Establishing Sericea on Highway Slopes

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Turf for erosion control should be composed of adapted plants that can be quickly and easily established at low costs. The root system, plant persistence, and fertility requirements are also important factors to consider in turf species.

Lespedeza cuneata, hereafter called sericea, is a deep-rooted perennial legume that is widely adapted in the southeastern United States. This legume is persistent because of its tolerance to dry soils, reasonably low temperatures, low fertility, and acid soils. It is also persistent because it is not readily injured by diseases and insects and it is aggressive toward weeds. It has a deep, vigorous taproot system, hence it is a desirable plant for erosion control. The cover provided by leaf litter gives additional protection from erosion; accumulation of such leaf mulch has been observed to be of considerable magnitude over a period of years (1). The short growing season and frost-browned foliage are objectionable. Established sericea is an effective plant for erosion control (1). However, because sericea is slow to establish, special precautions must be taken to control erosion during the initial period of growth. One or more quickly establishing species seeded with sericea helps control erosion, but this competition may destroy sericea seedlings. Kentucky 31 fescue and redtop seedlings are very competitive toward the less vigorous sericea seedlings; Kentucky 31 fescue and redtop produced 4.8 and 3.1 times as much growth, respectively, in 51-day-old seedlings as did sericea (3). High nitrogen fertilization was found to be deterimental to the stands of certain legumes (4). It is also well known that nitrogen fertilization augments grass growth and its aggressiveness toward seedling legumes.

The experiment reported here is a study of seedling competition and establishing stands of sericea as related to seeding rates and mixtures of grasses with rates of nitrogen fertilization.

PROCEDURE

Seventy-five pounds of sericea per acre was seeded with the grass species and mixtures used in factorial treatment combinations with three nitrogen rates (Table 1). The experiment was established March 27, 1961, on two southerly exposed 2:1 cuts on Highway 11 in Pulaski County, Va.; one replication on each of the two slopes (Fig. 1). The soil was uniformly treated with 100 lb of K_2O, 200 lb of P_2O_5 and 1 ton of finely ground dolomitic limestone per acre. A check of no-nitrogen was omitted due to the very low soil nitrogen in these subsoils and parent materials.

The seedbed was prepared by hand raking. The seed and fertilizer were applied by hand after mixing with sawdust to give more bulk for a more even distribution. The entire experiment was mulched with approximately 1.5 tons of straw per acre which was sprayed with a liberal application of asphalt. All data through August are based on actual stand counts and seedling weights; September data are based on visual estimates of percent cover and plant heights. Stand counts, taken 50, 75, and 122 days after seeding, were made with quadrats. Totals of 6, 12, and 36 sq ft per plot were sampled on each of the respective dates. Early counts were made with quadrats 6 by 24 in.; later in the season, the large-sized plants necessitated the use of quadrats 12 by 24 in.

RESULTS AND DISCUSSION

Early Sericea Establishment

Sericea Stands.—The data from stands of sericea on three sampling dates as influenced by nitrogen fertilization, species, mixtures, and rate of seeding is given in Table 1 and some of the data are shown in graphs (Figs. 2 to 4). Nitrogen fertilization caused drastic stand reductions of sericea as shown by samplings on June 7 and July 25. For example, on July 25, there were 45, 30, and 22 plants per sq ft, respectively, for 20, 60, and 120 lb of nitrogen per acre. Sericea stands decreased as nitrogen fertilizer applications promoted increased grass growth and aggressiveness. The sericea stands were not appreciably affected in May by nitrogen because the grass seedlings were small and had not yet responded to the nitrogen boost; also, there was little competition for moisture and nutrients at this time.

On May 13, the moderate seeding rates of grass associates appeared to be beneficial to sericea stands at the higher nitrogen levels (Table 1). Nitrogen absorption by the grass association apparently reduced the harmful effect of soluble nitrogen salts in the seedling zone. When nitrogen salts were applied at the 20-lb rate the grass associations were harmful to sericea stands. Comparing the data taken in May

TABLE 1

EFFECT OF SPECIES, MIXTURES, AND NITROGEN FERTILIZATION ON SERICEA STANDS[1]

Sampling Date (1961)	Grass Seeding[2] Mixer	Rate (lb/acre)	Sericea Stands (plants per sq ft) 20 Lb N per Acre	60 Lb N per Acre	120 Lb N per Acre	Avg.
May 13	None		37	18	20	25ab
	Fescue	15	31	27	28	29ab
		60	20	23	24	22bc
	Redtop	1	41	32	29	34a
		10	18	25	21	21bc
	Fescue and redtop	15 + 1	25	26	19	23bc
		60 + 10	15	16	9	13c
	Average		26	24	21	
June 7	None		41	30	22	31a
	Fescue	15	32	20	19	24ab
		60	23	12	7	14bc
	Redtop	1	32	21	15	23ab
		10	26	13	8	16bc
	Fescue and redtop	15 + 1	27	18	12	19b
		60 + 10	17	6	4	9c
	Average		28a	17b	12b	
July 25	None		53	47	42	47a
	Fescue	15	36	31	25	31b
		60	40	24	10	25b
	Redtop	1	55	28	19	34ab
		10	51	27	28	35ab
	Fescue and redtop	15 + 1	40	27	23	30b
		60 + 10	39	23	5	22b
	Average		45a	30b	22b	

[1] Average values in a column or a row not having the same letter differ significantly.

[2] Each plot contained 75 lb of sericea per acre.

Figure 1. General view of one replication, September 14, 1961. Foreground is plot with 60 lb of Ky. 31 fescue and 20 lb of nitrogen per acre. Plot being observed has 10 lb of redtop and 120 lb of nitrogen per acre. Sericea, 75 lb per acre, was seeded over entire area. Experiment established March 27, 1961; plots are 12 by 40 ft in size and located vertically on slopes to minimize variance among treatments.

for the 20-lb nitrogen application, the heavy seeding of redtop gave 18 sericea plants per sq ft, whereas there were 37 sericea plants per sq ft with no grass association.

