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OF NEW JERSEY

BETTER GRASSES FOR ROADSIDES

FINAL REPORT
HPR – 7726

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and

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16. Abstract
Grasses for roadsides generally evolved from agricultural and soil conservation practices. The growing importance of maintenance costs and environmental aesthetics dictate the need to develop better grasses. Over a thousand varieties or strains, including 36 different species of grass, plus mixtures, were established in plots along eight roadsides throughout New Jersey and three Experiment Station sites over five years. Coarse grasses, including Kentucky 31 tall fescue and redtop consistently produced conspicuous persistent seedheads which detract from the appearance of the grassy landscape. Finer turfgrasses, including certain varieties of Kentucky bluegrasses and four fine fescues established readily and produced fewer, and less objectionable seedstalks. Perennial ryegrass varieties produced an abundance of foliage and seedstalks initially, crowded associated grasses excessively, and disappeared after two years of low intensity management. Outstanding performance of spreading fine fescues at several locations prompted the development of a new variety, 'Fortress', synthesized from locally collected elite plants. Commercial production of it, and a superior Chewings variety, 'Banner' are anticipated. Such grasses should improve the quality of roadside mixtures, particularly when used with "common-type" varieties of Kentucky bluegrasses such as 'Kenblue'. The importance of seed-free mulch is shown. Better appearance with less mowing can be achieved with mixtures of certain varieties of fine fescues and Kentucky bluegrasses.

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fine fescues, Kentucky bluegrasses, mowing, mulch, seedling establishment, seedstalks, seed mixtures, grass color, grass development, environmental quality.	Unrestricted, suggested for those interested in roadside development, maintenance, and environment, or low intensity management of turfgrass in general.

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BETTER GRASSES FOR ROADSIDES

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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

INTRODUCTION

The search for superior grasses for roadsides was prompted by an increasing cost of maintaining more miles of roadsides on restricted budgets and an increasing public awareness of environmental quality. Roadside mixtures have evolved out of agricultural experiences where production was an asset utilized in the form of pasture or hay.

Tall fescue (Festuca arundinacea Schreb.) is widely used along roadsides today largely because of the impetus given by the Soil Conservation Service to this widely adapted, robust plant. Redtop (Agrostis alba L.) is frequently included in roadside mixtures as a fast-starting grass adapted to wet acid soils. Ryegrasses, both perennial (Lolium perenne L.), and annual (Lolium multiflorum L.), are commonly included, particularly for their early emergence and great seedling vigor. These grasses excel in quick initial coverage thereby diminishing opportunities for loss of soil by erosion. With superior mulching techniques which are now widely employed one may question the need for such vigor, particularly when subsequent mowing needs and appearance are considered. Intact, functioning mulches of either hay or straw are easily found along roadsides mulched six months previously.

Kentucky bluegrass (Poa pratensis L.) is generally accepted as having better appearance than the aforementioned species. This grass is commonly included in roadside mixtures as a small percentage hoping that it will be manifest on the more productive soils. The fine fescues, particularly the creeping (Festuca rubra L. subsp. rubra), and the Chewings (Festuca rubra L. subsp. commutata Gaud.) are also included in roadside mixtures with the aspiration that they might contribute where infertile, dry, and acid soils occur. Martin and Kaufmann (1970) reported that from mixtures of perennial ryegrass, Kentucky bluegrass, and red fescue, the dominant grass after four years was Kentucky bluegrass on a loamy-clay site, and red fescue on a sandy site. The Kentucky bluegrasses and fine fescues are less vigorous components of most roadside mixtures, and in competition with taller species may be unable to survive on most roadsides. The ryegrasses and redtop commonly disappear in the second year after seeding, and tall fescue frequently becomes the dominant component of the stand.

Apparently it mattered little in the past that tall fescue was more productive and required more frequent mowing to maintain appearance, for mowing machines were becoming more efficient. As road systems expanded, and rights of way widened (a present average of 25-30 acres of grass per mile of interstate highway), the cost of mowing grass became a large factor in road maintenance.

When roadsides were left unmowed because of budgetary restrictions, the unsightliness of productive grasses and their seedstalks could be recognized as a major negative feature of the landscape.

According to a survey made by Hottenstein (1969), species were generally specified in mixtures of grasses for roadsides, but cultivars were seldom specified. Kentucky 31 tall fescue was the cultivar most frequently mentioned in the mixtures. When no cultivar is designated the natural inclination is to use common types, for these are usually cheaper than named cultivars. With the increase in numbers of named cultivars of turfgrasses available, the likelihood of "common" seed being some named cultivar that has failed to meet certification requirements is increasing. Thus differences between lots of seed of "common" of any one species may become increasingly variable.

Establishment of the more productive or hay-type species occurs through viable grass seed in the hay mulch applied over the grass seeding. These frequently include orchardgrass (Dactylis glomerata L.), timothy (Phleum pratense L.), bromegrass (Bromus inermis Leyss.) and reed canarygrass (Phalaris arundinacea L.). Unlike legumes and broad-leaf weeds that can be controlled with selective herbicides, these grasses cannot be removed with such agents. The hay-type species volunteering from seed in hay mulches may dominate certain areas, often as distinctive patches.

The less productive, finer type turfgrasses should be more attractive, require less mowing for roadside maintenance, and look better if unmowed. Boeker (1969) pointed out the advantages of low-growing grasses along roadsides in Germany. He also indicated the inappropriateness of complex mixtures including coarse grasses and herbs. Mixtures of 3 or 4 species, Agrostis tenius, Festuca ovina, Festuca rubra, and Poa pratensis, should suffice. Langvad (1969) indicated that the aesthetic function of grass must be considered in addition to the erosion control aspect and the vehicular safety feature. Hence seed of tall, coarse grasses used in Sweden until 1963 were replaced in subsequent mixtures with lower growing grasses. White and Smithberg (1972) in Minnesota concur that K-31 tall fescue, perennial ryegrass, and mixtures of these and redtop could not be recommended for general use along roadsides. Several red fescues and mixtures with certain low-requirement Kentucky bluegrass varieties were acceptable.

OBJECTIVES

The practical objective in evaluating grass varieties for roadsides should be to develop mixtures that will provide the

best appearance for the most months of the year with the least mowing maintenance, and still provide sufficient certainty of establishment over variable situations. In addition, these grasses should be serviceable with regard to erosion control, weed exclusion, and support for vehicles leaving the pavement. They should be tolerant of roadside environments, and not constitute a hazard by way of obstructing vision, causing snow to be deposited on roads or burning readily.

METHODS

Grasses currently specified for roadsides in New Jersey were compared with commercially available grass varieties, plant introductions, experimental seed of various sources, and more recently, seed of our own development. Over a thousand grass varieties or strains of 36 species were sown in 4-square-yard ($3.3m^2$) plots, replicated four times, which including mixtures totaled 6,472 plots along eight newly constructed roadsides throughout New Jersey, and at three Experiment Station sites over five years. Establishment conditions were according to New Jersey Department of Transportation specifications except that rate of seeding was at 40 lbs/acre (44 K/ha) rather than the standard 100 lbs/acre (112 K/ha), and no legumes were added. Legumes, under certain conditions, can dominate grasses, thereby making comparisons of grasses uncertain. Plots along roadsides were mulched with seed-free hay. Other plots were unmulched. Management was minimal in the first years, but in later tests single nitrogenous topdressings were applied to hasten the transition from the seedling stage to a mature sod for critical evaluation. Data were analyzed statistically, and least significant difference (LSD) values were computed when justified.

Soils of roadside locations where grass studies were conducted were sampled to determine soil acidity, nutrient availability and texture. Nutrient availability at the sites are given in Table 1 before and after the application of lime and fertilizer at most locations. Roadside sites were relatively level and uniform areas that had received four inches (10 cm) of topsoil as is specified by the NJDOT. Soil tests indicate that the topsoils compared favorably with those of agricultural areas, Adelphia, Cranbury and Belle Meade, etc., except with respect to low potassium in several roadside locations (See Table 1). One difficulty in soil sampling at various roadsides is the overly hard compact nature of the sub-soil which may be impenetrable with a soil sampling tube. Such compaction inhibits percolation of water (thereby increasing runoff) and root development and thus may lead to failure of grasses during stress periods.

Table 1. Soil test data from soils involving roadside grass studies.

LOCATION	DATE	pH	Pounds/acre available Mg	P	K	TREATMENT	TEXTURE
Allentown, Rt. 195	9/28/70	5.9	300+	178	186	None	Sandy loam
Stanhope, Rt.80	9/22/70	6.9	300+	40	78		Sandy loam
Fairlawn, Rt. 208	10/6/70	5.6	140	34	111		Loam
Allentown, Rt. 195	10/28/74	6.2	300+	276	215	fertilized & limed	Sandy loam
Stanhope, Rt. 80	7/9/74	6.7	159	290	34	" "	Sandy loam
Fairlawn, Rt. 208	7/9/74	6.5	90	174	48	" "	Loam
Millville, Rt. 55	8/23/71	7.4	284	34	30	" "	Sand (96%)
Holmson, Rt. 195	9/16/71	4.9	180	130	210	None	Sandy loam
" "	10/28/74	6.3	300+	116	194	fertilizer + lime	Sandy loam
" "	10/28/74	5.1	300+	31	189		Sandy loam
" " Redtop topsoil	10/28/74	4.9	268	32	157		Sandy loam
Holmson,Rt. 195 Redtop sub-soil	10/28/74	4.7	151	21	100		Sandy loam
Route 18 ext.	10/23/73	5.1	152	40	153	None	Loamy sand
" "	6/6/74	6.0	535	70	117	fertilized & limed	
Agricultural Soils							
Adelphia, Gr. Reg.	11/11/73	5.4	140	68	135	fertilized & limed	Sandy loam
" 21S	11/11/73	5.5	202	176	228	" "	Sandy loam
" HM Rd.	11/11/73	5.3	270	66	129	" "	Sandy loam
" Fortress	11/11/73	5.4	160	42	114	" "	Sandy loam
" pH test	1/18/74	5.3	152	58	246	" "	Sandy loam
Cranbury pH pots	1/18/74	5.4	118	300	375	" "	Loam
Belle Meade pH pots	1/18/74	5.3	232	34	228	" "	Sandy loam
Centerton, Fescues	10/17/72	5.6	48	116	54		

Comparisons of mowed vs. unmowed grasses were initiated at Adelphia in 1970. The objective was to determine the effect of a single early fall mowing on spring appearance and subsequent development in terms of recovery from dormancy, degree of stemminess and smothering. Three replications were mowed in early fall 1971, and raked clean. The remaining three replications were left unmowed.

Additional testing was conducted under intensive turf management at Adelphia and New Brunswick. These tests received twice weekly mowing and fall and spring applications of fertilizer. The purpose was to evaluate commercial fine fescue cultivars and progenies of selected fine fescues.

Plants with good seed production, disease resistance, and other desirable agronomic attributes were recurrently selected for five generations. Clonal evaluations were made of these selections and open pollinated seed progeny were evaluated in both minimum maintenance and in mowed plots. Over 19,000 such plants were screened in the greenhouse and field with an additional 6,000 plants involved in the production of breeder's seed of the newly developed cultivars 'Fortress' (spreading fescue) and "Banner' (Chewings fescue).

A parallel effort was made to clarify the breeding interrelationships of fine fescues. Fine fescue clones and commercial cultivars were characterized morphologically from spaced plants in the nursery in 1970 and 1971. Characteristics observed (Schmit 1973) included leaf morphology, rhizome development and chromosome number. Date of anthesis, peak pollen production and time of day when pollen was shed were also determined.

RESULTS AND DISCUSSION

Preliminary evaluation of grasses and mixtures for roadsides.

Several commercially available grasses were sown alone, in simple and complex mixtures at Adelphia in 1968 (See Tables 2 and 3). These included species such as tall fescue, perennial ryegrass, redtop and Canada bluegrass. These grasses alone and in mixtures proved inferior in turf quality, because of stemminess, or conspicuous seedstalks, coarse and/or poor colored foliage, and low stand density when compared to plots of Kentucky bluegrass and fine fescue sown separately or combined. LSD (least significant difference) values at the 1 and 5% probability levels serve as guides for real differences between means of entries. Mixtures containing K-31 tall fescue appeared to be dominated by this grass which, on a productive site, frequently increased in percent composition and rated similar to pure stands of it. Redtop and Canada

TABLE 2. Quality ratings of grasses and mixtures by observer A and B at an early dormant stage and at a later active growth stage - 1970.

	Quality Rating A April 8	Quality Rating B April 8	Quality Rating A June 3	Quality Rating B June 3
1. K31 + Pennlawn	5.1	6.1	3.9	5.6
2. K31 + Pennlawn + Linn	4.8	5.8	4.1	5.4
3. K31 + Pennlawn + Linn + Newport	6.1	6.7	4.0	5.7
4. K31 + Pennlawn + Linn + Newp. + Redtop	5.7	6.3	4.3	6.3
5. K31 + Pennl. + Linn + Newp. + Rt + Can.Bl.	5.8	6.6	4.3	5.7
6. Pennlawn + Newport	7.9	7.7	5.3	6.6
7. Pennlawn + Kenblue	8.2	7.8	6.1	7.0
8. Pennlawn + Manhattan	4.6	6.3	5.6	6.2
9. Pennlawn + Linn	4.2	5.9	5.1	6.2
10. Kenblue + Manhattan	6.9	7.4	6.5	6.7
11. Kenblue + Manhattan + Pennlawn	7.2	7.4	6.8	7.1
12. K31 tall fescue	5.0	5.9	4.0	5.8
13. Pennlawn	6.7	7.2	5.3	6.3
14. Linn	3.6	5.2	3.3	5.1
15. Newport	8.3	7.9	5.3	6.8
16. Kenblue	8.7	8.1	7.0	6.6
17. Redtop	5.4	6.2	5.5	6.7
18. Canada blue	5.7	6.3	4.4	6.5
19. Manhattan	3.4	5.1	4.4	5.9
20. Kenblue + Manhattan + white clover	6.9	7.4	6.8	7.4
* LSD @ 5% =	0.7	0.6	0.6	0.9
LSD @ 1% =	0.9	0.8	0.8	1.1

Quality ratings 9 = best 1 = poorest

*Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

Table 3. Estimate of species composition of mixtures as related to nitrogen fertilizer treatments. Plots were two years old.

MIXTURES	NITROGEN RATE/LBS./A 0	25	50
1. K-31 tall fescue (50)	53%	55%	63%
Pennlawn red fescue (50)	48	45	38
2. K-31 tall fescue (33)	46	55	60
Pennlawn red fescue (33)	40	38	33
Linn ryegrass (33)	14	8	5
3. K-31 (25)	45	48	48
Pennlawn (25)	38	21	23
Linn (25)	8	4	8
Newport (25)	10	28	23
4. K-31 (20)	39	54	53
Pennlawn (20)	18	18	5
Linn (20)	8	5	8
Newport (20)	3	8	25
Redtop (20)	33	16	0
5. K-31 (17)	34	55	53
Pennlawn (17)	19	4	2
Linn (17)	8	6	8
Newport (17)	4	20	38
Redtop (17)	36	15	0
Canada Bluegrass (17)	0	0	0
6. Pennlawn (50)	58	63	50
Newport (50)	18	38	50
7. Pennlawn (50)	90	85	84
Kenblue (50)	10	8	14
8. Pennlawn (50)	90	85	84
Manhattan (50)	10	8	14
9. Pennlawn (50)	90	68	60
Linn (50)	10	15	40
10. Kenblue (33)	90	100	95
Manhattan (33)	3	0	0
Pennlawn (33)	8	0	5

Table 3. (continued)

MIXTURES	NITROGEN RATE/LBS./A 0	25	50
11. Newport (33)	10%	60%	83%
Manhattan (33)	6	1	0
Pennlawn (33)	82	40	15
12. Kenblue (33)	91	99	99
Manhattan (33)	9	1	1
White Clover (33)	0	0	0

1. Values represent the mean of four replications.

2. ( ) parenthesis represent percent composition of original mixture.

bluegrasses persisted as pure plots, but eventually disappeared from mixtures with tall fescue. They appeared acceptable only temporarily in the spring, prior to seedstalk formation.

Perennial ryegrass varieties such as Linn and Manhattan proved short lived in plots and mixtures. Generally this species proved to be overly competitive initially, was reduced markedly in the second season (see Table 3), and was found only as traces in the third season. Even the well adapted variety Manhattan disappeared after two or three years when unmowed at low fertility. Without mowing, the ryegrasses were extensively damaged by anthracnose (Collelotricum graminicolum Ces. (Wils.) which accumulates to lethal levels on the foliage.

Inclusion of redtop in mixtures reduced the K-31 component somewhat at zero nitrogen (see Table 3, mixtures 4 and 5). With successive applications of nitrogen, the Kentucky bluegrass component was increased at the expense of the redtop. Canada bluegrass was crowded out of the mixture by the second season. Pennlawn fescue dominated Kenblue at all N levels and over Newport at low nitrogen. Kenblue proved attractive alone and in combination with Pennlawn. When Manhattan ryegrass was included in the mixture Kenblue or Newport dominated Pennlawn in the second season. Newport proved less competitive in such mixtures at low fertility.

