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Fertilized and Seeded Grazed FIREBREAKS

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Summary

Evaluation tests of seeded and fertilized grazed firebreaks were carried out to determine how to establish and maintain the most efficent and economic breaks. These tests were initiated as a cooperative study between the Texas Agricultural Experiment Station and the Texas Forest Service in 1949 and 1951 on Caddo and Bowie soils in Southeast Texas. These soils represent poorly drained and well-drained sites, respectively, of the lower Texas coastal plain. Observations and results indicate the best types of soil, of seed and of fertilizer and the combinations of these that produce the lowest flammability, the best grazing and the lowest cost of installation and upkeep.

BEST SOIL

Caddo soil. Where possible, breaks should be laid out on Caddo in preference to Bowie soils. More effective firebreaks appear possible with lower establishment and maintenance investments on Caddo soil than on Bowie. Sixty pounds of phosphoric acid at establishment and every third year thereafter appear sufficient to maintain seeded common lespedeza and a closely grazed break on Caddo soils.

Bowie soils require nitrogen and phosphoric acid at 60 and 120 pounds per acre, respectively, or a combination with 60-pound rates of potash and lime at 1 ton per acre to produce a closely grazed break the first year. Every fourth or fifth year a comparable topdressing of phosphoric acid and potash should be considered to maintain the lespedeza and insure close grazing.

BEST FERTILIZER

Phosphoric acid. On Caddo soil phosphoric acid proved more effective than either nitrogen or potash applied alone or in combination. It gave greater fuel flammability reduction, greater preferential grazing and greater economy. A 60-pound-per-acre application of phosphoric acid was sufficient to create, within 1 year, a satisfactory lane from which backfiring could be done except under extreme prolonged drouth. There was no apparent advantage in heavier applications of phosphoric acid.

BEST PLOT TREATMENTS

Seeded plots. Fertilized plots seeded with Dallis, Bermuda and carpetgrass, common lespedeza or mixtures of fall-seeded white, hop and Persian clover were grazed significantly more than fertilized plots which contained only native species.

BEST SEEDED SPECIES

Common lespedeza. This species proved most economical and efficient. Seeding of other species in initial treatments does not appear justified when management requirements and costs are considered.

SEEDING-FERTILIZER-GRAZING INTERACTION

The combination of seeded common lespedeza on Caddo soil with 60 pounds of phosphoric acid per acre proved to be:

LEAST FLAMMABLE. Flammability tests made under extreme drouth conditions and high fire index ratings indicated the following:

These areas had the smallest amount of carpetgrass development. Dormant or drouth-killed carpetgrass is highly flammable and will, even though closely grazed, carry fire across backfire lanes into the protected area unless it is patrolled and the fire kept within bounds by use of a hand rake or flap. Carpetgrass stands generally were sparse where good stands of common lespedeza had been established with 60 pounds per acre of phosphoric acid.

These firebreaks may serve as effective backfiring lanes all year except during the September-November period of drouth years or for lesser limited periods of 3 weeks or more without rain.

MOST ECONOMIC. Lowest in cost to establish and maintain, lespedeza usually reseeds even under the heaviest grazing and needs only 60 pounds of phosphoric acid per acre on Caddo soil to produce a practical stand.

BEST GRAZING. This combination of seed-fertilizer produced preferential grazing. The relatively high protein and phosphoric acid level of seeded lespedeza provided supplementary forage that helped offset nutritive and mineral deficiencies of native grasses. Cattle readily locate such treated areas and concentrate their grazing in an apparent effort to obtain forage that will furnish nutrients needed for maintenance and gain.

Close grazing reduces the grass volume and sharply lowers the flammability.

Fertilized and Seeded Grazed Firebreaks

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INVESTMENTS IN FOREST MANAGEMENT have expanded greatly in the last decade. More than 200,000 acres in East Texas have been replanted with pine (7).[1] Stand improvement measures have been carried out on many thousands of acres of the nearly 12 million acres of commercial forest land to release natural pine regeneration and permit greater growth. An additional 3,000,000 acres probably will be replanted as rapidly as seedling and personnel limitations permit.

A considerable portion of the planting and hardwood control investment has been concentrated in the southeastern part of the State. The main flora is a plant association of longleaf and loblolly pine and bluestem grasses. During the dormant season, and especially during extreme periods of drouth, this fuel is highly flammable.