Stands of sericea were reduced after the grasses became well established as shown by the data taken in June and July (Fig. 3) (Table 1). Stands of sericea were reduced as seeding rates of individual grasses or grass mixtures were increased. Low grass seeding rates, 1 lb of redtop or 15 lb per acre of Kentucky 31 fescue, did not seriously reduce the stands of sericea. For example, on July 25, there were 47 sericea plants per sq ft without grass as compared with 37 and 22 plants, respectively, when seeded with 1 lb of redtop and a heavy seeding rate of a Kentucky 31 fescue-redtop mixture. During early seedling establishment, only the heavy seeding rates of individual grasses or grass-mixtures reduced sericea stands. Kentucky 31 fescue at high and low seeding rates was more harmful to sericea stands than redtop. Moreover, the 1-lb redtop rate had 1.5 times more seed per unit area than the 15-lb rate of Kentucky 31 fescue. These data support earlier work of Blaser, et al. (2), showing tall fescue to be more aggressive than redtop.

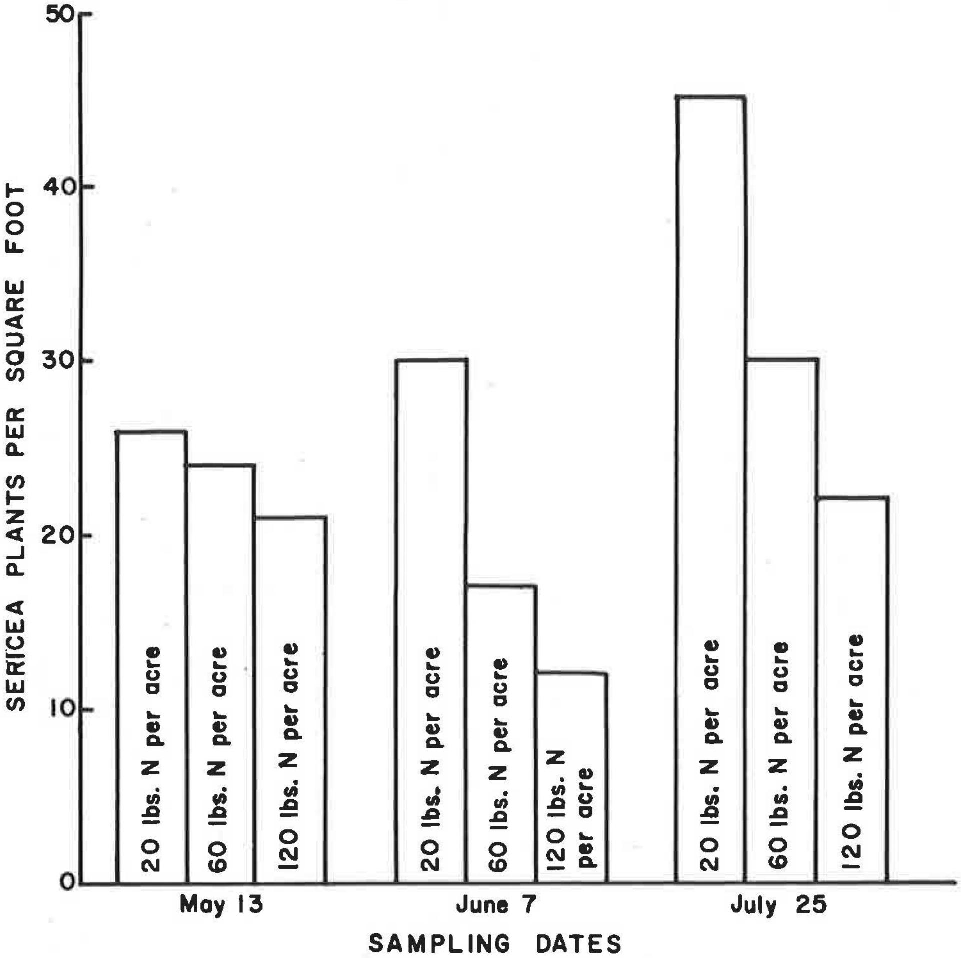

Figure 2. Sericea population as influenced by nitrogen fertilizer. Experiment established in March when all nitrogen was applied. Values are averages for all mixtures at three dates of sampling.

The combined effect of grass associations and nitrogen fertilization on stands of sericea in July is shown in Figure 4. Nitrogen fertilizer reduced the stands of sericea when grown alone or with any grass association. Sericea stands were seriously lowered when heavy rates of nitrogen were used for any grass-sericea seeding treatment; these reductions in sericea stands are in agreement with the data reported for other legumes (4). Reduction in stands at all dates due to high seeding rates of companion grass is attributed to seedling competition and the superior vigor of seedling grasses. Generous nitrogen applications augmented the aggressiveness of the grass. Although nitrogen fertilizer with grass associations reduced the sericea stands, the stands were satisfactory for all grass associations when no more than 60 lb of nitrogen were used. To avoid erosion when establishing sericea, it appears practical to use about 40 lb of nitrogen per acre, along with a light seeding rate of a grass or a mixture of grasses.

Seedling Growth of Sericea and Grasses.—Data were taken on the above-ground growth of sericea, redtop, and Kentucky 31 fescue seedlings for the nitrogen treatments with the grass seeding rates and mixtures (Table 2) (Fig. 5).

During early establishment (see data for June) nitrogen had little effect on the size of sericea plants. Sericea plant sizes were decreased by seeding any grass or grass mixture with it. Sericea plants were the smallest when associated with the grass mixtures at heavy rates of seeding.

In July, the weight of sericea plants grown without grass increased as nitrogen was added, but nitrogen reduced the size of sericea plants when grown in sericea-grass mixtures. Also, in July, sericea seedlings without companion grasses were 53 percent larger with 120 lb of nitrogen than on the plots with 20 lb of nitrogen; however, the sericea plants with the heaviest grass mixture were 60 percent smaller with 120 lb of nitrogen than with the 20-lb nitrogen rate. The fact that grass associates reduced the size of sericea seedlings at the two nitrogen levels is clearly shown in Figure 5. Moreover, grass associates with only 20 lb of nitrogen per acre did not appreciably affect the growth of sericea plants.