From this study it was concluded that Kenblue (a common-type Kentucky bluegrass) and fescues such as Pennlawn provided the most stable cover with the best appearance when sown alone and/or in simple mixtures.

Roadside Tests

These early observations were confirmed when test plots of species, varieties, and combinations that are presently used or might be considered for roadside mixtures were established under conditions simulating roadsides. These were rated for quality at various seasons. Quality incorporated completeness of soil cover and uniformity in: color, texture, and in topography (microrelief). The data in Table 2 are typical of many observations indicating that additions to the vigorous, dominating, widely used K-31 tall fescue made relatively slight changes in quality ratings; such plots still looked like tall fescue.

Along many New Jersey roadsides good stands of tall fescue are found where growing conditions are favorable; particularly at the toe of a bank or at original grade at the top of a cut. On the face of steep banks tall fescue is frequently sparse or missing. Here fine fescues typically provided most of the cover. Such a

slope may reveal spots of bare soil due to loss of other species from the mixture, and the failure of remaining plants in spread.

A trial of six commercial varieties of tall fescue under low intensity management failed to show real differences between varieties of this species. This gave impetus to concentrating research attention on fine grasses like those that persist along old roadsides.

Subsequently, a series of 36 grasses, including simple mixtures, were sown at four roadside locations. Entries were primarily commercial materials but included experimental low growing turf-type Kentucky bluegrasses (Poa pratensis L.). These were included courtesy of Dr. C. R. Funk of Rutgers University. Sites ranged from a productive soil at the Allentown interchange to a particularly infertile droughty roadside near Millville in southern New Jersey as shown by soil test results (Table 1). At the Millville site, none of the entries indicated in Table 4 fared well. At the productive site at Allentown even the low growing Kentucky bluegrasses established and covered the soil adequately. On less productive sites, such as Stanhope, emergence and initial establishment of turf-type Kentucky bluegrasses was barely adequate, and complete soil coverage never materialized even with further fertilization. The common type Kentucky bluegrasses such as Kenblue, Arboretum and a Minnesota strain established quicker, and coverage was more complete than with turf-types, as indicated in Table 4. While the perennial ryegrasses began with great vigor, plants at all locations died by the second year under no-mow management. The fine fescues, either alone, or in mixtures provided better coverage at all sites for the duration of the trials. The two tall fescues established well enough, but thinned to individual clumps and were rated rather low in quality eventually. The tall fescues failed completely on the poorest site. The one hard fescue (F. longifolia Thuill.), C-26 was slow to establish, but eventually provided the highest quality cover in most ratings.

With time, most entries were rated lower in quality. This was more serious for the turf-types than the common types of Kentucky bluegrasses. Deterioration with time occurred among the commercially available fescues also, but the hard fescue, C-26 retained quality better than any other entry in the test. The final stand of the mixtures was generally dominated by the fescue component.

The Stanhope site consists of a sandy subsoil with 2 to 6 inches (5 to 15 cm) of loamy topsoil added. Initial establishment was good, but deterioration of stand with time was noticeable. Approximately two years after seeding, half of each plot

Table 4. Quality ratings of 36 grass entries at four roadside locations.

Location	Allentown	Fairlawn	Fairlawn	Millville	Millville	Stanhope	Stanhope	Stanhope	Stanhope	Stanhope
Sown	9/17/70	9/30/70	9/30/70	9/26/71	9/26/71	9/23/70	9/23/70	9/23/70[1]	9/23/70	9/23/70[1]
Rated	6/8/72	6/16/72	6/18/74	3/26/72	10/18/72	6/28/72	5/29/73	5/29/73	6/18/74	6/18/74
Turf-type Ky. bluegrass										
Merion	7.0[2]	6.2	2.5	2.2	2.2	4.5	2.7	3.7	1.5	2.0
Newport	5.7	5.2	2.5	3.0	1.0	6.2	3.0	4.0	1.7	2.5
Fylking	6.7	7.0	3.0	1.2	1.5	5.7	3.0	4.0	1.0	1.7
Nugget	7.7	5.0	2.7	2.2	1.2	5.5	2.0	2.7	1.0	1.5
P-114	6.5	4.0	1.5	0.5	0.7	4.5	2.0	3.0	1.2	1.7
P-69	5.5	4.7	2.7	1.7	1.5	4.0	1.7	2.5	0.7	0.7
P-107	5.7	5.5	2.0	1.7	1.0	5.5	2.2	3.2	1.0	1.5
P-113	5.7	5.5	1.7	0.2	0.0	4.5	1.7	3.2	1.0	1.7
P-77	6.7	4.5	2.5	0.5	0.0	4.0	2.0	2.7	1.5	2.0
P-72	6.0	3.7	1.7	0.7	0.7	4.2	1.5	2.5	0.5	1.0
P-123	5.5	5.7	1.7	2.2	1.0	4.7	1.7	2.7	1.2	1.5
P-84	6.0	6.5	2.5	1.0	1.5	4.7	2.0	2.7	1.2	1.5
P-57	5.5	5.7	2.7	0.7	0.0	5.0	2.2	4.0	1.0	1.5
P-29	7.0	6.5	3.0	2.2	1.0	4.7	2.5	3.5	1.0	1.2
P-106	6.7	5.0	2.2	0.7	0.0	5.2	2.5	3.0	1.2	1.7
Common-type Ky. bluegrass										
Kenblue	6.5	6.0	3.5	2.2	2.0	7.0	3.7	4.5	3.5	4.2
Arboretum	8.2	6.0	3.2	3.2	1.5	6.0	3.5	5.0	3.0	3.7
Minnesota	8.2	5.2	4.2	3.5	1.2	5.5	3.0	4.5	3.0	3.5
Creeping fescue										
Pennlawn	5.5	5.2	3.2	1.0	1.5	7.7	4.0	4.5	3.0	3.5
Ruby	6.0	6.2	2.7	2.5	1.5	8.0	3.7	4.7	2.2	3.2
Golfrood	7.0	6.0	2.7	0.7	0.2	6.2	2.7	3.0	0.7	1.5

Table 4 (continued)

Location	Allentown	Fairlawn	Fairlawn	Millville	Millville	Stanhope	Stanhope	Stanhope	Stanhope	Stanhope
Sown	9/17/70	9/30/70	9/30/70	9/26/71	9/26/71	9/23/70	9/23/70	9/23/70 1/	9/23/70	9/23/70 1/
Rated	6/8/72	6/16/72	6/18/74	3/26/72	10/18/72	6/28/72	5/29/73	5/29/73	6/18/74	6/18/74
Chewings fescue										
Highlight	6.2	5.2	3.7	3.5	3.5	8.0	3.7	5.7	3.0	4.2
Jamestown	5.7	3.0	3.0	1.0	2.0	4.0	2.5	3.5	2.2	3.0
Wintergreen	7.0	5.0	3.7	2.5	2.5	7.5	3.0	5.0	2.2	3.0
Ft.McHenry	8.0	6.2	4.5	3.5	3.2	8.0	4.0	6.0	3.2	4.7
Hard fescue										
C-26	7.2	8.0	6.5	2.0	3.2	6.7	4.0	6.7	5.5	6.5
Tall fescue										
K-31	4.7	5.0	4.2	0.0	0.2	5.2	2.5	3.5	3.0	3.7
Kenwell	4.2	4.2	3.2	1.5	0.7	4.7	2.2	3.2	2.7	3.2
Perennial ryegrass										
Linn	0.5	0.7	2.5	1.0	0.7	2.0	0.0	0.0	1.0	1.0
Manhattan	1.5	4.0	2.2	3.5	1.0	3.0	0.0	0.0	0.7	1.0
Pennfine	3.0	3.0	1.7	3.5	1.2	3.0	0.0	0.0	1.5	2.0
Mixtures										
Kenb+Ruby	6.5	5.2	3.5	2.5	2.2	8.0	3.7	5.2	3.2	3.5
Fylk+Ruby	5.5	7.0	3.5	2.2	2.0	7.0	3.2	4.5	2.0	3.0
Kenb+Ruby+Man.	5.7	6.2	4.5	3.5	0.7	5.7	3.2	4.5	2.5	3.2
Fylk+Ru+Man.	6.0	5.2	3.5	3.5	2.0	5.7	3.0	3.7	2.5	3.0
New+High+Linn	6.2	6.0	3.5	2.5	3.2	6.5	3.5	4.7	3.5	3.7
*LSD @ 5%	2.1	1.9	1.3	1.5	1.2	1.3	1.1	1.0	1.1	1.3
" 1%	2.9	2.6	1.7	2.0	1.6	1.8	1.5	1.4	1.5	1.8

1/ This half of plots fertilized 10/17/72

2/ Rated on 0-9 scale. 9 = best turf.

*Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

was fertilized with 500 lbs/A (550 kg/ha) of 10-6-4. The improvement persisted into the following spring and was still detectable on most grasses at last observation, 21 months after application.

In a supplemental variety trial on the sandy soil at Millville several fine fescues improved with time. Data indicated that 'Banner' Chewings fescue, (F. rubra subsp. commutata Gaud.), 'Fortress' spreading fescue, and K-114 sheep's fescue (F. ovina L.) were among the better entries initially and continued to improve their ground cover with fine foliage relatively free of unsightly seedstalks.

Frequently poor grass performance along roadsides may be attributed, in part, to soil conditions that might be amended. At Millville, on soil that was 96% sand, the problem was primarily one of establishing a stand on soil with a low moisture-holding capacity. Better establishment of grasses was obtained at this location in supplemental plots amended with 2 inches (5 cm) of silty clay tilled into the surface soil. Intense grazing of the small plots of superior vegetation (in contrast with surrounding pine barrens vegetation) by rabbits further limited grass development.

Mixtures of grasses at the roadside locations confirmed the finding of the mixture management study at Adelphia. The perennial ryegrass components, Linn and Manhattan, proved unsightly upon maturation, competed severely with associated grasses under no mow management, and left a sparse turf when they died out after two years. Kenblue + Ruby tended to rate higher than Fylking + Ruby in long term evaluations, particularly in combination with Manhattan. Newport, Highlight and Linn provided adequate cover but were very stemmy.

Seedling Vigor

Quick emergence and growth of sown species is usually considered desirable, particularly where an erosion potential is of concern. At the outset of these field trials differences among grass species in seedling vigor were readily apparent. Somewhat less striking, but nevertheless quite consistent and significant, were differences between varieties within species. An appreciation for the extent of the differences was not found in turfgrass literature, for mowing minimizes these differences. Data in Table 5 typify results of several trials. Measurements in the spring of seedlings emerged the previous fall, and unmowed, indicated great vigor of coarse species such as meadow fescue, (F. pratensis Huds.), intermediate height of the spreading fescues, and smaller stature of Chewings varieties, and a hard fescue.

Table 5. Seedling height of selected fescues and Kentucky bluegrass varieties. Fall sown, measured prior to heading in spring.

VARIETY	CM
Meadow fescue	34.0
130-16 spreading fescue	17.2
130-17 spreading fescue	18.3
Atlanta Chewings fescue	11.7
Wintergreen Chewings fescue	13.5
C-26 hard fescue	8.0
Kenblue Kentucky bluegrass	12.5
So. Dakota Kentucky bluegrass	10.0
Merion Kentucky bluegrass	5.5
Sydsport Kentucky bluegrass	5.2
*LSD @ 1% = 5.0	

*Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

Differences among varieties of a species appear when comparing the common-type varieties 'Kenblue' and 'South Dakota Certified' and 'Sydsport'. In all field trials, except one on soil that was 96% sand, initial establishment of petite types such as Merion Kentucky bluegrass and C-26 hard fescue was satisfactory in pure stands.

Data in Table 5 also indicate the height advantage of spreading fescues over Chewings fescues. Figure 1 illustrates the vigor of another spreading fescue over a Chewings fescue in the seedling stage. Seedlings of fine fescues selected from progeny tests at Adelphia and New Brunswick show good agreement between seedling weight and height. Thus, height measurements in the plot represent a quick and efficient method of assessing the vigor of fine fescue progeny.

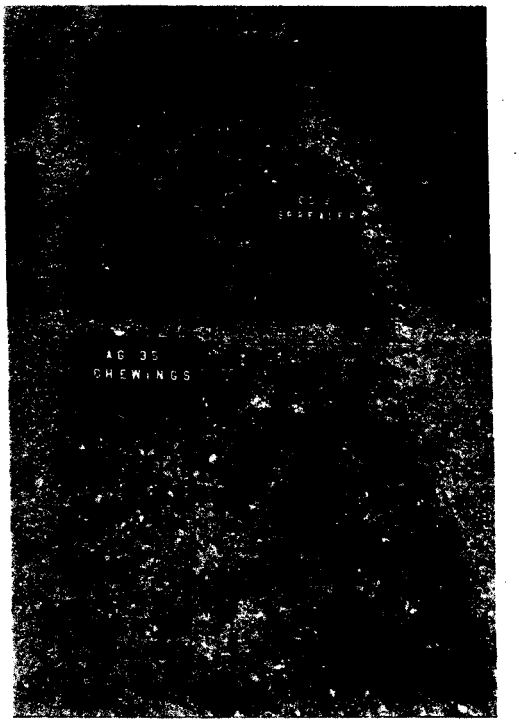

Figure 1. Plots of experimental grasses six weeks after seeding illustrate typical differences in seedling vigor between Chewings and spreading type fine fescues.

Table 6 contains data on seedling vigor at the Route 195 and New Brunswick locations. Vigor ratings of October 8 suggest greater vigor in the spreading and creeping types over the Chewings and other entries at Route 195. Ratings at New Brunswick on the same date (and three days later) involved younger seedlings, and the vigor differences are less clear. Seedling weights and height measurements proved significant differences among entries. The data at both locations indicate greater seedling size for the spreading and creeping types, but probably no difference between these two. The two hard fescues generally appear inferior to most Chewings types in various measures of seedling size. The consistently poorest rating of the fine leaved fescue may be due in part to the fact that this was an old lot of seed. These seedlings developed from New Jersey-grown seed which is typically lighter in weight (stored energy reserves) than commercial seed produced in a more favorable climate. An even greater advantage in seedling vigor is anticipated when western-grown seed of these types becomes available.

Perennial ryegrass varieties in a separate but similar study indicate that Linn, a common type, was 41 cm tall while Manhattan, a turf-type, was 23 cm tall. These spring measurements of fall-sown ryegrass were taken later than those in Table 6, and are therefore not comparable. They do illustrate differences between varieties. Six varieties of perennial ryegrass were observed to persist only two or three years under no-mow, low fertilization management. Their initial competition with less vigorous seedlings resulted in appreciably weaker stands of the truly perennial fine fescues or Kentucky bluegrasses. Excessive vigor in the seedling stage of a mixture component is therefore undesirable. Considering that a good straw mulch is generally observed to be quite intact six months after seeding, the need for fast vegetative cover at the expense of good later coverage is indeed of questionable value.

Growth Habit and Seedstalks

Seedling characteristics foretell subsequent plant development, particularly in unmowed turf. Grasses with vigorous seedlings may attain the critical size in a fall seeding to be vernalized ("cold-induced") to produce seedstalks the following spring. Spreading fescues and common type Kentucky bluegrasses sown in the fall generally produce seedstalks the following spring while Chewings fescues and turf-type Kentucky bluegrasses under the same conditions typically produce none. Other species of roadside grasses that flower the first spring after a fall seeding include the ryegrasses, Canada bluegrass, tall fescue, and sheep's fescue.

Table 6. Seedling vigor of selected entries from the fine fescue progeny test sown at Route 195 on September 16, 1970 and at New Brunswick on September 30, 1971.

		Route 195		New Brunswick		
		Weight (mg)/ seedling	Height (cm)	Weight (mg)/ seedling		
Fescue Type	Identity	Oct. 8	Nov. 17	Oct. 13	Oct. 19	Oct. 29
Spreading	CD-2	4.7	8.5	4.7	8.5	11
"	121-1 F-3	5.2	8.2	4.2	8.0	14
"	Fortress	4.7	9.2	4.7	9.2	11
"	Central Park	4.2	7.5	5.0	6.7	13
"	Central Park (shade)	3.5	5.0	6.3	8.2	6
"	Ruby	3.7	7.7	4.5	7.5	10
"	Pennlawn	4.7	9.0	3.5	6.2	11
Chewings	Banner	3.0	5.5	4.4	3.0	6
"	Highlight	3.0	6.0	3.2	5.7	5
"	Ft. McHenry	3.2	6.5	3.5	3.7	8
"	RU Syn. A	3.2	6.2	3.5	4.2	5
"	Phila. Art	3.0	4.5	3.2	3.5	7
"	Plainfield	2.7	4.7	3.1	3.5	7
"	Ft. Tyron	3.0	4.7	3.0	3.5	6
Hard	C-26	2.0	4.0	4.4	2.5	5
Fine leaved sheep's	F. tenufolia	1.2	3.0	1.7	2.0	2
*LSD .05		0.9	1.5	1.4	1.4	4
LSD .01		1.1	2.0	1.9	1.8	6

*Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

Seedstalks affect appearance, and as such are important quality characteristics. In this regard varieties within species differ. Among the Kentucky bluegrasses (Table 7 and Figure 2) Newport produced a large number of seedstalks annually even when not mowed for five years. These stalks also remained upright and conspicuous most of the year.

