Principles of Making Turf Mixtures for Roadside Seedings

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•HIGHWAY SEEDINGS made up of a mixture of several species are used because the chance of obtaining a good sod is improved. Mixtures should be reasonably simple. A species should be used in a mixture only if it makes a contribution for establishment, or for maintaining a desirable perennial sod along roadsides.

VARIABLE MICROCLIMATE

One reason for using more than one species in a mixture, is that germination, growth and sod survival among turf grasses and legumes differ with sods and the microclimate in the seedling community. For example, bluegrass and redtop respond quite differently with season of sowing. The excellent emergence and growth of redtop in mid-August as compared with bluegrass is attributable to rather high temperatures and comparatively low moisture. On the other hand, a bluegrass-redtop mixture seeded in mid-September produced a bluegrass-dominant sod. This occurred because of the better germination and seedling growth of bluegrass under the low temperature and more favorable moisture in September. These data have direct application to highway seedings, as temperature and moisture status cannot be predicted because of variations in seeding dates, slope exposure, soil conditions and climate. More significantly, just after seeding when germination and growth processes begin, the seedlings encounter an interplay of all the unpredictable environmental factors simultaneously. Some turf plants respond in germination and growth to variable environmental conditions more favorably than others; hence, it is desirable to include the best-adapted variety of a number of species. It should be stressed that there is little excuse for including more than two to four turf species in a mixture.

It is not wise to make rigid seedings' specifications for seeding contractors, because the time of the year when seedings are made cannot be foretold. Certain species such as Bermuda grass and Sericea lespedeza fail except for winter and spring seedings. Mixtures should be altered for season of seeding, since microclimate, soil, and biotic factors vary with season.

In many areas, it would be desirable to change seeding mixtures for a given seeding contract depending on the specific date of seeding and microclimate differences resulting from steepness and direction of slope exposure.

EMERGENCE AND SEEDLING GROWTH

A second reason for using several turf species in a mixed seeding is that some very desirable perennial species are slow to establish even under very favorable conditions (Table 1). Ky. 31 fescue seedlings, 51 days after seeding, were 5 times the size of bluegrass. Italian ryegrass seedlings were 25 times larger than bluegrass. The rate of emergence and seedling growth among species may be classified in categories from very agressive to non-agressive. Cereal crops that are often used as companion grasses and which also occur naturally in straw, grow much faster than ryegrass. Crown vetch and Sericea lespedeza, very desirable legumes where adapted, have exceedingly poor seedling vigor. When using species that are slow to make a sod, it is necessary to use companion grasses in the mixtures in order to control erosion while slow growers get established. Companion grasses also have a moderating effect on soil temperature;

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TABLE 1

GROWTH RATE OF SEEDLINGS AS SHOWN BY PLANT WEIGHTS 51 DAYS AFTER SEEDING UNDER A FAVORABLE ENVIRONMENT

Seedlings	Weight (grams)	Relative Weight
Grasses:		
Italian ryegrass	2.70	500
Perennial ryegrass	1.51	364
Ky. 31 fescue	0.54	100
Redtop	0.15	28
Bluegrass	0.11	20
Red fescue	0.25	46
Legumes:		
Red clover	1.17	214
Ladino clover	0.42	78
White clover	0.32	59

TABLE 2

RATE OF OBTAINING SOD COVER FROM SPECIES AND MIXTURES SEEDED ON US 11 NEAR DUBLIN IN SEPTEMBER 1958[1]

No.	Mixture (lb/acre)	Sod Cover March 1955	Sod Conditions 1960
1.	Ky. bluegrass-60	44	Excellent
2.	Redtop-60	54	Sparse, poor
3.	Creeping red fescue-60	61	Sparse, fair
4.	Ky. 31 fesue-60	66	Excellent
5.	Perennial ryegrass-60	80	Very poor
6.	Ky. bluegrass-45, white clover-5, redtop-10	35	Excellent
7.	Creeping red fescue-25, Ky. bluegrass-30, white clover-5	51	Excellent
8.	Perennial ryegrass-10, Ky. bluegrass-45, white clover-5	56	Excellent
9.	Ky. 31 fescue-25, Ky. bluegrass-35	64	Excellent
10.	Ky. 31 fescue-55, Ladino clover-2, white clover-3	65	Excellent
11.	Ky. 31 fescue-20, Ky. bluegrass-35, white clover-4, and Ladino clover-1	66	Excellent
Average		60.2	

