, 5, 8).

Some consideration must be given to determining which species are desirable and which are not. Usually, this is a function of cultural or geographic distinction. Sweetgum (*Liquidambar styraciflua* L.) is regarded as a nuisance or weed species in southeast Virginia, while residents of northern and western Virginia regard it to be a desirable landscape tree. Conversely, eastern red cedar (*Juniperus virginiana* L.) is a major weed tree in the Shenandoah Valley where it spreads rapidly to adjacent agricultural land. In an urban corridor seed dispersal is not a problem, and it is considered an acceptable landscape species.

Additionally, one must consider seed mixtures (species mixtures) and seed placement carefully. For ex-

ample, flowering dogwood does not have universal adaptability. For dogwood to thrive in a harsh environment it should be placed in a border or fringe setting. This requires that seed be sown indiscriminately in hopes that it will find its niche. With more careful consideration, individual species may be targeted to localized areas with appropriate environmental conditions. This approach would require much more planning, but would ultimately be more cost effective. These same basic principles impinge on selection of seed mixtures. A sweetgum-dogwood mixture would be expected to yield a sweetgum stand. Successful dogwood establishment could be achieved by seeding after the environment has been altered by formation of a sweetgum overstory.

Seed Source

Seed may be obtained from either a commercial seed dealer or by local gathering. For a highway project, a commercial dealer would probably be the least expensive and most practical source. Additionally, such a source would more likely assure seed viability and subsequent germination, a quality necessary for determining consistent reliable seeding rates (9).

Seed Treatment

Past experiences indicate that seed scarification, prior to planting, is to be avoided for roadside planting. This is commonly done in commercial nurseries to insure a high germination rate when seed has been held in storage and planting is to occur at a time other than when nature would have dispersed the seed. However, nurseries have the necessary manpower and resources to provide adequate care for such plantings under adverse environmental conditions. Fall seeding followed by natural stratification provides greater adaptability to environmental or climatic change and thus greater chance of success under the highway environment. Hence, while initial germination rates may be lower, successful vegetation establishment rates may be higher. Additionally, seed which does not germinate the first year can remain viable and germinate later. Artificially scarified seed which do not germinate the first year are normally lost to possible germination in subsequent years (6, 13, 14).

Planting Time

The use of non-treated seed dictates that planting should occur at the time of natural dispersal. For most native flora, dispersal occurs from late spring through late fall. Practically, planting should occur between late summer and mid-autumn. Little is to be gained by spreading seed in May or June as the seed of most species will simply lay fallow until the following spring. Additionally, commercial seed sources are oriented to provide seed from mid-summer on and acquisition of fresh seed may not be possible at earlier dates. Overwintered seed, while subject to rodent, bird and other natural predation and destruction will be more readily adapted or synchronized to its habitat than spring planted treated seed (14).

Nurse Crop

The use of a nurse crop with direct-seeded woody species is particularly important on bare soil which is found in new construction areas. This will insure some degree of soil stabilization prior to the germination of the woody species. Logic dictates, however, that the accompanying herbaceous plant material not be so vigorous as to out-compete the woody species such that the nurse crop succeeds and the woody species does not. Annual rye grass would appear to be a reasonable cover crop due to its short life and reduced competitive ability (17). Additionally, seeding the nurse crop at a rate of perhaps one-half the normal rate would provide a more open herbaceous community and give the woody species a more pronounced competitive edge (18). Research in Maryland has shown that sod-forming grasses should be avoided in favor of bunch grass-legume mixtures which allow woody species to emerge in open spaces (16). Fertilization should be adequate to insure the success of the nurse crop but should also have some slow release characteristics such that proper nutrients are available for the spring germinating woody species (2).

Soil Characteristics

Soil characteristics will vary distinctly from site to site. In areas with established vegetation, some mechanical surface disruption may be necessary to insure seed contact with the soil (6).

This concept is subject to experimental verification. On areas of new construction, bare, uncompacted mineral soils may prove ideal. These areas often have a low pH and little or no seed inventory. This will reduce the incidence of competition from otherwise present vegetation. Non-compaction of the soil will further insure seed-soil contact and better aeration. This will produce better root growth and reduce the time required for the plant to become self-sufficient.

Mulching Methods and Materials

The types and uses of mulches vary considerably. On sites with existing vegetation, low mulching rates may suffice as the vegetation which is killed prior to seeding will provide a measurable amount of cover. A cellulose mulch in this instance would serve as an initial seed cover with the existing vegetation collapsing over it as death occurs. On bare earth, a heavier mulching has been reported to be necessary (14). Successful mulching regimes have included wood chips, straw, excelsior and cellulose fiber (13, 14, 18). For hydroseeding, an initial cellulose fiber mulch followed by straw may prove necessary (18).

International Efforts with Direct Seeding

A comparison of direct seeding failures (in the United Kingdom) and successes (in the Federal Republic of Germany) (14) yields a series of distinct contrasts.

In the United Kingdom the biology of the species being sown was poorly understood. This, coupled with seed mixtures containing vigorous herbaceous species, led to intense competition for the desired woody species and assured failure. Additionally, seeded sites were top-

soiled areas which already contained a heavy seed inventory. Finally, site conditions and seeding specifications were inadequately documented such that subsequent evaluations and recommendations were useless.

In the Federal Republic of Germany, techniques and specifications were developed specifically for woody species and methods of sowing involved only one or two simple and easily reproduced operations. Only dormant seed was sown and seed mixtures contained a wide range of tree and shrub species. Accompanying herbaceous species were seeded at low rates and only species of low vigor and persistence were chosen. Additionally, only subsoil and bedrock sites were chosen and large quantities of mulch were used. Finally, complete records were maintained which allowed for evaluation and specification development.

Significance to the Nursery Industry

As highway maintenance costs increase, costs associated with landscape work is coming under increased scrutiny. One cost that is immediately identified is that required to maingain intensely landscaped areas, especially those containing non-native species where initial financial outlay was significant. It is becoming increasingly difficult to justify multi-million dollar landscape projects which require hundreds of thousands of dollars per year in maintenance costs. One of the alternatives being considered is direct-seeding of desirable native species, especially on rural interstate highways. This concept, if implemented to its fullest potential, could have a significant impact on those nurseries which deal heavily with highway landscapers. While nursery stock use may be reduced, the use of direct-seeding may generate contracts for those prepared to undertake more specialized hydroseeding.

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