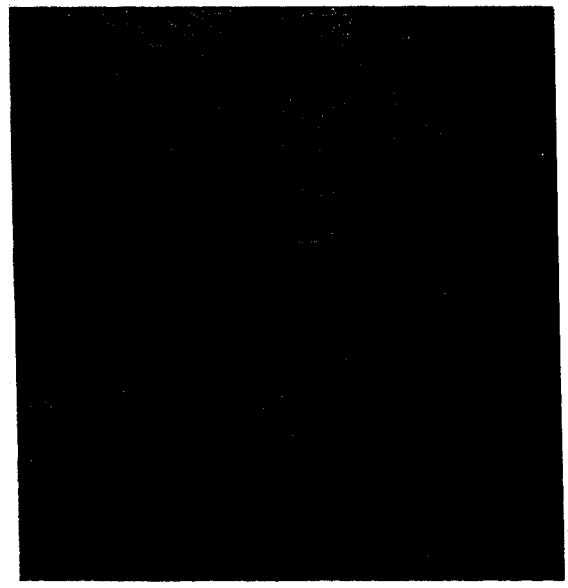

Figure 2. Newport Kentucky bluegrass consistently produces more seedstalks than Kenblue Kentucky bluegrass even when unmowed for several years.

Seed bought as "common" Kentucky bluegrass, or if variety is not specified, is apt to be Newport, or any other high seed yielding variety. A true common type, typified by Kenblue, consistently produced fewer seedstalks which were tall but lodged (laid over, nearly horizontal) readily and were soon covered by its long leaves. Turf-types such as Fylking (Table 7 and Figure 3) produced few seedheads and maintained good foliar cover in productive sites. Along infertile roadsides, turf-type Kentucky bluegrasses provided only sparse cover.

Studies of Kentucky bluegrasses under unmowed conditions have revealed other important differences among varieties (see Table 7). Differences in vertical growth of varieties in the seedling stage tend to be reflected in leaf length of mature plots. Leaf length of mature plots are, however, masked by lodging of the

Table 7. Summary of characteristics of Kentucky bluegrass varieties sown at Adelphia in 1969.

	Average Vertical Growth cm 6/26/69	Quality Rating 8/1/69	Color Rating 8/1/69	Leafspot Rating 8/1/69	Leaf Length cm 8/1/69	Lodged Height cm 8/1/69
Kenblue	16.1	7.9	6.7	7.4	53.4	19.8
Newport	12.1	4.8	6.4	4.2	48.0	23.0
Merion	10.0	4.7	7.3	5.0	36.7	23.0
Delta	16.3	5.4	4.4	4.4	46.1	19.4
So. Dakota Cert.	16.7	4.0	3.6	2.2	46.3	23.2
Belturf	9.6	4.8	8.1	6.0	35.6	16.2
Fylking	12.7	8.1	3.8	8.5	28.0	15.3

Ratings 9 = best quality, color, least leafspot
1 = poorest quality, color, most leafspot

grass. Lodging of long leaf blades creates a smoother, more uniform appearance. It covers existing seedstalks and suppresses the number of new seedstalks and invading weeds thereby raising the quality of the turf. Kenblue and Delta, in particular, are characterized by long foliage (which tends to lodge) and produce low (8"), uniform canopies of high quality. The few tall seedstalks also lodge readily, are covered by foliage, and become inconspicuous.

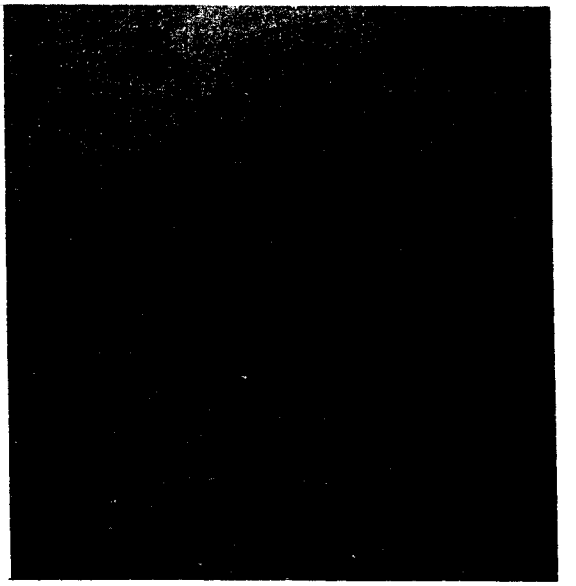

Figure 3. Merion Kentucky bluegrass annually produces more seedstalks than Fylking, but fewer than Newport.

While seedstalk production characteristics of Kentucky bluegrass varieties continue perennially after maturity, those of many fine fescues do not. The first spring after a fall seeding, the size of seedlings (controlled in part by variety) determines the number of seedstalks. "Fine fescues" include "red fescues," as well as sheep's and hard fescues, but excludes tall and meadow fescues.

Among commercially available red fescues sown in 1970, results through 1972 showed that Ruby spreading fescue possessed better cover and fewer seedstalks (See Table 8). Vigorous types such as Ruby developed a denser cover of fall foliage when unmowed than did Chewings types such as Highlight (Figure 4). Ruby creeping red fescue retained better green color than Pennlawn creeping red fescue (Tables 8 and 9). Ruby and Pennlawn fescues are

Table 8. Fine Fescues Sown at Adelphia on May 1, 1970.

		Cover Rating	Injury Rating	Height (cm)	Color Rating	Leaf Length (cm)	Lodged Height (cm)	Dormancy		Stemminess	
								Mowed	Unmowed	Mowed	Unmowed
		7/28/71				11/19/71		5/17/72		7/20/72	
1.	Pennlawn	7.7	2.2	13.5	5 mg	40.3	17.6	9.0	8.0	3.0	4.0
2.	Ruby	7.3	6.2	16.0	4 dg	44.3	18.6	8.7	7.3	2.0	5.3
3.	Alaska Station	8.3	9.0	11.9	6 b	26.3	17.6	4.0	2.3	3.7	5.7
4.	Arctared	6.3	7.5	10.9	3 dg	23.3	16.0	8.3	5.0	2.7	1.0
5.	Reptans	6.8	5.8	20.3	3 dg	39.7	18.0	9.0	7.6	2.0	4.3
6.	Sceempter	6.5	4.8	16.0	5 mg	45.0	19.3	9.0	6.3	5.3	8.0
7.	ZW-42-7	7.5	5.0	17.3	3 mg	47.0	18.3	9.0	6.3	4.0	7.3
8.	ZW-42-8	5.7	4.2	18.5	6 dg	41.3	14.3	9.0	5.7	1.3	2.0
9.	ZW-42-37	7.8	3.8	10.7	3 dg	36.0	20.6	7.7	5.7	2.3	4.3
10.	Golfrood	8.3	8.8	9.6	5 brlg	32.3	18.0	8.3	5.3	7.3	5.3
11.	Wintergreen	7.3	4.2	10.9	4 mg	27.6	17.0	8.0	5.7	2.7	3.7
12.	NK-046	6.0	6.7	17.0	5 dg	39.6	15.6	8.3	6.3	3.0	5.0
13.	NK-981	8.0	2.7	10.7	3 dg	30.0	14.0	8.3	6.3	3.0	4.0
14.	Highlight	7.8	3.2	10.7	6 mg	31.3	15.6	9.0	6.3	2.0	3.7
15.	C-26 HF	7.0	8.8	9.4	6 dg	21.0	12.6	3.3	3.3	3.7	3.3
16.	N4-132 HF	5.2	9.0	10.2	6 b	19.3	13.6	5.7	5.0	1.7	3.0
17.	NKO-16 SF	6.2	5.6	10.7	3 dg	20.3	13.3	3.0	2.3	1.7	2.0
18.	NKO-17 SF	6.8	7.5	15.2	2 mg	27.3	13.6	3.3	2.7	3.3	2.3
19.	NKO-18 SF	8.0	8.8	12.7	6 b	29.3	18.3	4.0	2.7	3.7	3.3
	*LSD .05 =	1.7	1.7	2.5		6.1	4.0	0.9	1.6	1.7	1.8
	LSD .01 =	2.3	2.3	3.3		8.1	NS	1.2	2.1	2.3	2.5

b = blue, g = green, l = light, m = medium, d = dark, br = bright

Ratings 9 = best cover, least injury, least dormant.
1 = poorest cover, most injury, most dormant.

*Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

Table 9. Performance of Fine Fescue Experimentals Sown May 1, 1970 at Adelphia.

Entry	Cover Rating	Drought Injury Rating	Foliar Height (cm)	Leaf Length (cm)	Lodged Height (cm)	Dormancy Rating	Stemminess Rating
		7/28/71		11/19/71		5/17/72	7/20/72
K8-151 RF*	7.0	4.0	10.2	30.6	19.0	3.7	4.0
200-84 RF	7.7	5.7	14.5	38.3	19.6	3.3	2.3
200-86 RF	8.3	4.0	13.5	37.6	16.3	6.0	6.3
200-90 RF	8.3	4.3	10.2	29.0	18.3	5.3	5.0
201-14 RF	8.7	4.0	11.9	33.6	17.3	5.7	3.3
201-29 RF	8.3	4.0	11.9	24.6	17.6	6.3	3.7
201-31 RF	8.3	3.7	13.5	32.0	18.6	7.7	2.7
201-45 RF	9.0	5.0	13.5	29.0	18.6	6.7	5.0
201-54 RF	8.7	4.7	14.5	27.0	18.6	6.0	6.3
201-68 RF	8.7	3.7	10.2	13.6	16.0	5.3	1.3
200-15 SF	7.3	7.7	17.0	31.3	18.6	5.3	1.0
200-45 SF	9.0	8.7	16.0	30.0	17.6	2.0	3.7
200-47 SF	8.7	8.7	18.5	30.0	17.0	1.0	2.3
Pennlawn RF	8.7	4.0	14.5	38.6	18.0	6.7	4.7
*LSD .05	NS	1.2	3.2	6.0	NS	1.3	1.6
LSD .01	NS	1.7	4.3	8.1	NS	1.7	2.2

*RF = red fescues SF = sheep's fescues

Ratings 9 = best cover, least injury, dormancy, seedstalks
1 = poorest cover, most injury, dormancy, seedstalks

*Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

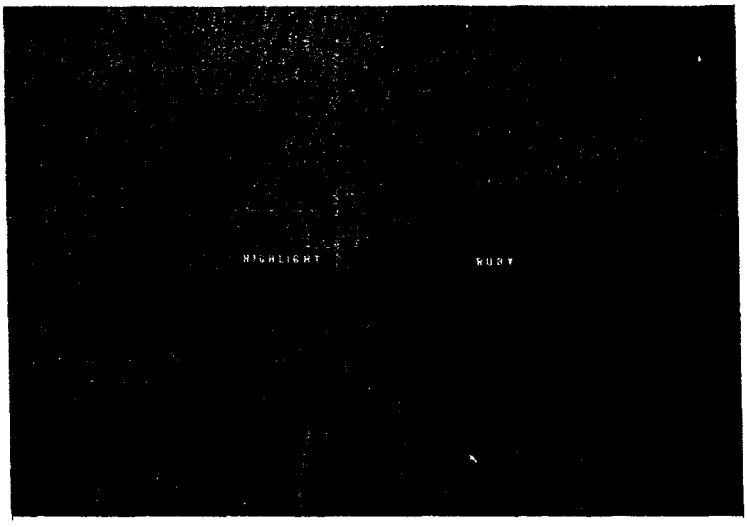

Figure 4. During summer drought Ruby creeping red fescue retained better color than Highlight Chewings fescue.

called "creeping red" in current seed-trade terminology. There is evidence (Schmit 1974) that within these varieties many plants may be spreading types and possess 2n = 56 chromosomes. The spreading fescue selections were consistent in retaining a good deep green color during summer drought. Observations such as this stimulated interest in developing an improved spreading variety.

Fall Mowing Effect on Stemminess and Dormancy

Three replications of 19 fine fescues sown May 1, 1970 at Adelphia were mowed in early fall of 1971 and immediately raked clean, and three replications remained unmowed. Table 8 indicates that varieties such as Pennlawn, Ruby, Reptans and Highlight were less dormant on May 17, 1972 than most other red fescue varieties in the mowed plots. Red fescues as a group were less dormant than C-26 hard fescue and experimental sheep's fescues both in mowed and unmowed tests. Differences between means of these groups were frequently statistically significant when compared with the LSD (least significant difference) values at the 5 and 1% levels of probability. Early breaking of dormancy or "greenup" has obvious aesthetic appeal.

Unmowed plots appeared less stemmy than those mowed the previous fall. This appears most pronounced in the creeping red fescues such as Ruby, Sceempter and Zwaan (ZW) selections and Northrup King - KO46. Only Golfrood appeared significantly less stemmy when mowed. The hard and sheep's fescues including Arctared, appeared to be the stemmiest group whether mowed or unmowed.

There was no evidence of smothering in either the mowed or the unmowed plots in the summer of 1972. Unmowed plots appeared to have accumulated a deeper cover of foliage. Fall mowing and removal of a seasons accumulation of growth from fine fescues increased the production of stems or seedstalks as compared with unmowed plots the following spring. Data in Table 8 illustrate the consistency with which varieties increase seedstalk production when mowed. The suppression of seedstalks by unmowed grass is another argument for restricting the mowing of roadsides.

The physiological explanation for this phenomenon is that mowing results in the removal of the insulative canopy of foliage and permits more light to impinge on the lower grass nodes. This stimulates development of more stems in the fall and assures their development as flowering stems in the spring. Conversely, unmowed plots on productive sites accumulate foliage to the extent that smothering may become a problem.

Dormancy ratings of the mowed plots on March 23, 1973 indicate that all entries except Alaska Station fescue, hard and sheep's fescue had broken dormancy while those in the unmowed series remained dormant. In early summer, varieties as Pennlawn, Wintergreen and NK hard fescue were less stemmy than the majority of the other fine fescues which had been mowed. Most mowed plots were considerably stemmier than plots which were not mowed the previous season.

In an adjoining test, (See Table 9) 14 entries of fine fescue seedstalk production was inhibited in the following year. Spreading fescues (See Table 8) as Ruby, Sceempter and ZW42-7 produced fewer seedheads than Highlight and Wintergreen Chewings fescues (See Figure 5). The following year foliage produced by all varieties was sufficient to inhibit seedstalk production, and differences between varieties were not significant.

Color Characteristics

An attempt was made to characterize fine fescues as to color (See Table 8). The numbers indicate the consistency with which these color designations were assigned to an entry. The "blue" foliage was never confused with any other designation. Certain

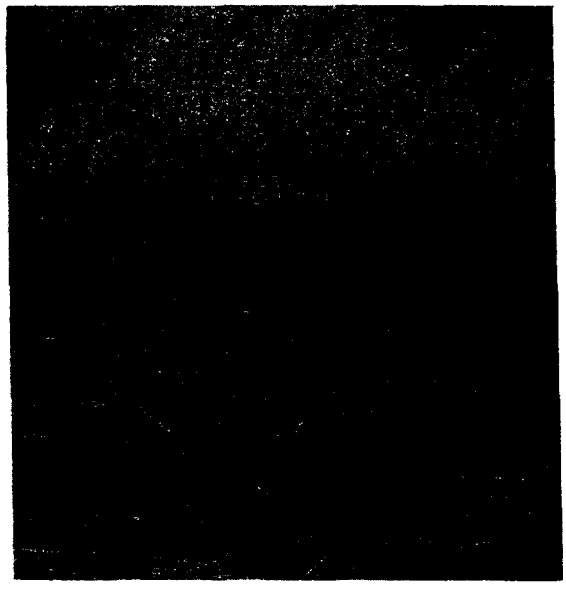

Figure 5. Second spring after fall seeding, vigorous Ruby suppressed seedstalks more than did Highlight in background.

entries were sufficiently distinctive in the other color categories to be consistently identified, others were occasionally designated to a neighboring category, and a few were indistinctive. These data indicate that color, even within the fine fescues, cannot be ignored when compounding mixtures. Natural selection sorts out genotypes with different colors from mixtures, resulting in a disconcerting polka-dot effect that has been noted in lawns and roadsides.

Also, the color characteristics of these grasses vary with seasons and management. During summer months Chewings fescues are particularly prone to develop brown (senescent) leaves that discolor unmowed grass on poor sites. In contrast, C-26 hard fescue and sheep's fescue selections retain their color throughout the growing season (Table 8). Typically, the sheep's fescues are blue green, and the hard fescue (in three replications) were also left unmowed in 1972 and in 1973. The test included Pennlawn as standard and Northrup King experimental red and sheep's fescues. These commercial red and sheep's fescues were not selected specifically for the roadside environment, and none were found to have desirable characteristics under conditions that simulated such.