[1]The experiment was established on a 4:1 northerly exposed, cool slope on limestone soil, fertilized with a 10-10-10 fertilizer at 800 lb per acre in 1954, and refertilized in 1958 at the rate of 400 lb per acre.

the insulating qualities of the sod formed by quick-growing grasses reduce the loss of radiant energy during the night and limit soil temperature increases during the day. The moderating effect of temperature in the seedling environment may also improve soil moisture because of a decrease in transpo-evaporation.

Data from an experiment along US 11 show that the most rapid initial sod cover was generally obtained from turf species or mixtures with the best seedling vigor (compare

TABLE 3

GROWTH RATE OF SEEDLINGS AS SHOWN BY PLANT WEIGHTS 51 DAYS AFTER SEEDING[1]

Mixture	Weight (grams)	Relative Weight
Italian ryegrass	2.70	100
Ky. bluegrass	0.11	4
White clover	0.32	12
Redtop	0.15	6

[1]Ryegrass strongly dominant in sod, depending on seeding rate.

Tables 1 and 2). The percent of soil covered with sod in March after a September seeding of five species was: 80% for perennial ryegrass; 66% for Ky. 31 fescue; 61% for creeping red fescue; 54% for redtop; and 44% for bluegrass. Adding a turf species with aggressive seedling growth to one with slow seedling growth resulting in faster sod establishment. However, the permanent sod cover, six years after seeding, was unsatisfactory for redtop, red fescue and perennial ryegrass. These grasses are not hardy perennials because they are not adapted to the moisture, temperature, and disease complex in most Virginia environments. Any seeding with Ky. 31 fescue or bluegrass produced a desirable perennial sod cover.

SEEDLING COMPETITION IN MIXTURES

Mixtures should be simple and turf species with aggressive seedlings should be used sparingly or omitted. As seeds germinate, a dynamic environment is created where species with aggressive seedlings crowd out the non-aggressive seedlings because of competition for light, moisture, and nutrients. Turf plants with aggressive seedlings become dominant in a sod (Table 3). With slow-growing plants such as bluegrass, light seeding rates of aggressive grasses are usually desirable to aid in erosion control. Heavy seeding rates usually inhibit the establishment of the perennial sod-forming species, and are therefore harmful. Annual cereal grains in unthreshed straw often exterminate desirable sod-forming plants. When the small-grain plants die, the soil begins to erode or slough due to moisture accumulation and attendant supersaturation.

Mixtures with Ky. 31 fescue should not include aggressive companion grasses, except for out-of-season seedings. Ky. 31 fescue is easy to establish because of its wide adaptation and good seedling vigor.

ESTABLISHING LEGUMES WITH POOR SEEDLING VIGOR

Low soil nitrogen is a major problem in maintaining grass sods. Ureaformaldehyde is the only source of nitrogen that has a rather long-lasting effect because of its slow release through soil microbes. Hardy perennial legumes do not depend on fertilizer or organic nitrogen, because they fix atmospheric nitrogen. In Virginia, Sericea lespedeza is widely adapted and it appears that crown vetch grows satisfactorily in the mountainous regions, and on the cooler slope sites. Both of these legumes have poor seedling vigor; hence, seeding mixtures and fertility practices must be carefully manipulated to get good stands.

