Direct seeding of shrubs along roadsides in Massachusetts

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Direct seeding trials of six native shrubs in combination with four grasses led to these recommendations and conclusions: (1) shortlived grosses should not be used; (2) at least double the seeding rates used in this test should be applied; (3) mixtures of grasses tailored to specific sites and seasons, should be used; (4) spring seeding of the shrubs is preferred over fall seeding.

The problem of revegetating roadsides and then maintaining this vegetation has long been a concern of highway engineers. Infertile and acid soils, soils with low moisture retention capacities, southern exposures, and steep slopes are a few of the factors that characterize many roadsides. The problems that these factors precipitate and the high costs of dealing with them have necessitated much research in roadside development.

The ideal solution for roadsides would be to establish permanent native vegetation which requires little or no maintenance, is not too costly to plant, and yet is aesthetically pleasing. For many years the standard practice in vegetating and stabilizing roadsides has been to seed with grass, and in many areas of the country this practice is quite successful. how ever, in the eastern United States, grasslands are neither natural nor a climax vegetation. This must he maintained by liming, fertilizing, and mowing. Proper maintenance, although it wields good results, can be costly.

An alternative to the sole use of grass has been to revegetate with native shrubs and trees. The great expense of planting nursery stock. either bare-rooted or containerized, has led to interest in the direct seeding of shrubs on roadside slopes. This was first suggested by Greene in 1957 (5).

Because of extremes in temperature and moisture, woody species do not readily establish themselves on hare soils. However, some native species occur in areas that already have grasses or weeds. Grass sods tend to moderate soil surface temperature, conserve moisture, and supply shade, three very beneficial factors influencing the establishment of shrubs. (1,2,5, 6).

Experiments in the direct seeding of native woody species along with grasses to act as a living mulch and temporary vegetation have been reported by Everett (3), Hill 1-4), Zak and Bredakis (7), and Zak et al. (8). They all found that success was limited by poor shrub seed germination, drought, and competition from the grasses.

The objectives of the present experiment were fourfold: (1) to investigate the feasibility of direct seeding of shrubs in combination with grasses; (2) to evaluate six native shrubs that had proven successful in previous direct seeding experiments; (3) to determine the compatibility of four grass species seeded with the shrubs: and (4) to compare such combination seedings made in the fall to seeding s made in the spring.

Materials and Methods

The experiment was located on a 2:1, south-facing, sandy (96 percent) slope along Exit 2 to Mashapaug Road of Interstate Route 86 in Sturbridge, Massachusetts. Construction of this exit was begun in 1969 and the slope was left entirely without vegetation.

In this experiment, three separate seedings of six shrubs and five grass combinations were compared in a split-split plot design. The seeding dates (fall of 1970, spring of 1971, and fall of 1971) comprised the main unit. The sub-units consisted of four grass species - domestic ryegrass (*Lolium* sp.), redtop bent (*Agrostis alba L.),* rye cereal *(Secale cereale* L), weeping lovegrass *(Eragrostis curvula* Nees.), and a check plot not seeded to grass. Seeding rates were 22.4, 2.8, 33.7, 2.8, and 0.0 kg/ha (20, 2.5, 30, 2.5, and 0 lbs/acre), respectively.

The shrub species investigated were autumn olive *(Elaeagnus unibellata.* Thunb.), bayberry *(Myrica pensylvanica Lois.)*, bristly locust *(Robinia fertilis* Ashe), dyer's greenweed (*Genista tinctoria L.),* indigo bush *(Amorpha fruticosa L.),* and tatarian honeysuckle *(Lonicera tatarica T..),* each seeded at a rate of 98 seeds per sq. m. (10 seeds per sq. ft.) ; these served as the sub-units. The design was replicated in three complete blocks.

Shrub seeds sown in the spring were treated to overcome dormancy. Seeds sown in the fall were not treated.

Prior to seeding, 2,244 kg/ ha (2,000 lbs/acre) of limestone and 449 kg/ha (400 lbs/acre) of 5-10-10 fertilizer were broadcast and raked into the soil. Seeds were hand broadcast and raked lightly into the soil. Then, a wood cellulose mulch (Weyerhaeuser "Silva Fiber") was applied with a "Finn Equipment Hydroseeder" at a rate of 1,682.8 kg/ha (1,500 lbs/acre)This amounted to a mulch covering of about 1/2, cm.

Observations were made on the growth and value of the grasses as a living mulch for the shrubs and as an aid in erosion control. Data were compiled on shrub numbers and height over a 2-year period for each of the three seedings. These data were regarded as indices of plant performance.

Results and Discussion

Early observations indicated that the grasses seeded in the fall of 1970 and spring of 1971 germinated and grew well. In July 1971, it appeared that the shrubs seeded in combination with the ryegrass and rye were making little or no growth. However, shrub seedlings in the redtop, weeping lovegrass, and control plots were growing well.

The grasses seeded in the fall of 1971 did not germinate satisfactorily. By spring, 1972, there was sonic erosion in these plots. The grasses seeded in the fall of 1970 and spring of 1971 blocks continued to grow well during the spring of 1972. However, by September of that year much of the grass and many of the weeds in all the plots had withered and died leaving little more than stubble. Signs of erosion, mostly sliding of the sand, were observed in many plots. A year later (summer, 1973), very little grass was left in any of the plots. None of the grasses appeared superior to another. There were no differences in the degree of grass cover in the grass plots and the check plots.

The seeding rates, which were made low to reduce competition of the grasses with the shrubs. were insufficient for this site. Soil moisture was inadequate and soil temperatures were high during the summer months. These appeared to be the two major factors causing the poor survival of The gasses.