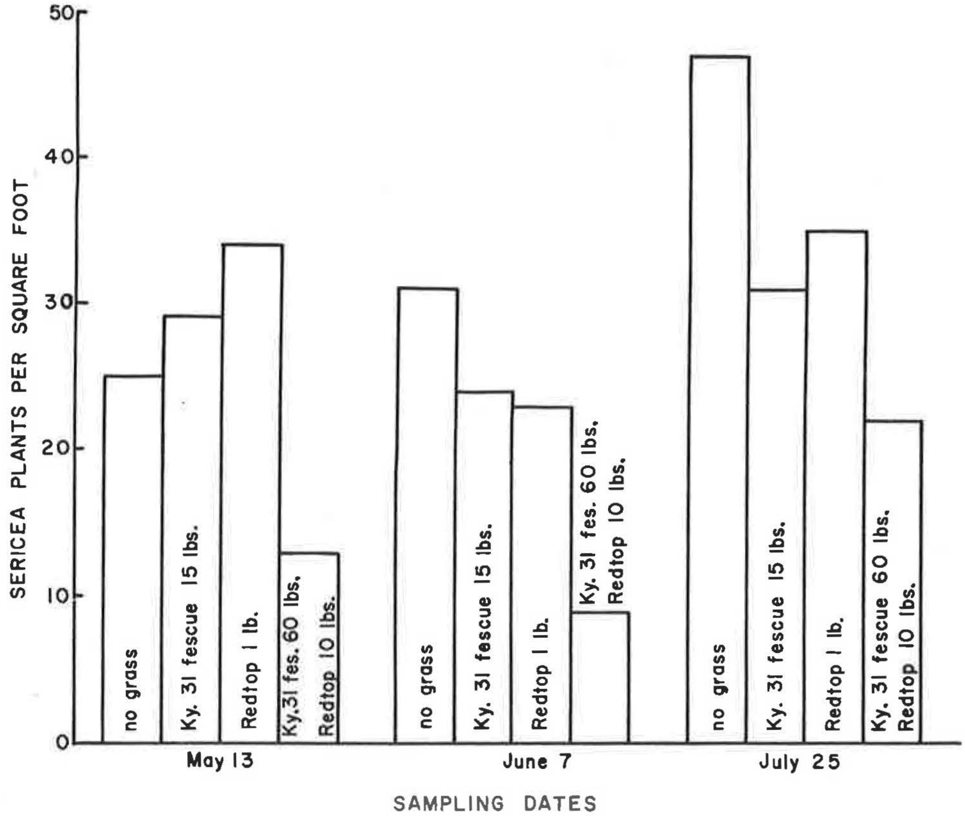

Figure 3. Sericea population as influenced by grass species and mixtures. Values are averages for all nitrogen rates; all mixtures contained 75 lb of sericea per acre.

The effects of nitrogen and seeding rates on the comparative size of the grass and sericea seedlings are given in Table 3. High nitrogen fertilization increased the size of Kentucky 31 fescue and redtop seedlings with a given seeding rate. However, the grass seedling weights were decreased by heavy seedings for a given nitrogen rate. The reduction in plant size of all species with high seeding rates of grasses is attributed to inter- and intra-species competition; the grass seedlings were competitive toward sericea as well as with each other. In July, the light seeding rates of Kentucky 31 fescue and redtop increased sericea size at the 60-lb nitrogen rate (Table 2). This increase in sericea size may be due to the previously mentioned reduction in salt concentration caused by the absorption of these salts by the grasses. However, because nitrogen fertilization greatly increased the size of sericea plants without grass associates, factors other than the reduction of harmful salt concentrations may also have been of importance. It is possible that the light seeding rates of grasses reduced weed competition, increased the infiltration of water, reduced the soil temperatures, or moderated severe temperature changes in the soil.

Yield. —Yield data were obtained by multiplying plants per square foot by plant weight (Table 4). Some of the data are shown in Figure 6. Yields are not of primary concern in highway turf; nevertheless, yields are excellent indicators of sod establishment and sod stabilization. Nitrogen fertilization generally reduced the yields of sericea; these reductions even occurred without grass associates. As previously mentioned, nitrogen fertilization increased the size of sericea plants, but the reduced stands caused a net reduction in sericea yields, Figure 7.

All grass species or mixtures reduced sericea yields. Heavy grass seeding rates lowered the sericea yields more than the light seeding rates. The greatest reductions in sericea yields were with heavy seedings of grass mixtures that were also fertilized with high rates of nitrogen. It is readily apparent that heavy grass seedings and high nitrogen fertilization cannot be used together to establish sericea. It seems that high nitrogen fertilization without grass is not only unnecessary, but even wasteful. Heavy seedings of grasses, with low rates of nitrogen, are not excessively harmful, but moderate seedings of grasses appear desirable for erosion control.

Established Stands of Sericea

The September data on percent ground cover and yields were based on visual estimates (Tables 5 and 6). These data are considered as the end results of establishing sericea. Heavy nitrogen fertilization