Sericea lespedeza establishment was studied in an experiment on a steep, sunny slop on Interstate 81. High nitrogen fertilization and liberal grass seedings caused a tenfold reduction in Sericea plant stands and a fivefold reduction in the size of Sericea (Table 4). Thus, the establishment of Sericea, and the resultant sod cover was excellent with limited nitrogen and a low grass-seeding rate, intermediate for high grass-seeding rates with low nitrogen, and a near failure with liberal nitrogen and liberal grass seedings. Ky. 31 fescue and redtop seedlings grew 7 to 9 times faster than Sericea with low nitrogen, and 14 to 16 times faster than Sericea with high nitrogen fertilization.

TABLE 4

SERICEA LESPEDEZA[1], INTERSTATE 81 NEAR PULASKI, SEEDED IN MARCH, 1956, DATA FOR 1961

Companion Grasses	Nitrogen (lb/acre)	Plants/Sq Ft June	Wt. of 100 Plants June	Sod Cover Sept.
Ky. 31 fescue 15 lb	20	63	145	43
	120	24	85	13
Ky. 31 fescue 60 lb	20	60	121	35
and redtop 10 lb	120	6	28	4

[1] Sericea was seeded at 75 lb per acre, 2:1 slope.

TABLE 5

SEEDLING PLANTS AND SUBSEQUENT COVER OF CROWN VETCH WITH TWO MIXTURES WITH AND WITHOUT LIME—INTERSTATE 81, PULASKI

Mixture (lb/acre)[1]	Seedling Plants (per sq ft) May 13, 1962		Ground Cover (%) Nov. 13, 1962	
	No Lime	Lime	No Lime	Lime
Ky. 31 fescue 10, redtop ½	10	19	1.3	13.3
Ky. 31 fescue 60, redtop 1	9	12	1.2	10.2
Average	9.5	15.5	1.2	11.7

[1] 75 lb of Sericea was included with both mixtures; 4-20-10 fertilizer was applied at the rate of 1,000 lb per acre; experiment located on a 2:1 slope.

After Sericea seedlings are established, the plants become aggressive with respect to companion plants because the tall, erect growth reduces the light intensity at the lower levels where grasses grow.

Crown vetch establishment is often inhibited because of competition during seedling development. High nitrogen fertilization and liberal grass seedings exterminate many of the slow-growing crown vetch seedlings, thus, low seeding rates of companion grass and low application rates of nitrogen fertilizer encourage better populations of crown vetch.

Liming and the seeding rate of companion grasses influence crown vetch establishment (Table 5). There were 9.5 plants per sq ft on unlimed soil as compared with 15.5 plants where lime was applied at 2 tons per acre. Crown vetch ground cover the year after seeding was about 10 times better on limed soil than on unlimed soil. Heavy seeding of a grass mixture reduced the crown vetch ground cover, but the difference was minor because the nitrogen fertilizer rates were low. The tall, erect growth of Sericea in the second year reduced the growth of crown vetch. Sericea made excellent growth on this sunny slope.

SOIL FERTILITY AND PLANT ADAPTATION

It has been pointed out (1) that turf species used for roadside seedings differ in response to soil fertility and lime. Turf species can be selected for high or low fertility sites; but this is shortsighted since species such as redtop, that tolerate comparatively low fertility and high soil acidity, are not hardy perennials. Thus, it is wise to test soils and provide adequate fertility before making seedings. Sufficient lime and fertility

TABLE 6

INFLUENCE OF LIME AND PHOSPHORUS IN ESTABLISHMENT, COMPOSITION, AND MAINTENANCE OF SOD COVER (US 360, AMELIA—1:1 SLOPES)

Date of Fertilizer Application, (lb/acre)[1]		Percent Sod Cover in Oct., 1962					
		All Vegetation		Ky. 31 Fescue		Weeds	
1,000 March 1959	500 Sept. 1959	Lime	No Lime	Lime	No Lime	Lime	No Lime
A 10-5-10	10-0-10	63	38	40	3	3	15
B 10-5-10	10-5-10	70	48	49	6	5	10
C 10-10-10	10-0-10	75	48	48	3	3	7
D 10-10-10	10-10-10	68	65	45	15	3	12
E 10-20-10	10-0-10	80	58	58	8	2	11
F 10-20-10	10-20-10	80	50	53	13	2	12
G 10-40-10	10-0-10	75	55	53	24	1	9
H 10-40-10	10-40-10	83	60	55	28	2	9
Average		74.2	52.7	50.1	12.5	2.6	10.6

[1]Experiment was established in March 1959. Fertilizer application in September 1959 was for maintenance.