There were highly significant differences in both dormancy and stemminess ratings. Pennlawn red fescue and RF 201-31 broke dormancy earliest. Entries RF 200-86 and RF 201-45 appear least stemmy and comparable to Pennlawn. Sheep's fescues, SF 200-45 and SF 200-47 were the most dormant, whereas RF 201-68 and SF 200-15 were the stemmiest entries tested.

Fine Fescue Tests

Additional data on color and maturity of plots supporting the conclusions of fine fescue variety testing at Adelphia were obtained from a fine fescue regional variety trial, established along Route 18 (eastbound) in September 1969. Regional tests are those composed and conducted by scientists of several states;.. in this instance, turfgrass agronomists of the Northeastern states. The grasses of this test were rated for height of foliage and numbers of seedstalks the following summer. Data in Table 10 indicate that Tjelvar and Ruby, the only creeping red fescues in the test, were much taller than the other entries. Significant differences in plant height were found among the Chewings fescues also. It is important to note that in this trial Pennlawn ranks with the common Chewings types. In most other trials (with other seed sources) Pennlawn performs more like taller growing spreading fescues. The stability of characteristics of Pennlawn "red" fescue in current seed trade is therefore questionable. The one hard fescue entry was shorter (at the 5% level of probability) than the shortest Chewings entry.

Although no significant differences could be proved (due to variation among replicates), C-26 hard fescue had the highest mean value for number of seedstalks. This may relate to C-26 having a better stand. Stand was not consistent among replicates and an index of stand density was postponed hoping that the situation would improve. An application of soil sterilant (by the D.O.T.) meant for the guard rail three feet from the near edge of the first replicate caused such severe damage that this replicate could not be considered in further measurements.

During a summer dry period in 1971 it was noticed that C-26 retained its color very well while others in this test were severely injured. This injury was not related to smothering, for the plots were inadvertently mowed. Fall recovery of most entries was poor, particularly for the creeping types. Although analysis of variance was not run on the percentage persistence ratings of the two remaining replicates, the data indicated that C-26 consisted of a good stand of grass, and Ruby (among others) which had looked so promising in other trials was severely depleted and no longer provided adequate soil coverage.

Table 10. Performance of fine fescues from the 1970 Northeastern Regional Trial sown at Route 18 in September 1969.

Entries	Height (cm) 6/12/70	Estimated number of seedstalks per plot, 6/12/70	Rating of % persistence (2 reps.) 11/19/71
1. Jamestown	5.8	43.3	75
2. C-26	5.1	73.3	98
3. Tjelvar	15.2	35.0	12
4. Chewings	7.6	28.3	67
5. Cascade	8.4	36.7	62
6. Wintergreen	5.8	43.3	40
7. Pennlawn	7.6	43.3	60
8. Erica	5.8	31.7	22
9. Highlight	7.6	21.7	45
10. Ruby	15.2	56.7	15
11. Oregon D	5.8	18.3	11
12. Atlanta	8.4	10.7	3
*LSD .05	0.7	NS	-
LSD .01	0.9	NS	-

*Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

'Banner' and 'Fortress' are presently being tested in 20 turf trials throughout the Northeastern Region and at other locations throughout the United States, in Canada, and in Europe. Preliminary data under intense management is more abundant, therefore, and indications are that both varieties are superior when compared to their most similar commercial counterparts at most locations. This is an essential prerequisite, as it should assure a sufficient volume of demand to warrant their commercial production.

Regional fine fescue test plots were sown at New Brunswick in September 1971, at Adelphia on September 16, 1972 and at Centerton on October 2, 1972. The test at New Brunswick has been mowed closely (3/4 inch) twice weekly and received three fertilizer applications of one pound/1000 sq. ft. in fall and again in the spring. Summary rankings of entries in the Fine Fescue Regional Test (Table 11) by different observers reveal that 'Banner' and 'Jamestown' are superior Chewings fescues. C-26 and Scaldis hard fescue have also performed well under turf conditions. The taller growing Fortress did not perform as well as the best of the shorter Chewings-type fescues under close mowing but outranked all rhizomatous fescues in the mowed test.

At Adelphia, plots were rated for spring and summer color, stemminess, and recovery from mowing in 1973 (Table 12). Spring color of these plots (unmowed since sown the previous fall) varied appreciably. Hard fescues such as C-26 and Scaldis were quite dormant initially, and inclusion of Jamestown did not improve the rating of a mixture with C-26. Spreading fescues such as Duraturf, Nova rubra, and Roda had good color initially, but were excessively stemmy later. The hard fescues, C-26 and Scaldis, and the Rutgers Chewings, 'Banner', exhibited good color during midsummer after a mowing on July 31, 1973. Drought at the time of mowing and thereafter retarded recovery particularly for the taller growing spreading fescues. In addition, foliar height and seedheads per square decimeter were recorded in 1974 to test consistency of earlier observations. Data demonstrate that highly significant differences occur in foliar height of fine fescue. Pennlawn had the longest leaves while Banner, Jamestown, Highlight, Menuet and Waldorf had relatively short foliage. Thus Pennlawn in this test was quite different from known Chewings fescues.

Jamestown, Banner and Jade (Table 13) had relatively few seedheads per unit area compared to Barok, Barfalla, Flevo, Oregon "K" and Polar. Seedhead ratings (Table 13) at the Centerton test showed smaller differences in number of seedheads between varieties. Varieties, however, showed the same general trend in stemminess. Color ratings for the same date reveal the outstanding performance

Table 11. SUMMARY RANKING OF ENTRIES IN THE FINE FESCUE REGIONAL TEST
Sown at New Brunswick

Entry		Rank	Rank Funk	Avg. Qual. 1972	Avg. Color 1972	Avg. Color 1973	Avg. Qual. 1973 Funk	Avg. Qual. 1973	Avg. Qual. 1974 Funk	Avg. 1972-73	Avg. 1973-74 Funk
1.	Jamestown	1	2	6.30	6.70	6.70	6.0	7.03	6.3	6.7	6.1
2.	Banner	2	1	6.30	6.70	6.70	6.3	6.93	6.5	6.4	6.4
3.	C-26	3	4	5.65	7.00	4.90	5.8	6.93	6.1	6.3	5.95
4.	C-26 + Jamestown	3	3	5.80	6.30	6.00	5.7	6.60	6.3	6.3	6.0
5.	Highlight	3	8	5.15	8.00	7.30	5.2	4.15	5.2	6.3	5.2
6.	Encota	4	9	5.15	8.00	7.70	5.2	5.68	5.1	6.1	5.1
7.	Polar	5	5	5.65	6.00	6.00	5.1	6.08	5.9	6.0	5.5
8.	Menuet	6	5	5.35	7.00	6.00	5.4	5.35	5.7	5.6	5.5
9.	Fortress	6	9	4.30	6.70	7.00	4.7	5.58	5.3	5.6	5.1
10.	Flevo	6	10	5.15	7.00	6.70	5.3	5.10	4.8	5.6	5.0
11.	Scaldis	7	4	6.00	7.70	4.70	5.8	4.73	5.7	5.4	5.75
12.	Koket	7	7	5.00	7.30	6.00	5.0	4.75	5.5	5.2	5.25
13.	Amboise	8	12	5.15	7.30	6.30	5.4	4.48	4.0	5.2	4.7
14.	Waldorf	8	6	4.85	7.30	5.70	5.2	4.75	5.4	5.2	5.3
15.	Barfolla	9	11	4.50	6.30	6.00	4.5	4.93	5.0	5.1	4.75
16.	Pennlawn	10	15	4.00	7.00	4.70	3.5	4.68	4.9	5.0	4.2
17.	Oregon K	11	17	4.65	6.70	6.70	4.7	4.18	3.0	4.9	3.8
18.	F-84	12	15	4.35	4.70	5.30	3.4	4.85	5.1	4.8	4.2
19.	Jade	12	10	4.65	6.00	5.70	4.7	4.33	5.4	4.8	5.0
20.	Scarlet	13	8	5.15	7.00	7.00	5.0	3.00	5.4	4.7	5.2
21.	S-59	13	14	3.80	6.00	6.30	3.6	4.15	5.1	4.6	4.3
22.	Pseudovina	13	13	5.50	4.70	2.70	5.3	4.68	3.6	4.6	4.45
23.	Nova rubra	14	19	3.20	5.00	5.30	2.7	3.75	3.5	4.0	3.1
24.	Durlawn	15	18	3.50	4.70	5.30	3.1	3.58	3.9	3.9	3.5
25.	Duraturf	16	18	3.00	5.30	6.00	2.7	3.23	4.3	3.7	3.5
26.	Boreal	16	20	3.35	4.30	5.70	2.7	3.23	2.9	3.7	2.8
27.	Dawson	17	16	4.35	6.00	5.30	4.3	2.25	3.7	3.6	4.0
28.	Roda	18	21	3.15	5.30	5.30	2.7	2.43	2.5	3.3	2.6
29.	Barok	19	20	3.85	5.00	4.70	3.2	2.08	2.4	3.2	2.8
30.	Blere	20	22	2.00	3.70	4.30	1.9	2.08	1.8	2.6	1.85

Table 12. Results of Regional Fine Fescue Test at Adelphia, sown September 15, 1972.

	Turf Color 4/23/73	Stem Rating 7/31/73	Color Rating 8/10/73	Recovery from Mowing 9/25/73
Duraturf Sp	6.0	4.0	1.7	1.0
Nova rubra Sp	5.8	2.5	1.0	2.0
Jade	7.3	7.2	5.0	5.2
Barok (F. tenuifolia)	4.0	5.0	5.5	4.2
Menuet	7.5	8.2	4.5	6.0
Koket	6.5	8.0	3.5	5.7
Barfalla	6.3	3.2	2.0	3.0
Encota	6.5	2.7	2.0	1.7
Flevo	6.5	2.0	3.2	3.7
Polar	6.0	6.2	2.5	1.5
Pennlawn Cr.	6.0	4.2	1.2	5.0
C-26 HF	4.3	7.2	7.0	7.2
Jamestown	6.0	8.2	5.0	6.2
Banner	6.3	6.7	6.3	5.5
Oregon K	6.5	6.0	3.2	4.0
Jamestown + C-26	4.5	7.7	5.5	6.0
Highlight	6.5	7.5	3.2	3.0
EKG 11	6.5	5.0	4.0	2.7
Dawson Cr.	4.3	8.0	3.0	2.0
Scaldis HF	3.0	6.7	6.5	7.5
Waldorf	5.8	8.2	5.2	5.0
Scarlet	6.8	7.2	4.7	5.0
HF 11	7.3	9.0	4.0	4.7
Roda Sp.	6.0	3.5	1.2	1.7
Cebeco S-70-2	1.0	8.0	5.0	1.5
Cebeco S-HZ-71-4	4.5	7.0	6.0	6.2
* LSD .05	1.0	0.6	1.1	1.6
LSD .01	1.3	1.0	1.5	2.2

9 = best for all characters
1 = poorest

*Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

Table 13. Results of Regional Fine Fescue Test at Centerton, sown October 2, 1972.

	July 8, 1974 Color ratings*	July 8, 1974 Seedhead ratings**
MLM 1511	5.00	7.50
MLM 1512	5.00	7.25
Jade	4.50	7.75
Barok	8.00	5.50
Menuet	4 25	7.25
Koket	4.00	6.75
Barfalla	3.50	5.75
Encota	3.25	4.00
Flevo	3.00	3.25
Polar	4.50	7.00
Pennlawn	4.50	8.00
C-26	8.50	7.00
Jamestown	2.75	8.25
Banner (RU-45C)	3.25	7.50
Oregon K	4.00	6.75
C-26 + Jamestown	5.50	7.75
Highlight	3.00	6.25
ERG 11	3.00	5.00
Dawson	7.00	7.75
Scaldis	8.50	6.50
Waldorf	3.75	7.25
HF-9	4.25	7.75
HF-11	3.50	7.50
Roda	4.75	8.00
Cebco 570-2	7.50	6.50
Cebeco HZ 71-4	7.75	6.25
***LSD .05	1.24	1.18
LSD .01	1.65	1.48

* 0 = all brown
9 = all green

** 0 = full complement of seedheads
9 = no seedheads

*** Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

of C-26, Barok and Scaldis during the summer stress period. This, however, is negated by the poor seedling vigor of these which also are noticeably slower in breaking dormancy.

Kentucky Bluegrass Tests

A Kentucky bluegrass regional variety test was initiated at Adelphia in September 1972. Many newly developed varieties of this species had never been tested under low intensity management typified by roadside environments. Three replications of seventy entries of Kentucky bluegrass were sown alone, in blends of Kentucky bluegrasses, and in mixtures with a fine fescue or a ryegrass. Plots were given a minimum of maintenance, i.e. twice a year mowing, and fertilized with 500 lbs/A of 10-10-10 in the fall of 1973. This was deemed necessary to maintain the stand of turf types which typically have a higher fertility requirement.

Color ratings (See Table 14) on March 23, 1973 show Nugget (and Windsor, to a lesser extent) to be straw brown due to late dormancy. Foliage measurements reveal (as were reported earlier) the common Kentucky bluegrass types, as Kenblue, Park and Olymprisp were the taller growing varieties. The mixture of Fylking and Pennlawn fescue was the tallest entry in the test. This mixture was dominated by the Pennlawn component. After the first mowing, this mixture had the poorest turf quality ratings in August 1973.

In general, many turf type Kentucky bluegrasses, although somewhat sparse, made rather attractive unmowed turf. It was apparent, however, in acceptability ratings in late August 1973, that supplemental fertility was required to maintain the turf type Kentucky bluegrasses. The added fertility applied in the late fall of 1973 was reflected in the development of a tall but somewhat sparse stand of seedstalks the following spring. P-59 and Olymprisp, in particular, proved to be quite stemmy. Many cultivars as Fylking, P-29, Kenblue, Park, Monopoly, Pennstar, York, P-143 and others were almost lacking in seedstalks. Further observations at this site may determine if the optimum level of fertility has been established to maintain the turf type Kentucky bluegrasses with adequate ground cover and a minimum of stemminess.

Kentucky Bluegrasses and Fine Fescues Sown Alone and in Combination

Several Kentucky bluegrass and fine fescues were sown in a factorial field plot design on the least fertile (sandy loam) soil of the Tupper Farm at Centerton on October 3, 1972. The experiment was mowed once for weed control in the fall of 1973. Ratings for seedheads and color were made on July 8, 1974. Analyses of

Table 14. Summary of characteristics of Kentucky bluegrass varieties sown alone and in combination in a Regional Test maintained at Adelphia under simulated roadside conditions, sown September 15, 1972.