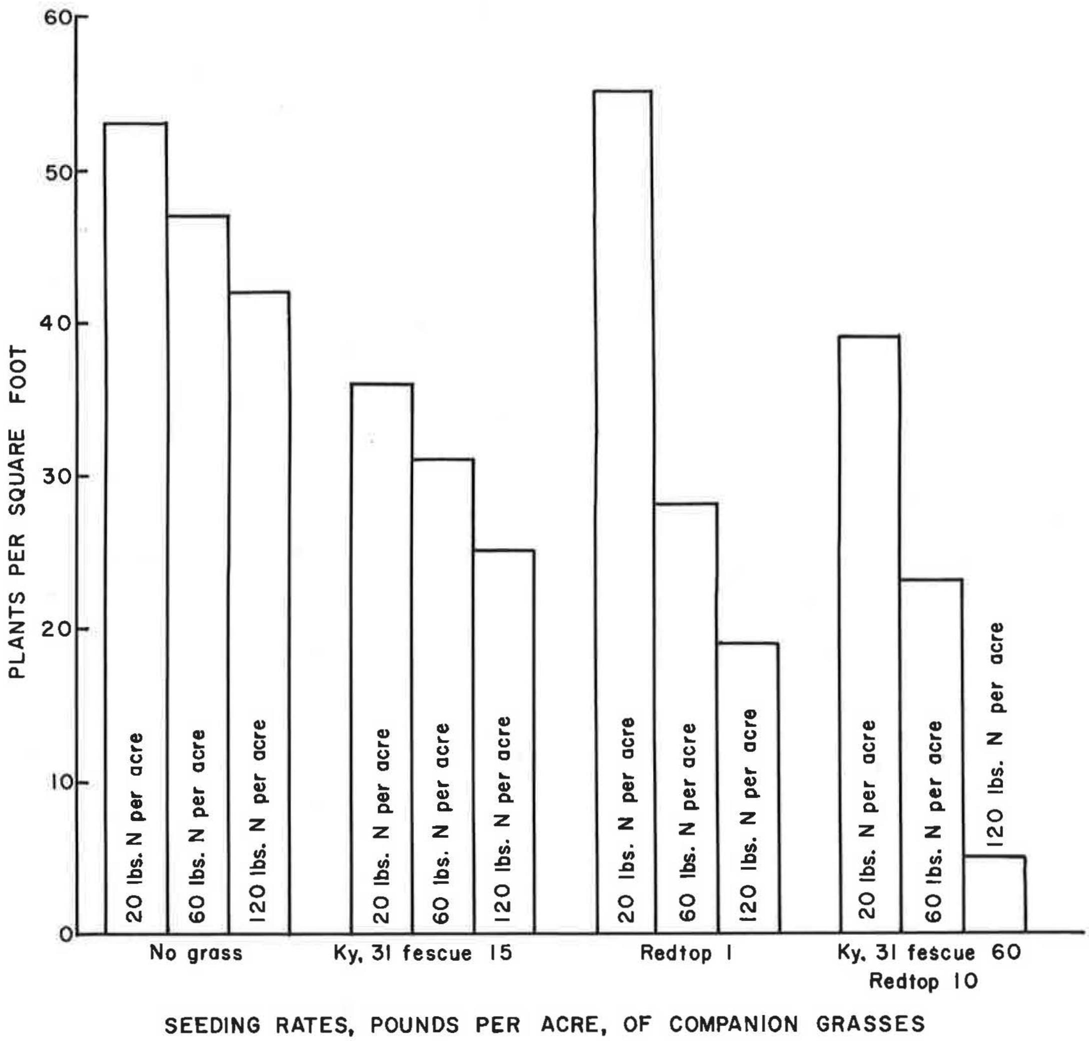

Figure 4. Sericea population, July 25, as influenced by grass species and mixtures and nitrogen fertilization. All mixtures contained 75 lb of sericea per acre.

reduced soil cover of sericea when it was grown in grass associations. Figure 8 clearly shows the effect of nitrogen fertilization on reducing sericea stands and plant size with the 10-lb rate of redtop. The dense stand of both sericea and redtop as well as the large-sized sericea plants at the low nitrogen rate are noteworthy. The 20-lb nitrogen rate reduced sericea cover only with the heavy seedings of both grasses together. When not stimulated by nitrogen fertilization, these final results show that the grasses were not aggressive toward the sericea. On the contrary, it appears that certain factors in the sericea-grass associations were beneficial to the sericea at the 20-lb nitrogen level. It has already been mentioned that grasses at light seeding rates may have improved moisture and temperature conditions.

Weeds were generally increased by nitrogen fertilization and reduced by grass seedings. At the 20-lb nitrogen rate, low seeding rates of grasses or grass mixtures reduced weeds and provided desirable grass cover without reducing the sericea stands (Fig. 9). The grasses apparently crowded out the weeds during seedling development as weed encroachment was greatest when companion grasses were not used.

The percent of soil covered with grass sod increased with nitrogen fertilization. Likewise, the total ground cover was increased by nitrogen fertilization but a less favorable ratio of desirable species was present at the higher nitrogen levels. Comparing the ratios in the 15-lb seeding rate of Kentucky 31 fescue, it is found that there were 43, 15, and 3 percent cover, respectively, for sericea, grass, and weeds at the 20-lb nitrogen rate; the values were 13, 40, and 15 percent cover, respectively, for the 120-lb nitrogen rate. In this sericea-grass association, there was only 7 percent more total cover with the 120 lb of nitrogen than with the 20-lb nitrogen rate (Fig. 9).

The yield indexes (Table 6) were obtained by multiplying percent ground cover by plant height; hence, these values indicate heights of a 100 percent ground cover. In agreement with the July data, nitrogen

TABLE 2

EFFECT OF SPECIES AND MIXTURES AT VARIOUS SEEDING RATES AND NITROGEN FERTILIZATION ON SIZE OF SERICEA PLANTS[1]

Sampling Date (1961)	Grass Seeding[2] Mixer	Rate (lb/acre)	Size (g of above-ground growth per 100 plants) 20 Lb N per Acre	60 Lb N per Acre	120 Lb N per Acre	Avg.
June 13	None		0.7		1.0	0.85a
	Fescue	15	0.5		0.7	0.60b
		60	0.4		0.5	0.45b
	Redtop	1	0.5		0.7	0.60b
		10	0.5		0.5	0.50b
	Fescue and redtop	15 + 1	0.5		0.4	0.45bc
		60 + 10	0.3		0.3	0.30c
	Average		0.48		0.60	
July 18	None		2.7	9.0	17.2	9.6 a
	Fescue	15	1.6	3.3	1.8	2.3 b
		60	2.8	1.7	1.9	2.1 b
	Redtop	1	2.2	2.4	1.7	2.1 b
		10	2.3	2.0	0.8	1.7 b
	Fescue and redtop	15 + 1	1.8	1.4	1.5	1.6 b
		60 + 10	1.5	1.3	0.9	1.2 b
	Average		2.1a	3.0b	3.7b	

[1] Values in a row or column not having the same letter are significantly different. Nitrogen-mixture interaction was significant on July 18.

[2] Each plot contained 75 lb of sericea per acre.