Data in table 1 show the difference in the numbers of shrubs by species was highly significant. Over the two seasons, dyer's greenweed and indigo hush were found in the greatest numbers. The species of grass seeded had no effect on the numbers of shrubs. In addition, there was no statistical difference in the numbers of shrubs in the grass plots compared to the controls. The numbers of shrubs of each species decreased significantly from the fall of 1972 to the fall of *1973*. This decrease appeared to correspond to the significant decrease in the amount of grass and weed cover in all plots over that period.

Data in table 2 on the numbers of shrubs per sq. m. of each species in relation to the season they were seeded show several highly significant differences. There were significantly fewer shrubs of all species in 1973 than in 1972 for each of the seeding dates. Dyer's greenweed and indigo bush were again present in the greatest numbers. It appeared that indigo hush seed sown in the fall of 1970 were nonviable.

Although more shrubs were counted in the spring of 1971 block than in the fall of 1970 block, this difference was not significant. However, both of the blocks had significantly greater numbers of shrubs than the block ceded in the fall of 1971.

The average height of the shrubs

Table 1.—Average survival count (number of shrubs/m²) of shrubs in grass-shrub combination over three seeding periods (fall–1970, spring–1971, fall–1971).

Shrub species	Grass species											
	Redtop bent		Domestic rye		Weeping lovegrass		Rye cereal		Check		Average	
	1972	1973	1972	1973	1972	1973	1972	1973	1972	1973	1972	1973
Autumn olive	5.3	0.3	4.7	0.2	2.4	0.6	5.3	0.7	3.7	0.1	[1] 4.3b	0.3c
Bayberry	3.2	0.6	5.1	1.1	1.7	0.7	2.8	0.6	3.1	0.8	3.2b	0.8c
Bristly locust	3.6	0.3	3.9	0.8	3.7	1.1	3.4	1.0	6.0	2.4	4.1b	1.1c
Dyer's greenweed	16.8	2.0	20.6	4.8	16.7	3.6	15.0	2.1	13.1	2.6	16.5a	3.1a
Indigo bush	15.7	2.9	13.7	1.1	17.4	1.9	15.3	0.8	13.2	1.3	15.0a	1.6b
Tatarian honeysuckle	0.3	0.1	2.2	0.4	3.3	0.9	4.1	1.4	5.0	0.8	2.9b	0.8c
Average	7.5	1.0	8.4	1.4	7.5	1.4	7.6	1.1	7.4	1.3		

[1] Averages in the same column not followed by the same lett er are significantly different at the 1 percent level of probability according to Duncan's New Multiple Range Test.

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Table 2.—Average survival count of shrubs in grass-shrub combination in three seeding periods (number of shrubs/m²).

Shrub species	Fall seeding—1970		Spring seeding—1971		Fall seeding—1971		Averages	
	1972	1973	1972	1973	1972	1973	1972	1973
Autumn olive	1.9	0.4	1.1	0.4	10.0	0.1	[1]4.4b	0.3c
Bayberry	5.5	1.5	2.1	0.5	1.5	0.1	3.1b	0.8c
Bristly locust	3.6	0.7	4.6	1.7	5.3	0.9	4.5b	1.1c
Dyer's greenweed	23.1	5.1	19.7	3.3	3.4	0.1	15.4a	2.8a
Indigo bush	0.0	0.0	31.0	4.4	13.7	0.4	14.8a	1.6b
Tatarian honeysuckle	7.4	2.1	1.2	0.4	0.3	0.4	2.9b	1.0c
Averages	6.9	1.6	9.9	1.8	5.7	0.3	7.5	1.3

[1] Averages in the same column not followed by the same letter are significantly different at the 1 percent level of probability according to Duncan's New Multiple Range Test.

Table 3.—Average height in cm. of shrubs seeded with grasses in three seasons.

Shrub species	Fall seeding—1970		Spring seeding—1971		Fall seeding—1971		Averages	
	1972	1973	1972	1973	1972	1973	1972	1973
Autumn olive	20.3	58.2	6.6	22.9	3.6	26.2	[1]10.2b	35.8c
Bayberry	15.5	41.2	4.3	27.4	3.8	28.7	7.9b	32.5c
Bristly locust	14.0	45.5	20.8	88.9	5.1	10.2	13.2b	48.3b
Dyer's greenweed	37.6	70.1	45.2	69.9	8.9	27.4	30.5a	55.9a
Indigo bush	0.0	0.0	8.9	46.0	3.6	14.0	10.9b	35.3c
Tatarian honeysuckle	18.5	19.3	5.1	10.2	2.5	11.4	8.6b	13.7c
Averages	21.2	46.8	15.1	44.2	4.6	19.7	13.6	36.9

[1] Averages in the same column not followed by the same letter are significantly different at the 1 percent level of probability according to Duncan's New Multiple Range Test.

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whether nitrogen alone would have produced this reaction. This was not significant when treatments 5 and 8 were compared with the control, but plant survival of treatment 5 was significantly greater than treatment 2. Also, survival from treatments 5 and 8 may have been enhanced by lack of toxic levels of phophorus.

We do not know exactly why dicalcium phosphate and triple-super phosphate were detrimental to plant survival on these spoils. We can only speculate that triple-super phosphate, when added to an already extremely acid spoil, was immediately soluble in the soil water and simply increased the acidity and salt concentration of the soil solution to a level that was highly toxic to the plants.

We cannot even speculate as to why dicalcium phosphate inhibited survival, except to say that there may have been a complex and detrimental chemical reaction.

Rock phosphate, on the other hand, is very slowly soluble and would have less effect on the acidity and salt concentration of the soil solution. In fact, rock phosphate added to acid spoils wi11 reduce the toxic effects of acidity in some spoils, much as the addition of lime does. Possibly, if the fertilizers had been broadcast or drilled instead of mixed and side dressed,. they would have given different results.