	3/23/73 Color Rating 1=poor	7/5/73 Foliar Height (cm)	8/10/73 Turf Quality 9=best	10/30/73 Acceptability	6/19/74 Head Height (cm)	6/19/74 Head Density #/dcm^2
Nugget	2.7	3.7	6.0	5.3	14.3	1.3
Merion	6.0	6.3	6.3	3.3	21.0	5.9
Fylking	5.7	10.3	5.3	3.3	23.7	0.2
P-29	6.3	4.0	4.7	3.0	12.7	0.3
P-142	4.3	8.3	6.0	4.3	25.3	7.5
Kenblue	6.3	19.0	3.7	2.7	41.3	1.0
Baron	5.7	7.0	6.0	4.3	14.7	5.0
Victa (Ba-62-5)	5.7	4.0	6.0	4.3	14.0	1.5
Ba 61-91	4.7	4.7	5.7	3.3	13.7	2.3
Ba 62-55	5.3	5.0	6.0	4.0	14.3	2.4
Vantage (Ba 61-24)	5.3	10.7	4.3	2.7	34.0	0.5
Park	5.3	16.0	3.3	2.3	30.0	0.5
Windsor	3.3	4.3	5.0	2.7	22.7	0.4
Sydsport	5.3	4.7	6.7	4.0	17.7	3.3
Bonnieblue (P-106)	6.3	7.7	4.7	2.7	17.0	2.5
Majestic (P-84)	7.3	5.7	6.3	3.3	16.7	1.0
Campira	5.7	9.3	4.7	3.0	18.7	9.0
Monopoly	5.3	11.0	4.7	2.7	29.7	0.2
Galaxy	6.0	7.3	6.0	2.7	16.3	1.9
Geranimo	5.0	7.7	6.0	3.3	23.3	1.7
P-57	6.0	6.3	7.0	3.7	22.7	5.1
NK Kl-131	5.7	7.0	5.3	3.7	19.0	0.6
NK Kl-132	5.3	8.0	5.0	3.0	18.7	0.5
NK Kl-133	6.0	8.3	4.7	3.0	29.0	0.4
NK Kl-138	5.7	4.7	5.0	3.0	16.7	4.5
NK Kl-143	6.0	6.3	5.0	3.0	16.7	0.4

Table 14. (continued)

	3/23/73 Color Rating 1=poor	7/5/73 Foliar Height (cm)	8/10/73 Turf Quality 9=best	10/30/73 Acceptability	6/19/74 Head Height (cm)	6/19/74 Head Density #/dcm^2
NK Kl-155	6.7	11.3	5.7	4.0	25.0	9.8
NK Kl-157	6.0	10.0	4.3	3.3	31.0	0.6
NK Kl-158	6.0	11.3	4.7	3.0	34.0	0.7
NK Kl-187	6.3	8.3	5.3	3.7	19.7	0.3
P-59	7.0	11.0	5.7	3.0	26.0	18.2
Sodco	4.7	8.7	5.0	2.7	30.0	1.2
MLM 18001	5.3	6.0	5.3	3.3	14.0	2.0
Adelphi	6.7	3.7	6.3	3.3	15.3	1.7
Parade	6.7	8.7	4.7	3.7	21.7	10.0
EVB-282	5.3	3.7	4.0	3.3	12.3	0.3
EVB-305	6.3	6.7	5.0	3.3	17.3	2.2
EVB-307	5.3	6.7	6.0	5.3	19.7	10.4
EVB-391	5.0	6.7	5.7	3.7	14.7	2.9
Pennstar	5.7	10.0	5.3	3.0	34.7	0.2
Mer. + Kenb.	6.0	13.3	4.0	3.3	34.3	1.8
Mer. + Penns.	6.7	9.0	6.3	4.0	20.3	2.4
Mer. + Baron	6.0	5.3	6.0	3.7	17.7	4.8
Nug. + Penns.	5.0	7.7	5.7	4.7	17.7	0.1
Nug. + P-29	6.0	5.0	6.0	4.3	24.3	0.5
Nug. + Park	6.3	12.7	4.3	3.3	32.0	2.8
Vantage + Victa	6.0	8.3	5.7	3.7	20.7	2.5
P-57 + P-59	6.7	11.3	5.3	3.7	26.7	7.2
Fylk. + James.	7.7	12.0	4.3	3.3	57.3	1.3
Fylk. + C-26	5.0	13.3	5.3	4.3	43.0	2.1
Fylk. + Pennlawn	8.3	36.3	1.7	2.0	65.7	5.2
Fylk. + Pennfine	8.3	8.3	3.0	1.3	30.0	0.2
Delft	6.3	7.7	6.7	3.3	19.0	0.4

Table 14. (continued)

	3/23/73 Color Rating 1=poor	7/5/73 Foliar Height (cm)	8/10/73 Turf Quality 9=best	10/30/73 Acceptability	6/19/74 Head Height (cm)	6/19/74 Head Density #/dcm^2
P-162 York 7	6.3	6.3	6.3	4.0	13.7	0.2
RAM #1	6.0	5.3	6.7	4.7	12.0	0.4
RAM #2	6.0	7.0	5.0	3.3	18.7	3.8
P-156	6.0	3.3	5.0	3.3	15.7	0.1
P-164	6.3	3.7	4.7	3.0	13.0	0.1
P-143	5.3	8.0	5.7	3.0	24.3	0.0
P-72	7.0	3.7	5.7	3.3	19.3	4.3
P-148	5.7	5.7	6.3	3.3	18.7	0.7
Adelphi + Nug.	6.3	4.3	4.7	4.3	14.7	2.4
Blend 38	6.0	9.3	5.3	3.0	27.3	3.3
PSV-150	5.7	9.7	3.7	3.0	38.7	0.3
PSU-169	5.3	13.7	6.0	2.3	35.7	0.7
PSU-190	6.0	5.7	5.0	3.7	19.3	0.4
PSU-197	5.7	7.0	6.0	3.0	33.0	0.5
K-860	7.0	3.7	6.0	3.7	17.0	0.1
K-808	6.7	4.7	4.7	3.3	15.3	1.5
Olymprisp	5.0	17.3	4.3	2.3	33.3	12.3
*LSD .05	1.1	3.8	1.5	1.3	8.6	2.4
.01	1.4	5.0	2.0	1.7	11.4	3.2

* Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

variance were employed to assess the relative performance of eight Kentucky bluegrasses, and four fine fescues, alone and in all possible combinations.

Significant differences (See Table 15) were apparent in the performance of Kentucky bluegrass and fescues in pure stands. The fescue components proved to be the predominant factor affecting the seedhead ratings of mixtures. In descending order of quality affecting mixtures the fine fescues ranked; Fortress, Ruby, Banner and Highlight.

The fine fescues were also the prime factor determining the color of these mixtures (See Table 16). There were also significant color differences in both the bluegrasses and fescues in pure stands. There was a trend toward better color in mixtures with spreading fescues and slightly poorer color in mixtures with Chewings-type fescues.

Polycross Progeny Performance

Having found no commercially available fine fescue varieties that were consistently superior, but finding evidence of superior clones of Chewings-type and spreading fescues, a decision was made to develop new synthetic varieties of these fescues. Their successful synthesis and commercial production would assure availability of superior grasses for roadside mixtures. The mechanics of synthesizing varieties that were eventually called Banner and Fortress are dealt with more fully in a Master's degree thesis (Schmit 1974). To test the compatibility of the selected parental clones, polycross progeny tests were established.

Seed of two polycross nurseries, a 45 clone Chewings-type fescue, and a 6 clone spreading fescue were harvested in July 1971. Seed yields exceeded expectations. After cleaning the artificially dried seed, germination tests were run. All progeny were found to germinate satisfactorily. The major portion of seeds were composited as a Chewings synthetic identified as RU-45C (later 'Banner') and a spreading synthetic was called RU 6-S (later 'Fortress'). The two synthetics were sent to cooperators in 25 states and three foreign countries for small plot testing.

Each synthetic was sent to a different commercial grower of seed in Oregon for production evaluation and seed increase. Seed yields have been adequate and both varieties have performed with merit at all testing locations. Varietal release of 'Banner' and 'Fortress' are soon anticipated upon enumeration of all data including Regional Testing discussed previously. Commercial seed of 'Banner' and 'Fortress' will be made available after varietal release.

Table 15. Seedhead ratings of Kentucky bluegrass and fine fescue sown in pure stands and in mixtures at the Tupper Farm at Centerton on July 8, 1974.

		Fine Fescues			
		Ruby	Highlight	Banner	Fortress
Kentucky bluegrass					
	None	6.8	7.5	8.3	6.3
Merion	7.5 1/	7.3	6.7	6.5	8.0
Kenblue	8.0	7.8	6.5	7.3	8.0
T138-13	6.5	7.8	6.7	6.7	8.0
T138-10	7.3	7.8	7.0	7.0	8.0
P-29	8.5	7.8	6.5	6.8	8.5
Bonnieblue	8.3	7.5	6.8	6.8	7.8
Majestic	8.3	8.0	7.0	7.0	8.0
South Dakota	7.3	7.8	6.8	6.5	7.8
$\bar{x}$	7.7	7.6	6.8	7.0	7.8

*LSD .05 = 0.92

LSD .01 = 1.22

1/ Values represent the mean of four replications

Ratings 9 = most seedheads
1 = fewest seedheads

* Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

Table 16. Color ratings of Kentucky bluegrass and fine fescues in pure stands and in mixtures at the Tupper Farm, Centerton on July 8, 1974.

		Fine Fescues			
		Ruby	Highlight	Banner	Fortress
Kentucky bluegrasses					
	None	5.3	4.3	5.8	7.8
Merion	7.3[1/]	5.5	5.0	4.0	6.0
Kenblue	5.3	6.0	5.5	4.5	5.8
T138-13	5.5	6.3	5.3	4.3	5.8
T138-10	5.7	5.5	5.5	4.8	6.0
P-29	7.8	6.3	5.3	4.8	6.0
Bonnieblue	6.8	5.8	6.0	4.3	5.8
Majestic	6.8	5.8	6.3	4.8	5.5
South Dakota	5.8	5.8	5.3	4.5	5.5
$\bar{X}$	6.3	5.8	5.5	4.5	5.4
*LSD .05	1.02				
LSD .01	1.4				

1/ Values represent the mean of four replications

9 = green
1 = brown

* Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

Seed of polycross clones were sown at several locations in New Jersey to further evaluate components. Ratings of parental clones are given in Table 17. The trial sown at New Brunswick on September 1, 1971 by Dr. C. Reed Funk of Rutgers was maintained by his staff under 3/4 inch twice weekly mowing and was evaluated for turf quality and color from May 1972 to December 1973. Differences among the Chewings-type progenies were less striking than anticipated. Spreading fescues, though subject to severe spring leafspot thinning, usually had more attractive winter color under mowing than did the Chewings fescues. The latter had more yellow leaves during the winter season. In general progenies compared favorably to standard varieties, and the composits, 'Banner' and 'Fortress' proved to be superior to their most similar varieties.

Progeny tests (Table 18) maintained under unmowed simulated roadside conditions at Adelphia, Route 195 and at Centerton have demonstrated a more variable performance closely related to the fertility of the site. Plots at Adelphia on productive soil included 66 entries of fine fescue progenies and standards. They showed almost uniformly poor survival after the second year due to smothering by foliage of the previous summer. Plots at Route 195 were thinned by excessive mowing under low fertility but have not suffocated from overgrowth and greater differences are apparent among entries. Centerton, the last location to be sown had reached maturity in the 1974 season. The color of Chewings fescues was poor in July. C-26 hard fescue, in particular, and the spreading fescue components of 'Fortress' showed better color with fewer seedstalks when compared to the Chewings-types which were characterized by browning due to leaf senescence.

Additional progeny tests of mainly spreading fescues were established at the Adelphia and Centerton Research Farms. The test at Adelphia included a trial maintained under high fertility and twice weekly close mowing (See Table 19) and a trial simulating roadside conditions (See Table 20). Three replicates of 33 entries sown at Adelphia on September 13, 1972 were evaluated for tolerance to mowing. Height of mowing was 3/4 inch during the growing season. Fertilizer was applied to maintain active growth. Ratings (Table 19) were made in January 1973 for leaf blight disease. Turf quality was evaluated on April 6 after breaking of dormancy and on July 16 during the summer stress period. Evaluations were made for color on August 10, 1973.

In the mowed spreading fescue test (Table 19) all spreading entries except 130-18 were susceptible to a leaf blight condition.

Table 17. Turf performance scores for quality and color of fine fescue progeny sown at New Brunswick on September 1, 1971.
-Turf performance = Quality + Color Ratings - 9 = highest quality
1 = poorest color

	1972						1973							Average Performance
	5/4 Qual.	5/17 Qual.	6/26 Qual.	8/1 Qual.	11/3 Qual.	12/7 Color	1/23 Color	3/26 Color	4/16 Color	8/7 Qual.	9/4 Qual.	10/2 Qual.	12/6 Qual.	5/4/72 12/6/73
Chewings Polycross Progenies														
3438-b GEB	7.5	7.0	5.5	6.0	7.5	6.3	5.3	6.0	5.5	4.5	5.0	4.7	5.7	5.9
3438-d Ft. McHenry	7.0	7.0	6.2	5.7	7.0	6.3	5.7	7.3	4.5	5.2	5.5	7.0	8.5	6.4
3438-g "	7.0	7.0	5.5	5.6	7.5	6.7	6.0	7.0	5.7	5.7	7.0	7.5	7.5	6.6
3440-a "	8.0	7.0	6.7	6.0	7.3	6.7	6.0	6.7	4.7	4.0	4.2	4.5	6.0	6.0
3440-b "	7.7	7.2	5.5	6.5	7.3	6.5	6.0	6.0	5.7	5.0	5.5	4.5	4.0	6.0
3440-d "	7.0	7.2	5.7	6.0	7.0	6.0	5.0	5.7	4.7	3.5	2.7	2.2	4.2	5.1
3440-e "	7.2	7.7	6.5	6.3	7.7	6.7	6.2	7.0	5.7	4.2	4.7	5.0	5.0	6.3
Syn A Chew. "	5.7	7.0	6.0	6.0	7.7	6.5	5.7	6.7	5.7	5.5	5.7	4.7	7.0	6.1
3440-g "	7.0	7.0	6.0	6.3	7.7	6.7	6.0	7.0	5.0	4.2	5.2	3.7	5.5	5.9
3442-d "	7.5	7.0	6.3	6.0	7.5	7.0	6.5	7.0	5.0	3.5	4.7	4.0	6.3	6.0
3442-g "	7.7	7.5	7.0	6.5	7.0	7.0	6.0	6.7	6.2	5.0	4.7	5.0	7.3	6.4
3444-b "	7.5	7.2	5.7	6.5	8.0	6.7	5.7	7.5	5.2	5.5	5.5	5.0	7.0	6.4
3444-c "	7.0	7.0	6.5	5.7	7.7	6.7	5.2	6.7	6.2	5.0	5.3	5.7	7.2	6.0
3444-e "	7.2	6.5	5.7	5.7	7.7	6.7	5.7	6.7	5.5	5.0	4.7	4.5	6.0	6.5
3444-g "	6.8	6.5	6.0	4.7	7.2	7.3	5.7	6.7	5.2	4.5	4.7	4.5	4.5	5.7
3446-a "	6.5	7.0	5.5	6.3	8.0	7.5	6.0	6.7	5.2	4.5	5.0	5.7	6.0	6.1
3446-b "	7.5	7.0	7.3	6.7	7.2	6.5	5.0	6.0	6.0	4.5	5.5	3.5	5.0	5.8
3446-d "	7.0	7.0	7.0	6.3	7.2	6.7	5.0	5.7	6.0	4.0	5.0	4.5	5.7	5.9
3446-g "	8.0	6.5	5.7	5.7	7.5	7.0	6.3	6.2	5.7	3.7	5.3	5.0	6.5	6.1
3448-b "	7.7	7.0	5.5	6.5	7.2	6.0	5.0	5.5	6.0	3.5	4.5	3.0	6.5	5.7
3448-d "	7.5	7.2	6.0	6.3	7.2	6.5	5.7	6.2	5.7	4.0	5.3	4.7	6.7	6.1
3450-d "	7.5	7.0	4.8	5.3	7.5	7.3	7.0	7.5	6.7	3.3	3.3	3.0	5.3	6.1
3450-e "	7.7	7.2	5.5	5.3	7.0	7.0	4.7	6.0	6.3	4.0	3.3	4.0	5.3	5.6
3922-a Jumping Brook 1	8.0	7.0	8.3	7.5	7.5	6.2	6.0	6.5	6.2	4.3	5.3	4.5	4.7	5.6

Table 17.(continued)

	1972						1973							Average Performance
	5/4 Qual.	5/17 Qual.	6/26 Qual.	8/1 Qual.	11/3 Qual.	12/7 Color	1/23 Color	3/26 Color	4/16 Color	8/7 Qual.	9/4 Qual.	10/2 Qual.	12/6 Qual.	5/4/72 12/6/73
3922-b Wakill	8.0	7.2	6.0	6.5	7.0	7.2	6.7	7.2	7.0	5.0	5.0	5.0	5.7	6.4
3922-c Wakill	7.2	7.0	6.3	7.0	7.7	6.7	6.5	7.2	5.2	4.7	5.5	5.7	7.5	6.5
3922-d Phil.Art Museum	7.0	6.7	5.0	5.7	7.2	7.0	5.2	6.5	5.2	5.2	5.5	4.7	6.2	5.9
3922-e Tennant Cemetary	7.5	6.7	5.7	6.5	7.2	6.2	5.5	6.0	5.2	4.3	5.5	5.7	7.0	6.1
3922-f Roosevelt Park	6.5	7.2	5.7	5.3	6.7	6.7	5.3	6.0	7.0	5.0	5.0	5.3	5.7	6.0
3924-b Ft. McHenry	7.2	7.0	6.3	6.0	7.5	6.3	6.0	6.0	5.5	3.7	6.7	5.5	7.3	6.2
3924-d Colonia	7.7	7.5	6.0	6.5	6.7	5.7	5.7	5.3	5.5	5.0	6.3	4.3	5.7	6.0
3924-f Personal Prod.	7.7	7.0	6.5	5.5	7.0	7.0	6.0	6.3	7.3	5.3	4.3	4.3	6.0	6.2
3926-d Plainfield 163	8.0	7.2	5.0	5.5	7.7	6.3	5.3	5.7	5.7	5.3	4.7	5.7	5.7	6.0
3926-e Ft. Tyron N.Y.C.	7.5	7.5	6.7	5.5	7.7	6.7	6.3	6.7	6.0	4.7	7.0	6.3	6.0	6.5
3928-b Bridgehampton 9	7.5	7.0	5.7	5.5	7.5	7.2	5.7	6.5	6.3	4.0	4.3	4.7	7.0	6.1
3932-d "	7.2	7.0	6.7	6.0	7.0	6.2	6.7	5.7	6.0	3.7	3.0	2.7	4.2	5.5
3932-e "	7.2	7.2	6.7	6.0	7.3	6.0	4.0	5.2	6.0	5.2	6.3	6.0	6.5	6.1
3932-f "	8.0	7.0	6.5	7.0	8.3	6.0	4.0	5.7	5.5	5.5	6.5	5.0	6.0	6.2
3934-c Bridgehampton 6	7.7	7.0	6.0	6.3	7.7	6.7	6.3	7.2	5.7	4.5	5.0	5.0	6.7	6.3
3938-d Bridgehampton 5	8.0	7.0	6.3	5.5	7.3	6.0	5.3	6.2	5.7	4.5	4.0	5.3	6.5	6.0
3942-c Creek #6	7.0	6.7	6.3	5.7	7.3	7.0	6.0	7.0	4.7	4.3	5.5	5.0	7.0	6.1
3942-e Creek #6	7.5	7.5	6.3	5.7	7.5	7.3	6.3	6.7	6.0	4.3	4.2	4.2	6.5	6.5
3944-a C.C. Mass.	7.0	7.5	5.5	5.7	7.7	7.2	6.7	7.0	5.7	4.0	5.2	4.7	7.2	6.2
3944-d Beachmont C.C.	7.5	7.2	6.2	5.5	7.7	6.0	6.3	7.3	5.0	4.0	4.5	4.7	5.5	6.0
3946-d Oakmont #7	7.0	6.7	6.5	6.0	6.7	6.3	5.7	6.7	5.0	4.3	5.0	5.3	7.0	6.0
3946-e "	7.2	7.2	6.5	6.3	7.0	6.7	6.3	6.5	5.2	4.0	5.0	4.0	6.0	6.0
3946-f "	7.5	7.2	6.0	6.0	6.7	6.2	6.2	6.5	6.2	4.3	5.7	4.7	6.3	5.6
Varieties														
Banner	8.0	7.7	5.5	6.7	7.0	7.2	6.5	7.0	6.3	5.7	6.0	5.7	8.2	6.7
Jamestown	7.2	7.2	5.3	6.0	8.2	7.2	6.5	7.7	6.5	6.2	6.7	6.2	7.5	6.8