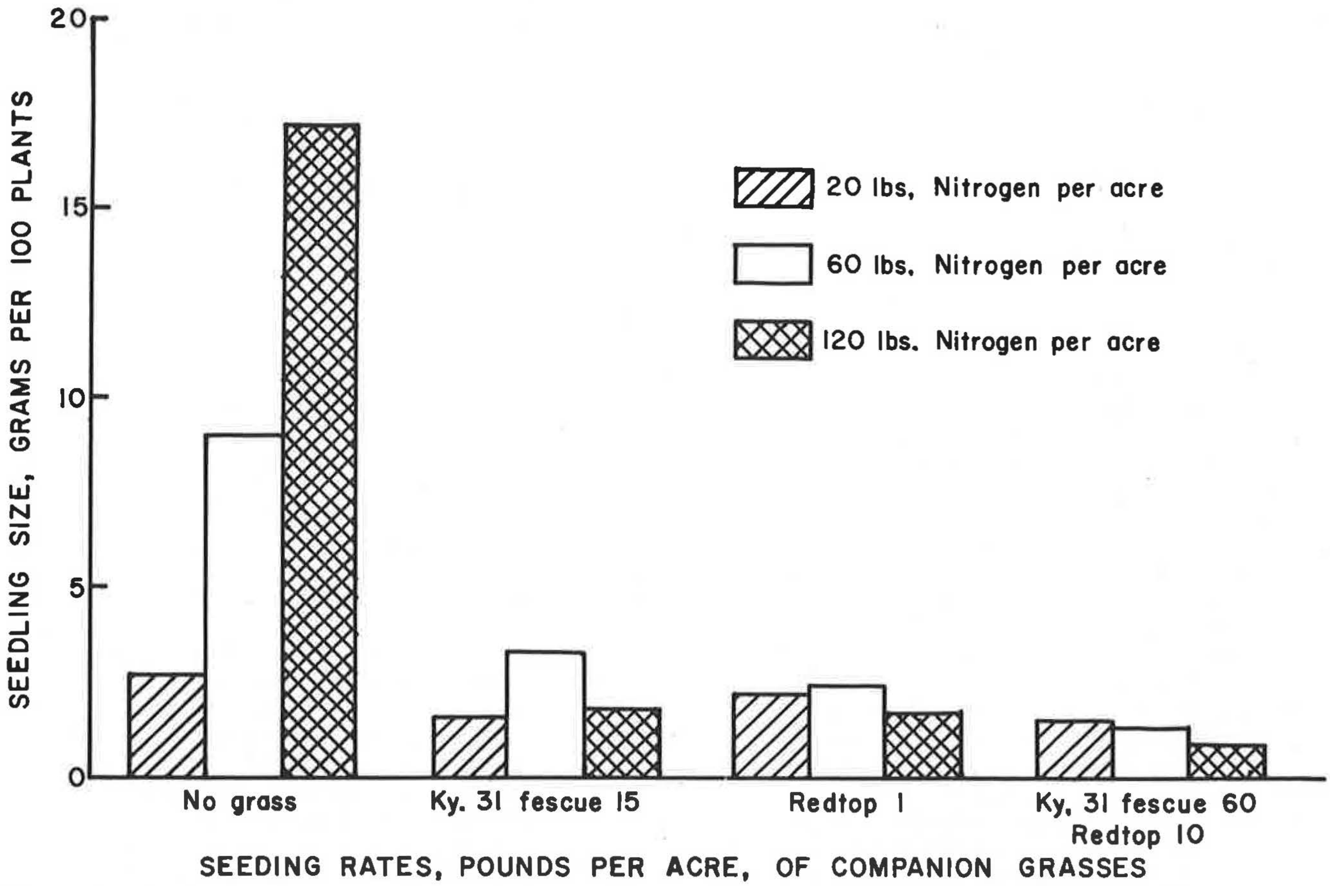

Figure 5. Sericea seedling size, July 18, as influenced by grass species and mixtures and by nitrogen fertilization. All mixtures contained 75 lb of sericea per acre.

TABLE 3

SEEDING VIGOR OF SERICEA, REDTOP AND KENTUCKY 31 FESCUE AS INFLUENCED BY SEEDING RATE AND NITROGEN FERTILIZATION, JUNE 13, 1961[a]

Grass Seeding[b]		Seeding Vigor (g of above-ground growth per 100 plants)			
Mixer	Rate	20 Lb N per Acre		120 Lb N per Acre	
	(lb/acre)	Sericea	Grass	Sericea	Grass
None		0.7	-	1.0	-
Fescue	15	0.5	4.7	0.6	16.7
	60	0.4	1.7	0.5	6.3
Redtop	1	0.5	6.4	0.7	14.3
	10	0.5	3.5	0.5	11.8

[a]Differences due to nitrogen, species, and seeding rates significant.

[b]Each plot contained 75 lb of sericea per acre.

TABLE 4

DRY MATTER YIELD OF SERICEA AS INFLUENCED BY NITROGEN FERTILIZER, SPECIES AND MIXTURE, JUNE 13, 1961[1]

Grass Seeding[2]		Yield (g of above-ground growth per sq ft)		
Mixer	Rate (lb/acre)	20 Lb N per Acre	120 Lb N per Acre	Avg.
None		0.30	0.22	0.26a
Fescue	15	0.14	0.14	0.14b
	60	0.10	0.04	0.07bc
Redtop	1	0.16	0.11	0.14b
	10	0.13	0.05	0.09bc
Fescue and redtop	15 + 1	0.12	0.05	0.09bc
	60 + 10	0.05	0.01	0.03c
Average		0.14a	0.09b	

[1]Values in a row or column not having the same letter differ significantly.

[2]Each plot contained 25 lb sericea per acre.

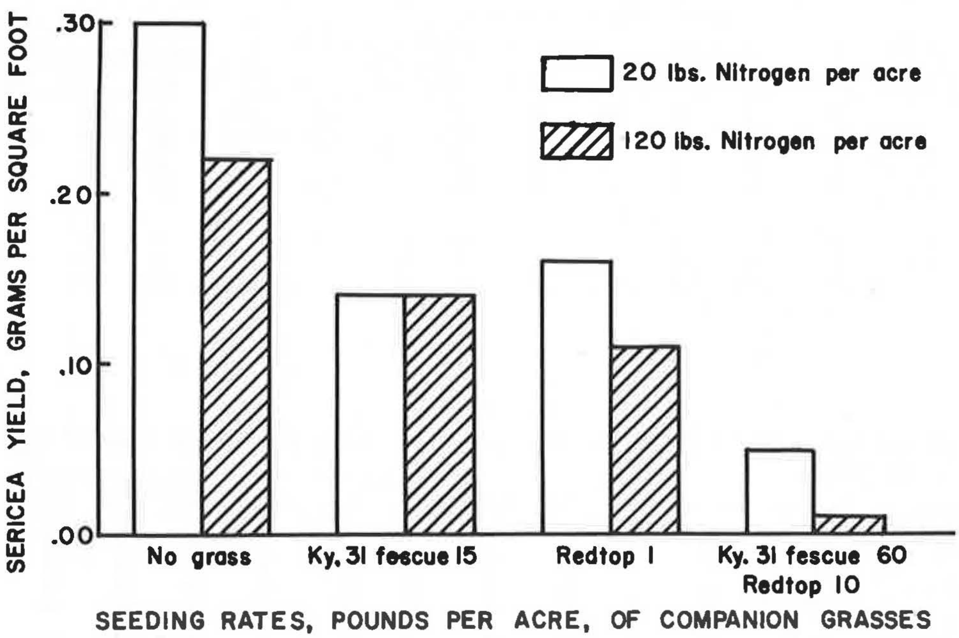

Figure 6. Yield of sericea, June 13, as influenced by grass species and mixtures and by nitrogen fertilization. All mixtures contained 75 lb of sericea per acre.