TABLE 7

Ca, Mg, P, pH AND ORGANIC MATTER CONTENT OF SOIL FOLLOWING APPLICATIONS OF LIME AND FERTILIZER (US 360, AMELIA, 1:1 SLOPES)

Date of Fertilizer Application (lb/acre)[1]		Soil Sampled, October 1962							
		Soil Acidity (pH)		Calcium, CaO (lb/acre)		Mg, MgO (lb/acre)		Phosphorus, P_2O_5 (lb/acre)	Organic Matter (%)
1,000 March 1959	500 Sept. 1959	Lime	No Lime	Lime	No Lime	Lime	No Lime		
A 10-5-10	10-0-10	6.0	4.3	1,650	55	365	56	21	1.2
B 10-5-10	10-5-10	6.3	4.3	2,438	20	365	28	25	1.2
C 10-10-10	10-0-10	6.0	4.3	2,563	20	347	62	51	1.2
D 10-10-10	10-10-10	6.1	4.6	4,500[2]	120	374	58	60	1.1
E 10-20-10	10-0-10	6.5	4.2	4,500	45	369	48	130	1.3
F 10-20-10	10-20-10	6.3	4.4	4,500	60	379	46	174	1.2
G 10-40-10	10-0-10	6.7	4.2	4,500	223	389	68	304	1.3
H 10-40-10	10-40-10	6.5	4.3	4,500	378	352	46	381	1.2
Average		6.3	4.3	3,643	115.1	367.5	51.5	143.2	1.2

[1]Experiment was established in March 1959. Fertilizer application in September 1959 was for maintenance.
[2]Exceeds 4,500 lb per acre.

generally stimulate rapid sod establishment and also improve the soil in later years, thus reducing maintenance problems (Tables 6 and 7). Liming improved the growth of all turf species and the total sod cover with all rates of phosphorus fertilization, however, the largest response occurred for Ky. 31 fescue which produced a 50.1% sod cover with lime as compared to 12.5% when lime was omitted. There were about one-fourth as many weeds on the limed soil as on the unlimed soil; the growth of desirable grasses crowded out most of the weeds. Sod cover was generally increased as the rate of phosphorus was raised to a 10-20-10 ratio.

A fertilizer-lime program should consider the residual build up of soil nutrients resulting from applications made for establishment, thereby reducing fertilizer costs for sod maintenance. The use of lime and phosphorus for sod establishment increased the soil calcium from 30 to several hundredfold three years after making the applications (Table 7). Dolomitic agricultural lime also caused an average sevenfold increase in soil magnesium. Residual phosphorus in the soil increased as the rate of phosphorus application increased. These residual fertilizer nutrients in the soil leach slowly or not at all, thus, they improve sod cover and lessen future maintenance problems.

Other soil analyses show that grass growth is limited by nitrogen as shown by the low content of organic matter. High levels of calcium, phosphorus and magnesium during the period of establishment represent a maintenance boon as only nitrogen will need to be applied for continued thrift of the sod cover. Ureaformaldehyde nitrogen used for establishment may have an effective nitrogen carry-over for more than one year.

MAINTENANCE PRACTICES

Specifications of seeding mixtures should consider maintenance management. For example, Sericea lespedeza and crown vetch should not be used on sites that will be mowed more than twice annually. Frequent mowing has converted such legume dominant sods to grassy sods.

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REFERENCE

1. Blaser, R. E., et al., "Turf Establishment and Maintenance Along Highway Cuts." HRB Roadside Development 1961, 5-19 (1961).