Table 17.(continued)

	1972						1973							Average Performance
	5/4 Qual.	5/17 Qual.	6/26 Qual.	8/1 Qual.	11/3 Qual.	12/7 Color	1/23 Color	3/26 Color	4/16 Color	8/7 Qual.	9/4 Qual.	10/2 Qual.	12/6 Qual.	5/4/72 12/6/73
Highlight	6.0	6.2	6.0	6.7	6.5	7.2	7.0	7.0	5.0	4.0	4.0	3.5	5.0	5.7
Menuet	5.5	4.5	6.5	6.2	8.2	7.0	7.7	8.0	5.0	3.0	3.5	3.2	4.5	5.7
C-26	6.0	7.2	7.2	7.0	8.2	7.2	7.7	4.5	6.5	5.2	6.0	6.2	6.2	6.2
Ruby	4.7	5.0	5.3	4.0	5.3	6.3	7.0	7.0	5.0	2.7	1.5	3.0	2.7	4.6
Pennlawn	4.5	5.0	4.7	4.7	5.7	6.0	7.2	5.3	7.3	2.5	2.5	4.0	5.2	5.0
Fortress	4.0	5.2	4.0	4.7	7.5	7.7	8.0	8.5	8.7	4.7	4.7	5.7	7.5	6.2
Golfrood	5.2	6.5	7.7	5.5	5.0	7.0	8.0	6.0	4.7	3.0	2.5	2.0	2.2	5.0
Spreading Polycross Progenies														
Ft. McHenry (130-17)	6.7	7.7	5.2	5.2	8.0	6.2	7.7	7.0	6.2	3.7	5.3	6.3	6.0	6.3
Ft. McHenry 2	5.0	6.7	5.0	4.7	6.0	6.7	7.7	7.0	8.3	3.0	3.3	3.7	3.5	5.4
Ethicon 162	5.7	6.3	6.0	7.0	7.7	6.0	7.0	6.0	7.3	5.0	4.3	4.3	5.7	6.0
Ethicon 121-1	5.0	6.0	5.5	5.2	7.0	7.5	8.7	7.7	8.0	3.0	3.7	4.0	4.7	5.9
Central Park Shade	6.7	6.7	6.0	5.5	7.0	6.5	6.5	6.3	5.0	4.0	4.3	5.3	4.0	5.7
Central Park	5.0	6.2	5.5	5.5	7.5	7.2	8.0	7.3	8.5	4.3	4.7	6.3	5.3	6.3
130-4	4.0	6.0	5.0	4.7	7.7	7.0	8.0	6.7	5.3	3.3	3.3	5.0	5.0	5.5
130-10	5.0	5.5	5.0	4.5	6.5	6.7	7.0	6.7	6.0	4.0	4.0	3.5	7.0	5.5
130-13	4.0	6.0	5.0	5.0	7.0	8.0	6.0	7.0	6.7	3.0	2.0	3.0	4.0	5.1
130-15	4.0	7.0	5.0	5.0	8.0	6.0	5.0	5.0	7.0	5.0	5.0	7.0	6.0	5.8
130-16	4.2	6.2	4.7	4.0	7.2	7.2	8.0	7.3	6.8	2.7	2.7	2.7	4.2	5.2
130-17	4.7	6.0	5.0	5.2	7.0	7.0	7.7	6.7	5.3	3.3	3.5	3.5	7.0	5.8
130-18	4.2	5.5	5.7	4.7	7.3	7.7	8.3	6.7	6.0	4.7	3.7	3.7	5.7.	5.7
130-19	4.5	6.2	6.0	5.0	8.0	8.3	9.0	7.7	6.7	4.0	4.0	5.0	5.0	6.1
130-20	5.0	6.5	5.5	5.5	7.5	8.5	9.0	8.5	7.0	2.7	2.7	3.0	4.3	5.8
CD-1	3.0	5.5	4.0	4.5	5.5	8.0	8.0	7.5	8.0	2.3	2.7	6.0	5.5	5.4
CD-2	4.0	4.2	4.3	4.2	4.7	7.3	8.0	6.7	6.3	3.7	4.3	5.3	4.7	5.2

Table 18. Seed yields and ratings of fine fescue progeny sown at Adelphia, I95 and Centerton under minimum maintenance.
Ratings 9 = best performance for all characters
1 = poorest performance for all characters

		Adelphia				I-95 - May 10, 1972						Centerton	
	Wt. Seed(g) 1971	CM Height 5/12/72	Color Rating 9/27/72	Dormancy Rating 4/5/73	Survival Rating 8/5/74	Color	Uni-formity	Den-sity	Appear-ance	Seed-stalks	Vigor	Color 7/8/74	Seed-heads 7/8/74
Chewings Polycross Progenies													
3438-b GEB	1400	12.3	5.0	5.5	3.5	8.7	7.7	7.5	7.7	7.0	6.2	3.0	6.3
3438-d Ft. McHenry	860	10.5	4.3	5.5	2.5	8.7	8.2	6.7	7.0	5.5	5.0	2.5	6.5
3438-g "	1030	11.0	4.5	4.8	2.8	8.7	8.2	7.5	6.5	6.7	5.0	2.0	7.3
3440-a "	1480	11.5	4.5	5.3	3.5	8.7	8.0	8.2	8.5	8.7	5.5	3.7	8.5
3440-b "	1595	11.0	5.3	4.8	3.5	9.0	8.2	7.5	6.0	4.5	5.7	2.5	7.3
3440-d "	870	10.5	4.5	5.0	3.0	8.5	8.2	7.2	8.0	7.0	5.0	2.5	7.5
3440-g "	1055	10.8	4.0	5.3	3.0	8.5	8.7	8.0	7.7	6.7	6.0	2.8	8.3
3442-g "	1560	9.7	5.0	4.8	2.5	8.5	8.0	7.0	7.0	7.2	5.0	2.8	7.3
3444-b "	760	12.5	5.3	6.3	4.5	8.2	7.0	7.0	7.2	8.5	4.5	2.8	7.7
3444-c "	1490	11.8	4.5	6.3	3.5	8.7	7.2	6.5	6.5	6.2	5.7	2.3	7.5
3444-e "	850	13.5	4.8	5.3	2.8	8.7	7.2	8.2	6.7	7.2	6.7	2.5	8.5
3444-g "	1103	16.5	4.8	5.5	4.5	8.5	7.7	7.7	5.7	6.7	4.5	2.5	7.0
3446-a "	1210	10.8	4.8	4.3	4.0	9.0	7.2	7.7	6.0	7.2	4.7	2.5	7.7
3446-d "	1540	11.5	3.8	2.7	3.0								
3446-g "	1600	17.3	4.8	4.3	2.5	8.7	7.5	7.0	6.5	7.0	4.7	2.8	7.5
3448-b "	2450	11.5	5.5	4.3	3.5	8.5	7.5	7.0	5.7	6.2	5.0	3.8	8.0
3448-d "	1325	10.8	4.5	5.0	2.7	8.7	8.0	6.7	7.7	8.0	5.7	2.8	7.5
3450-d "	1720	11.3	5.5	5.5	2.7	8.5	8.2	7.2	6.0	6.0	5.0	2.7	7.5
3450-e "	1485	13.5	5.8	4.5	3.5	8.7	6.7	8.0	8.2	7.7	5.2	3.0	7.3
3922-a Jumping brook 1	2325	11.3	5.0	3.3	4.3	8.5	8.2	7.5	8.2	8.5	4.5	3.7	7.3
3922-b Wakill	2320	11.8	4.7	4.3	3.7	8.5	7.7	7.5	5.7	3.7	4.7	4.0	8.0
3922-c Wakill	2360	11.0	5.0	4.5	3.5	8.7	7.7	7.5	5.7	3.7	4.7	3.5	6.5
3922-d Phil. Art Museum	1275	12.5	5.5	5.5	3.0	8.7	7.7	7.7	7.0	5.2	5.7	3.0	7.0
3922-e Tennant Cemetary	1930	10.3	4.5	4.8	3.8	9.0	7.5	7.5	4.0	4.7	4.0	3.0	7.1

Table 18. (continued)

	Wt. Seed(g) 1971	Adelphia CM Height 5/12/72	Color Rating 9/27/72	Dormancy Rating 4/5/73	Survival Rating 8/5/74	I-95 - May 10, 1972 Color	Uniformity	Density	Appearance	Seed stalks	Vigor	Centerton Color 7/8/74	Seedheads 7/8/74
3922-f Roosevelt Park	1490	10.3	4.5	5.5	2.5	8.7	8.0	7.0	6.5	5.2	6.7	2.8	8.0
3924-b Ft. McHenry	2490	11.3	4.8	4.5	4.0	8.7	7.7	7.5	5.7	3.7	4.7	-	-
3924-d Colonia	1955	14.0	5.3	5.8	3.5	8.7	8.2	7.2	8.5	5.5	5.0	2.5	7.3
3924-f Personal Prod.	1925	11.3	5.5	3.8	2.3	8.7	7.7	7.2	6.7	4.7	6.2	3.0	7.0
3926-d Plainfield 163	1050	11.0	4.8	5.8	2.3	8.7	6.7	7.2	6.0	4.0	5.7	2.8	7.8
3926-e Ft. Tyron N.Y.C.	1890	12.3	6.0	4.3	2.8	9.0	7.2	7.0	6.7	7.2	4.7	2.5	6.8
3928-f Bridgehampton 9	1705	11.5	4.3	6.5	3.3	8.7	8.0	7.0	6.5	5.3	6.7	2.8	7.8
3932-d "	1940	12.0	4.8	4.5	3.8	9.0	6.7	7.2	8.0	6.7	5.5	3.3	7.8
3932-e "	2030	9.8	4.5	5.0	4.5	8.0	7.2	7.2	8.0	6.7	4.2	3.3	7.8
3932-f "	2325	11.5	4.5	4.7	4.0	8.7	8.0	7.5	6.7	6.5	5.7	3.5	8.0
3934-c Bridgehampton 6	630	11.5	4.2	6.0	4.3	9.0	7.7	7.5	8.0	8.0	5.0	3.5	8.0
3938-d " 5	1720	12.0	4.5	4.3	3.3	8.7	7.0	7.7	6.5	6.2	4.7	3.0	7.7
3942-e Creek #6	1165	9.0	4.0	3.3	3.3	8.5	7.2	7.5	7.0	7.2	6.5	3.5	8.0
3944-a C.C. Mass.	400	9.5	4.3	3.0	4.0	8.5	7.5	7.5	7.7	7.7	4.5	-	-
3944-d Beachmont C.C.	1535	12.3	5.5	3.5	4.3	8.5	7.2	7.5	7.0	7.2	6.5	-	-
3946-d Oakmont #7	1785	12.5	4.5	3.0	2.5	8.5	7.7	7.2	7.2	8.2	5.0	3.3	6.8
3946-e "	1100	14.0	4.3	3.5	3.0	8.7	7.7	6.7	5.2	6.7	5.7	3.3	7.3
3946-f "	1790	11.5	4.5	3.3	3.3	8.7	8.5	7.7	6.2	7.0	5.0	2.0	7.3
Varieties													
Banner	-	12.8	4.8	4.8	3.3	8.7	8.0	7.5	8.5	6.7	5.7	3.0	6.8
Jamestown	-	-	4.8	5.0	-	-	-	-	-	-	-	-	-
Highlight	-	19.0	6.0	6.3	2.5	8.7	7.2	7.0	6.0	6.2	5.5	4.3	7.0
Pennlawn	-	22.5	7.5	6.3	2.5	8.7	7.5	8.2	7.5	6.2	6.5	6.8	8.3
C-26	-	10.0	7.5	1.0	1.3	7.0	5.7	4.0	4.0	4.7	4.0	9.0	6.0
Ruby	-	19.5	7.8	7.5	2.5	8.0	6.2	6.2	6.7	5.7	6.0	6.8	8.3
Fortress	-	17.8	5.5	6.3	2.8	8.5	6.5	6.5	6.7	6.2	6.2	3.5	6.8

Table 18. (continued)

	Wt. Seed(g) 1971	Adelphia CM Height 5/12/72	Color Rating 9/27/72	Dormancy Rating 4/5/73	Survival Rating 8/5/74	I-95 - May 10, 1972 Color	Uniformity	Density	Appearance	Seed stalks	Vigor	Centerton Color 7/8/74	Seedheads 7/8/74
Spreading Polycross Progenies													
Ft. McHenry 1 (130-17)	1570	17.0	7.0	4.3	3.5	8.5	7.0	7.5	7.0	7.5	6.2	7.0	8.5
Ft. McHenry 2	2725	27.5	7.3	5.0	5.3	7.7	8.5	7.7	6.7	5.7	7.2	6.3	8.8
Ethicon 162	2520	21.0	7.3	5.8	3.5	7.5	7.2	7.7	7.2	6.7	6.5	8.0	8.8
Ethicon 121-1	3080	23.0	7.0	4.7	2.8	8.5	7.7	7.7	7.5	8.2	7.0	7.3	8.8
Central Park Shade	2320	23.0	8.0	6.0	2.5	8.2	6.7	7.0	7.2	4.7	7.5	5.3	8.3
Central Park	2645	22.5	7.8	5.8	2.0	8.7	6.7	6.7	7.2	6.0	6.7	8.0	8.5
CD-2	-	24.5	7.3	6.0	2.3	7.7	8.3	8.0	6.7	4.7	7.2	6.0	7.8

Table 19. Characteristics of spreading fescues sown at Adelphia and maintained under close mowing.

	Leaf blight 1/2/73 9=no injury 1=severe	Turf Quality 4/6/73 9=best 1=poor	Turf Quality 7/16/73	Color 8/10/73
130-2	6.7	6.3	4.3	2.3
130-5	5.3	7.0	4.3	2.3
130-6	5.0	8.0	6.7	4.3
130-9	5.0	6.7	5.7	2.7
130-10	5.0	7.0	5.0	2.0
130-13	6.3	7.0	4.7	3.0
130-15	6.3	7.0	3.3	3.0
130-17	4.3	7.7	5.0	2.0
130-18	8.0	6.3	5.0	2.0
130-19	6.0	6.7	4.7	2.0
130-20	5.0	7.7	5.0	1.7
130-23	4.7	7.0	4.7	2.3
130-24	6.0	6.3	5.0	3.3
130-26	5.7	7.3	4.3	3.0
130-27	6.0	7.7	4.7	1.7
CD-2	5.3	6.3	5.7	5.3
3944 Central Park Shade	3.7	7.0	4.3	1.7
3944e GEB Ft. McHenry	2.0	6.7	4.0	3.7
3446-5 " "	3.3	5.7	5.3	5.3
3363 Ethic OP	5.0	7.0	5.7	3.3
3926a TPT 121-1 F-3	4.0	6.0	6.0	3.7
3928 TPT 121-6 F-3	5.3	6.3	5.7	4.0
3928 TPT 122-3 F-3	5.3	7.3	5.3	3.7
Fortress (RU-6S)	2.7	6.7	4.0	2.7
RU 21S	2.3	6.3	5.0	4.0
Pennlawn	2.0	6.0	4.3	3.7
Ruby	3.0	6.0	2.7	1.3
Banner (RU-45C)	7.3	8.3	6.3	5.7
Jamestown	8.7	7.7	6.0	4.7
C-26 HF	8.3	7.0	7.3	7.3
Highlight	8.0	8.3	4.3	2.0
Menuet	7.0	8.3	6.7	2.7
N.E. Chewings (Funk)	8.3	8.7	7.3	5.0
* LSD .05	1.7	1.2	1.4	2.2
LSD .01	2.2	1.6	1.9	2.9

*Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

Table 20. Characteristics of spreading fescues sown at Adelphia and Centerton, New Jersey and maintained under roadside conditions.