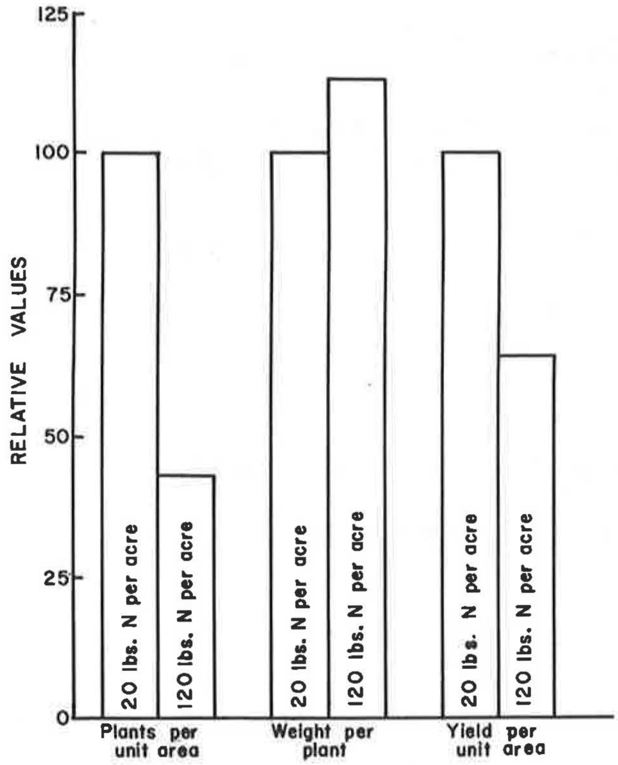

Figure 7. Relative population, weight, and yield of sericea in June as influenced by nitrogen. Sericea plants fertilized with 20 lb of nitrogen per acre were given value of 100; values are averages of all mixtures.

fertilization reduced the yields of sericea when in association with grasses. However, nitrogen fertilization increased sericea yields when no grasses were present; this is the reverse of the trend observed in July. The differences in growth habits among species are partially responsible for the changes in species balance with time. Kentucky 31 fescue and redtop grew rapidly in the seedling stage, but their growth rate was slow in later season. On the other hand, sericea seedlings develop very slowly, but their growth rate is accelerated later in the growing season. During the hot, dry season of summer, a deep root system and tolerance to hot weather give sericea an advantage over the more shallow-rooted and less heat-tolerant grasses. Sericea's erect growth is also an advantage as the tall growth shades the grasses in late summer.

Grass yields were increased by nitrogen fertilization and were greatest with the heavy seeding rates (Fig. 10). When attempting to obtain maximum growth from a mixture of species, it is apparent that the increased yields of the more aggressive species are compensated for by decreased yields in the less aggressive species. In reference to total yields, there is usually a compensating effect rather than mutually beneficial relationships among species in association (2).

TABLE 5

STANDS OF SERICEA AND GRASS AND WEED ENCROACHMENT AS INFLUENCED BY NITROGEN FERTILIZATION AND GRASSES, SEPTEMBER 8, 1961

Grass, Seeding[a]		Percent Ground Cover with Sod												
	Rate	20 Lb N/Acre				60 Lb N/Acre				120 Lb N/Acre				Avg.
Mixer	(lb/acre)	Sericea	Grass	Weeds	Total	Sericea	Grass	Weeds	Total	Sericea	Grass	Weeds	Total	Totals
None		38	0	23	61	43	3	33	79	40	0	30	70	70
Fescue	15	43	15	3	61	38	33	5	76	13	40	15	68	68
	60	53	25	0	78	30	38	8	76	5	75	5	85	80
Redtop	1	53	18	3	74	23	40	10	73	8	60	13	81	76
	10	50	15	3	68	18	68	3	89	16	64	5	85	81
Fescue and redtop	15 + 1	48	19	5	72	33	33	8	74	15	53	8	76	74
	60 + 10	35	25	5	65	25	55	3	83	4	81	3	88	79
Average		46	17	6		30	39	10		14	53	11		

[a]Each plot contained 75 lb of sericea per acre.

TABLE 6

YIELD INDEX[a] OF SERICEA AND GRASS AS RELATED TO MIXTURE AND NITROGEN, SEPTEMBER 8, 1961

Grass Seeding[b]		Yield Index									
	Rate	20 Lb N/Acre			60 Lb N/Acre			120 Lb N/Acre			Avg.
Mixer	(lb/acre)	Sericea	Grass	Total	Sericea	Grass	Total	Sericea	Grass	Total	Totals
None		32	0	32	44	2	46	50	0	50	42
Fescue	15	29	6	35	19	13	32	7	30	37	34
	60	45	7	52	15	15	30	2	60	62	48
Redtop	1	39	5	44	9	18	27	2	40	41	37
	10	44	4	48	10	32	42	5	32	37	42
Fescue and redtop	15 + 1	37	4	41	13	11	24	5	28	33	32
	60 + 10	30	10	40	12	19	31	1	52	53	45
Average		36	5	41	17	16	33	10	34	44	40

[a]Obtained by multiplying percent cover by plant height.

[b]Each plot contained 75 lb of sericea per acre.

Figure 8. Nitrogen increased aggressiveness of grasses. (With 75 lb of sericea and 10 lb of redtop per acre. Experiment established March 27, 1961; pictures taken September 14, 1961.) (a) With 20 lb of nitrogen per acre; sericea in foreground was cut to show dense stand of underlying redtop. (b) 120 lb of nitrogen per acre; note very small sericea plants by pencil.