	ADELPHIA						CENTERTON	
	Foliar height (cm) 7/6/73	Seed-head height (cm) 7/6/73	Recovery from close mowing (rating) 8/10/73	Color rating 9/25/73	Foliar height (cm) 6/21/74	Seed-head per dm^2 6/18/74	Color rating 5/8/74	Seed-head rating 5/8/74
L30-2	37.3	65.7	2.5	4.8	15.5	1.0	5.3	8.0
L30-5	30.3	67.0	1.8	4.3	15.7	1.6	5.3	7.7
L30-6	37.5	67.3	2.0	7.0	14.3	1.5	4.7	7.7
L30-9	37.0	67.3	2.0	5.3	16.7	1.5	5.0	7.7
L30-10	34.7	67.5	1.8	5.0	12.0	0.8	5.3	7.0
L30-13	37.0	68.5	2.0	3.5	12.3	1.2	6.3	8.3
L30-15	35.7	69.3	1.3	4.3	15.0	1.2	7.0	7.3
L30-17	40.7	71.5	1.3	5.5	15.3	0.5	5.3	8.3
L30-18	32.0	65.7	2.5	5.8	13.5	0.5	4.3	8.0
L30-19	38.0	70.3	2.0	5.5	15.0	0.9	6.3	8.3
L30-20	29.5	62.3	1.8	5.3	13.5	2.3	5.0	7.7
L30-23	36.3	65.0	2.0	4.5	15.3	0.5	5.0	9.0
L30-24	38.0	67.7	1.8	3.3	16.7	1.7	5.0	8.7
L20-26	34.3	66.0	2.0	4.3	14.3	1.3	6.0	8.3
L30-27	37.0	70.5	1.8	4.5	16.5	1.9	5.3	8.3
ED-2	42.0	77.5	1.5	4.5	17.5	3.2	4.7	6.7
Central Park Shade	41.3	76.5	1.5	2.3	16.0	5.4	5.3	7.7
Ft. McHenry 1	45.3	82.7	1.5	2.0	14.3	3.0	5.0	8.3
Ft. McHenry 2	48.7	80.0	1.0	3.5	18.3	2.7	4.7	7.3
Ethic.	31.5	66.0	2.3	2.5	13.3	1.5	6.0	8.0
L21-1 F-3	33.7	66.5	2.8	4.5	12.7	1.5	5.3	8.0
L21-6 F-3	34.0	62.0	2.0	1.8	13.7	4.7	6.0	7.7
L22-3 F-3	30.0	66.3	3.3	4.0	13.5	0.8	6.0	8.3
Fortress (RU-6S)	43.0	72.7	2.0	2.5	15.5	4.3	4.7	7.7
RU-21S	39.0	72.0	2.0	4.5	14.3	1.4	5.3	7.3

Table 20.(continued)

	ADELPHIA						CENTERTON	
	Foliar height (cm) 7/6/73	Seed-head height (cm) 7/6/73	Recovery from close mowing (rating) 8/10/73	Color rating 9/25/73	Foliar height (cm) 6/21/74	Seed-head per dm^2 6/18/74	Color rating 5/8/74	Seed-head rating 5/8/74
Pennlawn	50.3	77.3	1.5	5.8	17.7	1.9	4.7	7.3
Ruby	46.0	69.0	1.0	2.3	14.7	4.1	4.6	7.4
Banner (RU-45C)	16.5	61.5	5.5	5.3	9.3	2.6	4.3	6.0
Jamestown	15.7	57.5	6.0	5.0	8.7	2.2	4.0	7.3
C-26	16.5	49.0	8.0	6.3	10.7	8.9	8.3	6.3
Highlight	25.3	68.0	3.0	4.5	11.0	5.9	5.3	7.0
Menuet	23.2	64.5	4.8	5.0	9.5	3.4	7.3	7.3
NE Chewings	23.0	57.7	5.0	4.5	8.5	2.4	4.3	7.0
*LSD .05	6.0	5.4	1.1	1.2	1.4	1.4	1.2	1.0
LSD .01	7.9	7.1	1.6	1.4	2.0	1.8	1.6	1.4

Color Ratings 9 = green
1 = brown

* Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

C-26 hard fescue and the Chewings type fescues were moderately resistant and this was reflected in higher turf quality rating. Banner and C-26 hard fescue had the best color by mid-August 1973.

In the minimum maintenance test at Adelphia (See Table 20), Banner, Jamestown and C-26 hard fescue were characterized by short foliage. Differences in seedhead heights between varieties were less appreciable. Banner, Jamestown and C-26 also recovered best from a single close mowing in July which, compounded by drought, caused serious loss of stand among the spreading fescues. Some spreading fescue clones as 130-6 and Pennlawn recovered color by late September. Differences in foliar height were much lessened in the spring of 1974 with no added fertility. Seedhead production was sparse with the exception of C-26 hard fescue.

Minimum maintenance plots at Centerton indicate that certain of the first generation progeny of roadside selected spreading clones proved superior to commercially available fescues, (as well as Fortress and Banner) both in better color and fewer seedheads. C-26 hard fescue was again rated high in mid-summer color but had more seedstalks than the spreading fescues. Menuet was exceptionally good for a Chewings fescue in color rating.

Another test under minimum maintenance at Adelphia consisted of 19 entries of hard fescues sown in two replicates on September 16, 1973 (See Table 21). In the spring of 1973, 'Vendome' (F. pseudovina), and F-84 (the only spreading fescue in the test) broke dormancy earlier than the hard and sheep's fescues. Late breaking of dormancy is an undesirable characteristic of these types. With the exception of F-84 there were little differences in foliar and stem height among these entries. Vendome and several hard fescues were conspicuously free of stems. Color ratings (following mowing on July 31 and removal of hay) were made on August 10, 1973. Varieties as F-84 and Barok (F. tenuifolia) recovered poorly and consequently have low color ratings.

Fine Fescue Taxonomy

The relationship among diverse species and varieties of fescues is not clear in literature, and is often confusing in common usage. Most fescues are grouped as either red fescues or tall fescues. A category known as fine fescues is being used more recently to include the sheep's and hard fescues along with the red fescues. The red fescues (Festuca rubra L.) are a sufficiently diverse group to warrant recognition of at least three subspecies as we will show.

In an effort to properly identify fine fescues collected from roadsides, received from Plant Introduction Stations, commercial

Table 21. Characteristics of hard fescues sown at Adelphia and maintained under roadside conditions.

	Dormancy rating 3/23/73	Foliar height (cm) 7/9/73	Stem height (cm) 7/9/73	Stemminess rating 7/9/73	Color rating 8/10/73	Color 10/31/73
K2-16	4.0	20.5	55.5	4.0	6.0	blue green
K2-18	4.5	17.5	58.5	4.0	6.0	green
K2-19	4.0	14.0	50.0	4.0	7.0	green
K2-20	5.0	15.5	47.0	4.5	7.5	green
K2-21	4.0	15.0	50.0	2.0	5.5	green
K2-22	4.0	19.0	47.0	7.0	5.5	green
K2-23	4.0	16.5	53.0	4.5	4.5	green
K2-24	4.5	21.0	57.5	3.5	4.5	green
K2-25	3.5	21.5	54.5	3.5	5.0	blue + green
K2-26	3.5	23.5	45.5	6.5	5.5	green
Barok	4.5	21.5	29.5	5.5	3.5	l. green
F-84	6.5	29.0	68.0	4.0	1.0	green
Sheep's	2.5	18.5	48.0	4.0	4.5	blue-green
A-9	4.5	18.5	49.0	3.0	4.5	d. green
HDU-5	5.0	19.5	53.0	6.0	5.5	l. green
HDU-7	2.0	20.0	57.0	6.5	5.0	green
HDU-10	3.0	22.5	53.0	5.5	5.5	l. green
C-26	4.5	17.5	51.0	3.5	4.0	d. green
Vendome	7.5	19.0	30.0	8.0	4.5	l. green
*LSD .05	0.9	6.6	5.9	2.1	2.4	
LSD .01	1.3	-	8.1	-	-	

Ratings 9 = best performance for all characters
1 = poorest performance for all characters

* Differences between means that exceed the LSD (least significant difference) values are significant at the 5 or 1% level of probability.

seed sources, other plant breeders, or developed from our own crosses it was necessary to develop dimensions of known taxonomic characteristics.

Under mowed turf conditions, differences among species were found in leaf width and in number of epidermal ridges (Table 22). Fine-leaved sheep's fescue (F. tenuifolia Sibth.) had the narrowest leaf and lacked prominent epidermal ridges, resulting in a roundly infolded leaf. Sheep's fescues (F. ovina L.) had a narrow 'V'-shaped leaf with an indistinct epidermal mid-rib. Hard fescues (F. longifolia Thuill.) appeared similar, possessing a 'V'-shaped leaf but typically were wider with a well defined mid-rib and two less-distinct epidermal side ridges. Chewings and spreading fescues (F. rubra) had five or more epidermal side ridges and were distinctly greater in leaf width than the sheep's or hard fescues.

Presence or absence, and size of rhizomes were useful characters to categorize types of F. rubra. Chewings-type fescue (F. rubra subsp. commutata Gaud., 2n = 6x = 42) always lacked rhizomes. Strongly rhizomatous types of F. rubra subsp. rubra Gaud. were octoploid (2n = 8x = 56). These were characterized by aggressive spread in old turf and in the nursery.

These spreading types were distinct from the hexaploid (2n = 42) types which had small rhizomes (originally described as F. rubra subsp. trichophylla Gaud.) and which should remain designated as 'creeping' fescue. However, there is no term in current popular usage to distinguish the octoploid, strongly rhizomatous types from the creeping. Therefore, to make this distinction more apparent, we propose that the term 'spreading' fescue should be used to refer to octoploid, strongly rhizomatous types of F. rubra subsp. rubra.

Chromosome counts of the fine fescues were in agreement with those previously reported (cited in Hubbard, 1968). Hard, sheep's and Chewings-type fescue clones and cultivars examined had 21 bivalents in the pollen mother cells or 2n = 42 in the somatic tissue. Red fescue as previously reported (Hubbard, 1968) exists at two ploidy levels with Chewings fescue (2n = 42) being hexaploid and F. rubra subsp. tricophylla Gaud. also hexaploid (as typified by Dawson creeping fescue). F. rubra subsp. rubra Hack. is octoploid (2n = 56) and is represented in this study by Ruby and clonal parents of Fortress (RU-6S). Differences in ploidy levels within the subspecies of F. rubra should place a complete isolation barrier between the creeping (2n = 42) types and strongly rhizomatous (2n = 56) types.

Table 22. Vegetative characteristics of selected fine fescues taken from the 1972 regional test at New Brunswick, New Jersey.

Fescue type	Variety	Species	Number of prominent epidermal ridges	Range of leaf width in mm.
Fine-leaved sheep's	S70-2	F. tenuifolia	0	0.2-0.5
Sheep's	Barok	F. ovina	0*,1	0.3-0.5
Hard	HZ-71-4	F. longifolia	0*,1	0.5-0.7
Hard	C-26	"	1*,rarely 3	0.4-0.8
Hard	Scaldis	"	1*,rarely 3	0.4-0.7
		F. rubra subsp.		
Chewings-types	Banner	commutata	3,4,5*	0.8-1.2
"	Horritine	"	3,5*	0.7-1.3
"	Scarlet**	"	3,5*	0.8-1.2
"	Waldorf	"	3,4,5*	0.8-1.2
"	Polar	"	3,4,5*	0.8-1.2
"	Ore K	"	3,4,5*	0.9-1.3
"	Flevo**	"	3,4,5*	0.8-1.5
"	Amboise	"	3,4,5*	1.0-1.2
"	ERG 11	"	4,5*	1.1-1.4
"	Jamestown	"	3,4,5*	1.0-1.4
"	Koket	"	3,4,5*	1.0-1.5
"	Barfalla	"	3,4,5*	1.0-1.5
"	Encota	"	5	0.9-1.3
"	Menuet	"	5	0.9-1.5
"	Highlight	"	5	1.0-1.5
Rhizomatous Cultivars		F. rubra subsp.		
Creeping (small	HF-11	tricophylla	3,5*	0.8-1.2
" rhizome)	Dawson	"	4,5*	1.0-1.4

Table 22. (continued)

Fescue type	Variety	Species	Number of prominent epidermal ridges	Range of leaf width in mm.
		F. rubra subsp.		
Spreading (coarse	Boreal	*rubra*	4,5*6,7	1.0-1.8
" rhizome)	Pennlawn	"	3,4,5*	1.2-1.5
"	F-84	"	3,5*	1.2-1.8
"	Roda	"	5	1.0-1.4
"	Fortress	"	5	1.2-1.8
"	Durlawn	"	5	1.3-1.7
"	Novarubra	"	5	1.3-1.8
"	S59	"	5	1.0-1.5

* most common number observed

** described as Chewings types, but plants with rhizomes were found.

Further evidence for reproductive isolation is that with clones selected from locally adapted populations in a space-planted nursery, there were considerable differences among sheep's, hard, and red fescue with respect to flowering date and the time at which the bulk of the pollen was shed (Table 23). Generally, sheep's fescue types flowered earliest in the season, followed successively by hard and red fescue, so that one group shed the majority of its pollen before another group initiated flowering. Differences in flowering date may thus account for considerable reproductive isolation between species.

Perhaps more important, in terms of reproductive isolation, however, were differences in time of day when flowering occurred. (Table 23). Chewings-type fescues shed their pollen prior to 6 a.m. while anthesis of creeping and spreading fescues occurs from 3-5 p.m. at New Brunswick, N. J. These times have been observed on days favorable for pollination during four flowering seasons. Likewise, there appeared to be a difference in hour of anthesis between the sheep's and hard fescues. Hard fescues initiated anthesis prior to 8 a.m. while sheep's fescues shed pollen abundantly just prior to noon.

Time of flowering, or hour of pollen shed is an important mechanism of isolation enforcing speciation if grass pollen is very short lived. Percentages of germinated fescue pollen grains were tabulated to assess pollen longevity in artificial culture. It was apparent that pollen shed at 6 a.m. was incapable of germinating in the early afternoon. A similar reduction in pollen germination occurred in the spreading fescues which flowered in the late afternoon.

Thus, pollen viability is of most practical concern with regard to the reproductive isolation occurring within subspecies of F.rubra. It is apparent from field observations and the above data that Chewings-type and spreading type fescues are reproductively isolated by the relatively short period of pollen viability and the large time difference between time of anthesis of Chewings and spreading types. Pollen shed by the Chewings fescues in the early morning is dead by early afternoon, several hours prior to anthesis of spreading fescues. Likewise pollen shed in the late afternoon by the spreading fescue is incapable of pollinating stigmas of Chewings fescues flowering the next morning.

It is likely that under field conditions grass pollen is even more short-lived due to higher temperature and higher solar radiation during the season of pollination in late May and early June.

Table 23. Date of flowering and hour of anthesis of fine fescue clones and cultivars in the nursery at Adelphia and New Brunswick.

Types	1970	1971	1972	Hour of Anthesis
Chewings	5/28-6/3 53 clones	5/31-6/8 5 cultivars	6/5-6/12 14 clones	Prior to 6 a.m.
Spreading	6/5-6/10 7 clones	6/1-6/6 2 cultivars	6/6-6/12 23 clones	3-5 p.m.
Creeping	-	6/1-6/6 2 cultivars	-	2-4 p.m.
Sheep's		5/23-6/5 4 cultivars	5/24-6/1 11 clones	11-12 a.m.
Hard	-	5/25-5/28 2 cultivars	5/26-6/1 7 clones	Prior to 8 a.m.

The abundance of pollen grains available to a receptive stigma at anthesis and the speed with which these germinate support the hypothesis of reproductive isolation based on hour of anthesis. Once pollen grains have grown deep into the stigma to insure fertilization, the subsequent application of pollen from a later flowering plant would have no effect. This would combine a short period of stigma receptivity in the presence of abundant pollen with a limited period of pollen viability. This would be effective in preventing out-crossing of plants belonging to different flowering groups. Table 24 summarizes the characteristics and nomenclature of the various types of fine fescues.

Attempts to make interspecific crosses between the fine fescue species under discussion and among the subspecies of F. rubra have met with little success in isolated crossing and the usual result is selfing, (fertilization with the plant's own pollen). Emasculation of fescue panicles because of their small size and structure is particularly tedious and difficult. However, the chances for hybridization could be improved through the use of highly self-incompatible parents to make reciprocal crosses. Therefore, another phase of investigation was to assess self-compatibility of promising fescue clones.