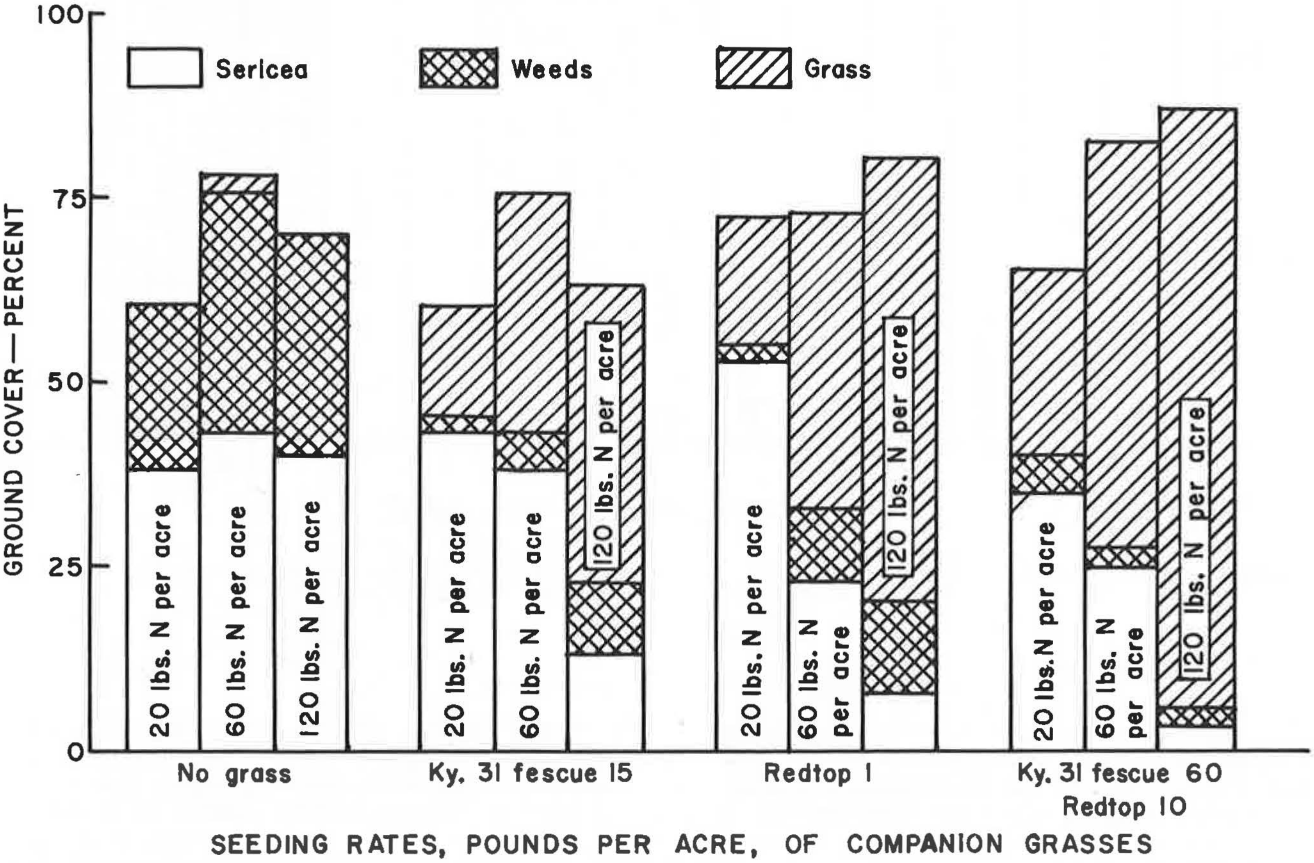

Figure 9. Percent ground cover as influenced by grass species and mixtures and by nitrogen fertilization, September 8. All mixtures contained 75 lb of sericea