Selfing studies on clones of Chewings-type and spreading type fescues revealed that production was reduced by selfing in all instances. Some clones set almost no seed when selfed while in some others the percent seed-set approached that of open pollinated panicles from the same plant. It was apparent that differences in degree of self-incompatibility existed in both species, with the greatest differences occurring among the Chewings types.

Further Research on Fescues

Observations in our selection nursery indicate further improvements through selective breeding can be made, particularly among spreading fescues selected from roadsides (See Figure 6). Plants in the third generation of selection are lower growing, denser, greener and have more desirable seed producing characteristics (high fertility of florets, uniform ripening, minimum shattering, and ease of threshing of seed) than the original selected parents, which flower and ripen seed earlier in the season. Early flowering usually occurs in cooler weather which is better for ripening quality seed (i.e. plump, full seed; free from diseases such as smut or ergot, which intensify as the season progresses).

The objective of the fine fescue improvement program has been to develop superior multiple-use fescue varieties. The basic

Table 24. Characteristics of fine fescues.

Type	Species	Height	Spread	Texture	Chromo. No.	Hour of flower	Typical Varieties	Color
Chewings	F. rubra L. subsp. commutata Gaud.	low	v. little	fine	42	6 a.m.	Highlight Jamestown Banner	lt. green dk. green med. green
Creeping	F. rubra L. subsp. trichophylla Gaud.	med.	little	med.	42	2-4 p.m.	Dawson Golfrood	med. green lt. green
Spreading	F. rubra L. subsp. rubra	mod. tall	good	broader (like Ky. bluegrass)	56	3-5 p.m.	Fortress Ruby Boreal	dk. green dk. green dk. green
Hard	F. longifolia Thuill	low	v. little	fine	42	6-8 a.m.	C-26	dk. green
Sheep's	F. ovina L.	low	v. little	wiry	28,42	12 noon	none available	blue-green
Pseudo-ovina	F. pseudovina	low	v. little	f. wiry			Vendome	v. lt. green
Fine-leaved sheep's	F. tenuifolia Sibth.	low	v. little	v. fine	14		Barok	lt. green

Figure 6. A dense, dark green, low-growing fine fescue found in the median of Route 130 near Robbinsville, New Jersey.

materials are naturally occuring fine fescue clones which possess a high degree of adaptation to New Jersey conditions. Presently, the Chewings type 'Banner' and the spreading type 'Fortress' fescues have shown sufficient promise under roadside testing, turf culture and seed production to encourage commercial release. These fescues, together with commercially available long-leaved Kentucky bluegrasses, should constitute superior mixtures for roadsides.

Parallel progeny evaluations of individual plant selection are carried out under both intensive turf evaluations in mowed plots and in unmowed plots under roadside conditions. The former provides data on turf quality and disease resistance. The latter provides data on adequacy of cover, stemminess, smothering and color. Under close, frequent mowing, and high N fertility, selection for resistance to leaf blotch and blight disease caused by Helminthosporium and other fungal pathogens devastating to fescue turf is essential. Hence, progeny testing under different management situations provides information how a selection transmits its characters through seed to its progeny.

Thus, the overall effort is to concentrate genes for desirable characteristics in a population through repeated selection and crossing of increasingly superior types. Eventually, elite

individual plants will be combined in one or more synthetic varieties by a progressive method of plant breeding; the polycross.

A polycross is a breeding procedure in which superior clones selected for particular characteristics or performance are propagated vegetatively, and planted in rows according to a randomized and replicated design to facilitate maximum inter-pollination.

The clones are harvested individually, dried and threshed. Seed of each clone is progeny tested in a replicated variety trial against known varieties. A specified amount of the seed of each clone is bulked (Syn.) for varietal testing at various locations in this country and in international variety trials. During varietal testing the parental clones are re-evaluated by periodic rating for appearance, disease resistance, persistence and seed yields. The variety is thus improved in steps. New clones may be added to increase the gene frequency in the population for various characters.

The breeder controls the composition of the variety through the maintenance of the parental clones, and the addition, deletion or substitution of these clones to improve the variety or correct any deficiencies. It is the breeders responsibility to furnish synthetic seed for the seed grower periodically on request. An agreement limits the number of years for which a seed producer can grow seed from a field established from breeders seed and still insure varietal identity.

Response of Grasses to Soil pH

Species adaptation to soil pH has been generalized in the literature without much experimental evidence. It is generally accepted that low soil pH may be one of the limiting factors in adequately establishing and maintaining a turf on many roadside and other low maintenance areas. Liming is widely practiced to alleviate excess soil acidity. Movement of lime through the soil profile is relatively slow; usually an inch per year, depending on soil texture. Surface liming may not always be adequate to correct soil acidity in time to establish an adequate vegetative cover.

A series of trials were conducted in the field on Freehold sandy loam that had been previously adjusted to provide a range of soil pH from 4.2 to 7.6. The details of plot design, soil profile, soil chemistry, and chemical analyses of plant tissue are given in a Master of Science thesis by A. J. Palazzo, Rutgers 1973, and also Palazzo and Duell 1974. A follow-up study was

done by R. Edelberg and is currently in preparation as a Master's thesis at Rutgers.

In both of the above studies the spreading fescues performed well at low soil pH. As anticipated legumes, including crownvetch, grew poorly at low pH. Their initial emergence was adequate, but seedlings subsequently died at lowest soil pH. Field emergence of grasses, even reputedly acid-tolerant Canada bluegrass and redtop, was noted to be impaired at low soil pH.

Evaluations of two other soils, a Penn sandy loam and a Sassafras loam, in addition to the Freehold sandy loam, were conducted in greenhouses. These soils were adjusted to a range of pH values similar to those in the field. Inhibition of emergence appeared to be related to a certain minimal exchangeable aluminum level in all three soils. For the fine fescues tested this value appears to lie between 1 and 3 milli equivalents of exchangeable aluminum per 100 grams of soil.

Adequate liming of these three soils significantly reduced aluminum availability and enhanced seedling emergence. Phosphorus fertilization often enhances seedling development and also ties up toxic levels of soil aluminum. In these tests, however, relatively high levels of phosphorus fertilization failed to reduce aluminum values and improve seedling emergence from low pH soils. Only adequate liming, to pH 5.2, sufficed.

Mulches

If we are to build minimum mowing into roadside mixtures by specifying only fine textured grasses, then we should avoid even inadvertent inclusions of coarse grasses. Establishment of coarse hay-type species frequently occurs through viable grass seed in the hay mulch applied over the grass seeding. These frequently include orchardgrass (Dactylis glomerata L.), Timothy (Phleum pratense L.), bromegrass (Bromis inermis Leyss.) and reed canarygrass (Phalaris arundinacea L.). Hay-type species volunteering from seed in hay mulches may dominate certain roadsides often as distinct patches. This is particularly conspicuous when fine grasses are sown. Specifying a straw mulch rather than a hay mulch is particularly important in this instance. Most broadleaf weed species can be selectively removed from turfgrass mixtures with herbicides, but perennial grasses cannot. Although specifications typically prohibit seed in the mulch, the seeds of perennial grasses are often overlooked. The seed of cereal crops in straw would be easier to detect, and if excessive, the straw should be rejected for mulch purposes.

The importance of seed-free mulch was demonstrated in a test at Adelphia in which bales of hay intended for mulching roadsides were obtained from several contractors and compared to seed-free Midland bermudagrass hay for mulch.

An area was treated with methyl bromide to kill soil born weeds, and after three days, rows of fine grasses and legumes were sown. One and two ton rates of seven sources of mulch hay were applied to three replicates of our standard size plots.

Only the plots mulched with Midland bermudagrass hay developed pure stands of sown species. Figure 7 shows grass contamination of plots with volunteer grasses from the various sources of hay. Timothy (Phleum pratense L.) and orchardgrass (Dactylis glomerata L.) were the most abundant perennial grasses. Rye (Secale cereale L.) as an unthreshed contaminant was conspicuous as a volunteer from certain mulches. These contaminants of mulches seriously impaired the establishment of desirable species.

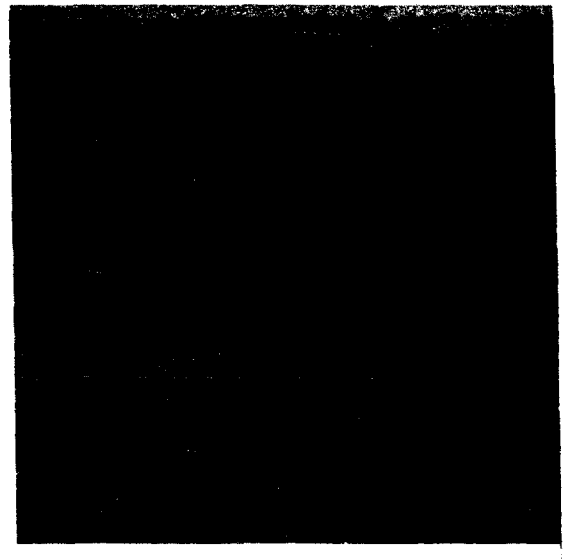

Figure 7. Volunteer grasses from various hay mulches mask rows of smaller species sown across weed-free soil. Plots 1 and 2 are unmulched.

CONCLUSIONS

Comparisons of grass species for roadsides indicate that fine textured grasses with moderate vigor would maintain more acceptable cover with less mowing than coarse hay-types. Varieties within species varied significantly. Contracts which fail to specify varieties of superior adaptation will usually result in inferior turf. Commercial availability of consistently superior varieties of fine fescues suited to roadsides was questioned. Hence, a program of development of locally adapted varieties was pursued.

Varieties or species that appear promising in early stages may not be the best vegetative cover to perpetually fulfill the basics of the "Complete Highway," that is designed for utility, safety, economy, and beauty. Ryegrasses, particularly under infrequent mowing, produce such an abundance of foliage and stems initially as to be excessively competitive with associated perennial grasses. Perennial ryegrasses disappeared completely from roadside plots after two to three years. Tall fescues were stemmy, coarse, and became sparse and eventually provided insufficient cover on poor sites. Stems of these and other coarse grasses were conspicuous more months of the year than those of certain fine fescue and Kentucky bluegrass varieties. Designation of variety was important also with regard to color characteristics during summer drought and spring breaking of dormancy.

Hay mulches frequently contain sufficient viable seeds of coarse grasses to negate the advantages of well-planned mixtures of superior fine-textured grasses. Proper mulching with weed-free grain straw would minimize coarse grass contamination and eliminate the need for annual species as "nurse" or "companion" grasses in seed mixtures. Selected varieties of spreading fescues and common-type Kentucky bluegrasses have sufficient vigor to establish well before a proper protective mulch degrades.

Selected fine fescues were found to be superior in several characteristics. These grasses should provide a more attractive roadside cover with less maintenance than is presently expended for mixtures dominated by tall fescue.

Fine fescue improvement requires a thorough understanding of isolating factors preventing or restricting cross breeding. Crossing of fine fescue types appears limited by anthesis date, hour of pollen shed and/or differences in chromosome number. Strongly rhizomatous Festuca rubra subsp. rubra plants have a chromosome number of 56, thereby isolating them from 42 chromosome, weakly

creeping types. Both, however, shed pollen in late afternoon. Chewings fescues (F. rubra subsp. commutata) and hard fescues (F. longifolia Thuill.) both have 42 chromosomes, and shed pollen in early morning. Typically, anthesis is several days later in the Chewings types than in hard fescues. Preliminary studies of pollen germination in vitro indicate that pollen viability drops off rapidly after dehiscence. Pollen shed in late afternoon by rhizomatous fescues lost viability by late evening. This reproductively isolates Chewings-type fescues from the rhizomatous types.

'Banner' and 'Fortress' developed at Rutgers under the present contract have performed well in small plot roadside testing and with distinction in varietal trials throughout the United States and in Europe. Both varieties are presently in commercial production in Oregon. Seed will be available soon in limited quantities.

It is anticipated that the lower growing finer textured commercial fine grasses and newly developed Fortress and Banner mixtures will require 2 to 3 less mowings per year. Based on the present New Jersey Department of Transportation's mowing costs the projected dollar savings will be $34 to $51 per acre per year. The difference in seed cost will be insignificant. Environment enhancement will be a simultaneous bonus. The above mixtures will have better tolerance to lower soil pH and fertility than present mixtures.

We concluded that to meet the objectives stated earlier, most of New Jersey's roadsides should be sown to a 1:1:1 ratio of certified seed of a spreading fescue, a Chewings or hard fescue, and a common-type Kentucky bluegrass.

RECOMMENDATIONS

The following recommendations pertain particularly to the typical loamy soils that are widespread through central New Jersey.

1. Most of New Jersey's roadsides and similar environments should be sown to a 1:1:1 ratio of certified seed of a spreading fescue, a Chewings or hard fescue, and a common-type Kentucky bluegrass. The following are suggested as desirable cultivars.

Spreading fescues	Chewings or hard fescues	Kentucky bluegrasses
Fortress	Banner	Kenblue
Pennlawn	Jamestown	South Dakota
Ruby	C-26	Delta

Preferred cultivars are listed above less desirable cultivars. A mixture of any combination of three categories should be sown at rates of 40-80 pounds per acre.

2. These lower growing finer textured grasses, having fewer seedstalks exclude weeds better and will, therefore, require 33 to 50% less mowing. Dollar savings will be proportionate and environmental enhancement will be a simultaneous bonus. These mixtures have better tolerance to lower soil pH and fertility than present mixtures. Differences in seed cost should be insignificant.

3. Most critical time of mowing is signaled by seedstalk elongation. Logistics and aesthetics may dictate mowing before and after this stage. Second most important mowing stage is in the fall; to curtail possible smothering on productive sites. Height of cut should not be less than 4".

4. Fertilization at seeding should be limited to 300 lbs. per acre of 10-20-10, incorporated 4" deep. An additional application of 30 lbs. of N per acre should be applied to seedlings approximately six months after seeding.

5. Straw should be used for mulch in preference to hay, particularly where fine grasses are to dominate. Straw should be well threshed to minimize contaminating seed. It should not be rotted as this would reduce its persistence on the soil surface. Rate of application may vary from 1 to 2 tons per acre which provides from 75 to nearly 100% coverage of the soil surface.

6. The development of a spreading fescue cultivar from stock on hand, improved through four generations of crossing and selecting, should be completed.

7. Alternative species for special roadside situations should be researched.

8. Improved seedling establishment techniques should be developed to assure coverage by sown species and exclude (maintenance-requiring) weeds.

9. Roadside renovation should be investigated as another means of introducting better vegetative cover requiring less mowing.

REFERENCES CITED

Boeker, P. 1969. The turfgrass situation in West Germany. Proceedings of the First International Turfgrass Research Conference. pp. 4-7.

Hottenstein, W. L. 1969. Highway Roadsides. In Turfgrass Science. Monograph 14. Amer. Soc. of Agron., Madison, Wisc. pp. 603-637.

Hubbard, C. E. 1968. Grasses. Penquin Books. Middlesex, England, and Baltimore, Md.

Langvad, B. 1969. Seeding techniques for establishing grass on Swedish roadsides. Proceedings of the First International Turfgrass Research Conference. pp. 580-583.

Martin, D. P. and J. E. Kaufman. 1970. Ecological relationships in establishment of roadside grass communities in Michigan. Agron. Abstracts. p. 73.

Schmit, R. M. 1974. The morphology, turf performance and breeding behavior of fine-leaved fescues. M. S. thesis. Rutgers University, New Brunswick, N. J.

White, D. B. and M. H. Smithberg. 1972. Turf method and materials for Minnesota highways. Final Report.

PUBLICATIONS

Duell, R. W. 1972. New concepts on grass to cope with old roadside maintenance problems. Rural and Urban Roads, Vol. 10, No. 3. pp. 48-51.

Duell, R. W. and R. M. Schmit. 1974. Grass varieties for roadsides. E. C. Roberts (ed.). Proceedings of the Second International Turfgrass Research Conference. Amer. Soc. of Agron., Madison, Wisc. pp. 541-550.

Duell, R. W. and R. M. Schmit. 1975. Better grasses for roadsides. Executive Summary, a special publication by the New Jersey Department of Transportation for the Transportation Research Board. pp. 1-25.

Edelberg, R. 1975. The effect of soil pH on emergence and growth of grasses. M. S. Thesis. Rutgers University.

Palazzo, A. J. 1973. The response of turfgrasses to soil pH and high Mn concentrations. M. S. Thesis. Rutgers University.

Palazzo, A. J. and R. W. Duell. 1974. Responses of grasses and legumes to soil pH. Agron. Jour. 66:678-682.

Schmit, R. M. 1974. The morphology, turf performance and breeding behavior of the fine-leaved fescues. M. S. Thesis. Rutgers University.

Schmit, R. M., R. W. Duell, and C. R. Funk. 1974. Isolation barriers and self-compatibility in selected fine fescues. Proceedings of the Second International Turfgrass Research Conference. E. C.Roberts (ed). Amer. Soc. of Agron., Madison, Wisc. pp. 9-17.