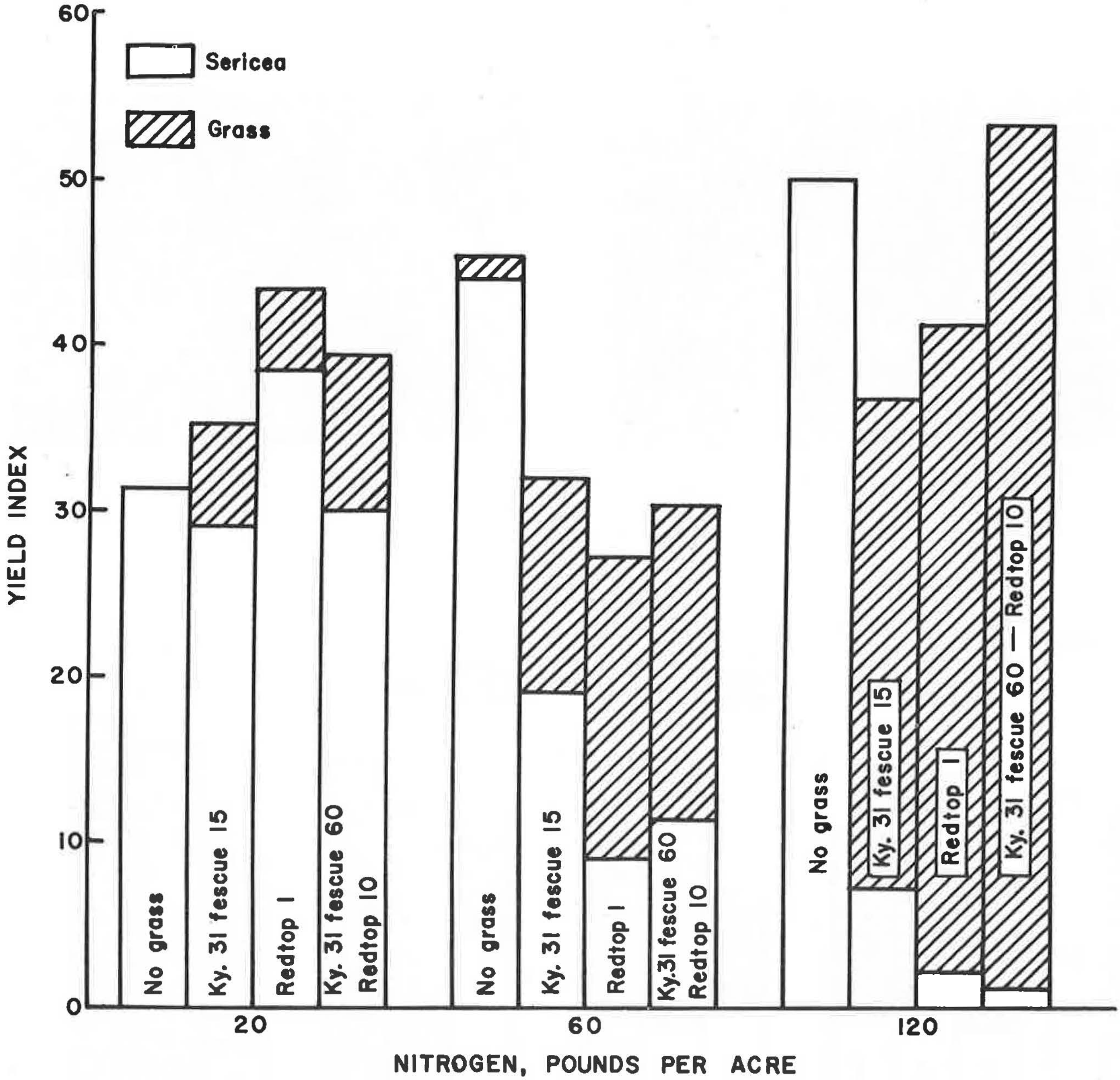

Figure 10. Yield index of sericea and grasses as influenced by grass species and mixtures and by nitrogen fertilization (data obtained in September 1961).

SUMMARY AND CONCLUSIONS

Changes occurred throughout the growing season in the relative effect of species, mixtures, and nitrogen on stands, plant size, and yields of sericea. In early spring, the grass associations reduced sericea stands more than nitrogen fertilization; however, in late summer, liberal nitrogen fertilization reduced sericea stands more than grass associations. In early summer, the grasses greatly reduced the stands of sericea; the higher grass seeding rates were harmful. During early development the sericea seedlings were generally small; hence, it is likely that moisture was the limiting factor rather than exclusion of light or competition for nutrients. As the seedlings developed, nitrogen became an important contribution to seedling growth and subsequent size of both the legume and grasses. Nitrogen so stimulated the grasses that the competition between the grasses and sericea for light, moisture, and nutrients retarded sericea. Grass associations with high nitrogen fertilization also had much disease as evidenced by fungi, rust, and molds in late summer. Diseases were probably very harmful to sericea.

Figure 11 compares the relative plant sizes of Kentucky 31 fescue and sericea in early and late summer. This figure graphically shows that the slow-starting sericea surpassed the quickly establishing Kentucky 31 fescue by late summer, when high nitrogen was not present to stimulate the grass. Based on general appearance, high nitrogen fertilization appeared to produce the more desirable turf in early summer; however, Figure 12 shows that the low nitrogen rate produced the best stands of strong sericea plants by late summer.

In appears desirable to seed grasses in combination with sericea to prevent erosion during the establishment period of sericea; however, nitrogen should be limited to about 40 lb per acre to avoid losing sericea stands. Grass seeding rates should be rather low, but it is more important to use low nitrogen than low grass seeding rates. The grass seeding rate and nitrogen fertilizer rate also depend on length and steep-

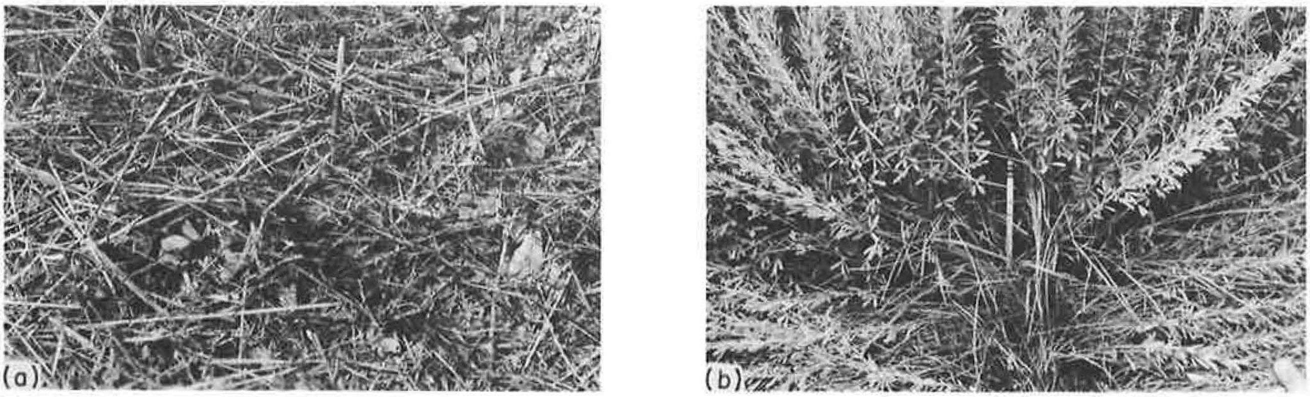

Figure 11. Plot with 60 lb of Ky. 31 fescue and 20 lb of nitrogen per acre. (a) As seen on June 13. Fescue seedlings 4 times heavier than sericea seedling plants which are difficult to see. (b) As seen on September 14; note dense stand and large size of sericea plants as well as underlying Kentucky 31 fescue stand.

Figure 12. Nitrogen, by stimulating grass growth, reduced growth and stands of sericea seedlings. (a) Sericea was uniformly seeded at 75 lb per acre in March when established. Plot on left, photographed in June, with 60 lb of Kentucky 31 fescue and 20 lb of nitrogen per acre had poor grass growth but excellent stand of sericea. Plot on right with 10 lb of redtop and 120 lb of nitrogen had good grass cover, but poor stand of sericea. (b) Same two plots taken in September. Note excellent stand of sericea with low nitrogen and little competition from grass. Final stand of sericea very poor with liberal nitrogen fertilization, as shown on right.

ness of slopes. Long steep slopes, prone to erosion, should have higher rates of seed and nitrogen than shallow slopes. Grass associates, although aggressive toward sericea, were desirable because they reduced weediness.

A suggestion for establishing sericea is to use 850 lb per acre of a 5-20-10 fertilizer and a seeding mixture of 50 lb of sericea, 1 lb of redtop, and 10 lb of Kentucky 31 fescue per acre. Seedings should be made in late winter or early spring.

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