Much of Southeast Texas is concentrated in large blocks under ownership of forest products industries. Roadways or natural barriers are limited over extensive areas. Occasional farm and community properties are interspersed throughout the area. This situation and a large transient population using the woodlands for hunting, fishing and camping pose a fire risk.

In the past, plowed or disked firebreaks of 6-foot minimum width (8) have been constructed around pine plantations and other high investment timbered areas as fire barriers. This provides partial isolation from adjacent high-risk areas and minimizes possibility of wildfire spread. Although usually effective, such firebreaks occupy a sizeable acreage of nonproductive area and require annual maintenance at considerable cost.

Grazed firebreaks have been advocated (3) as a means of providing effective fire barriers at reasonable cost. Fertilized and seeded strips induce preferential grazing on planned lanes. The close cropping reduces native grass volume and lowers flammability. Fertilizing and seeding also raise the nutritive level of forage and provide supplementary grazing necessary for cattle weight maintenance, especially in late summer and winter. Use of phosphate fertilizer helps offset the mineral deficiency in native forage. Grazing of native forage adjacent to firebreak strips also reduces amount and flammability of fuel. Grazed firebreaks have an advantage, over plowed or disked breaks, as access lanes during wet weather; they may serve to distribute cattle more uniformly and to provide more uniform grazing of native forage; they also may be used as backfiring lanes for prescribed burning work or in the control of wildfire.

Many of the farm cattle in Southeast Texas free-range or graze on owned or leased, fenced-woods range. A recent survey indicated that 53 percent of the tree farmers in the 11-county sample area grazed cattle in their woods, and more than 70 percent of the cattle feed for 56 percent of the cattle still comes from the forest range (6).

Fertilized and seeded grazed firebreaks are considered a possible means of bringing forestry and grazing interests together so they can be of mutual advantage. Such breaks are considered most practical where cattle can be run on fenced range and are subject to management so forage and timber values can be protected from overgrazing.

Studies were initiated in 1949 and in 1951 to determine means of establishment, proper maintenance and effectiveness of grazed firebreaks on two soil types most prevalent in Southeast Texas. The results should serve as helpful guides for installing grazed firebreaks on comparable sites.

Experimental Areas

The 1949 tests were established in the flatwoods area of the lower Gulf Coastal Plain. Soils are predominantly Caddo with moderate to imperfect surface and subsoil drainage. Interspersed are low ridges or small mounds of Bowie soil and frequent flats or

Contents

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[1]Numbers in parenthesis refer to literature cited.

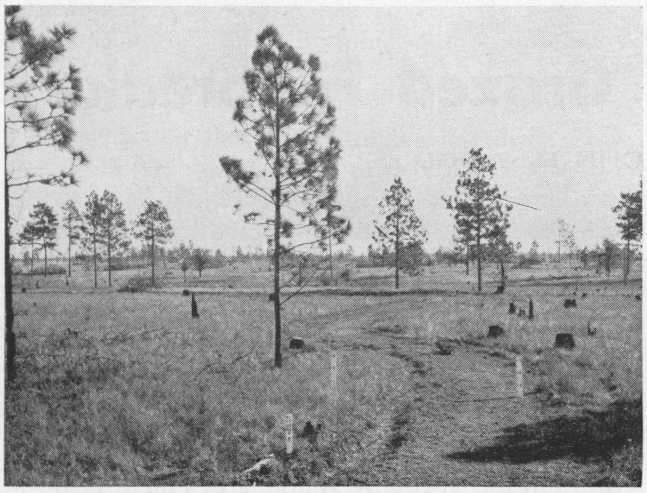

Figure 1. First-year condition of seeded and fertilized grazed firebreak on typical cut-over longleaf flatwood sites in Southeast Texas subject to free-grazing. Soil on this flat to slightly rolling land is mainly Caddo. Native grasses on either side of the firebreak are an admixture of slender bluestem, other Andropogon species, paspalum and panicgrasses.

nondrained basins of Plummer soil. Figure 1 shows that longleaf pine and bluestem grasses were the predominant flora on the low ridges and better drained flats. Soils were fairly high in organic matter, acid (pH 5.0 to 5.6), and subject to periodic inundation for several days during prolonged precipitation.

Tests established southeast of Kirbyville in 1951 were on moderate to well-drained Bowie soil areas. Here also, longleaf pine-bluestem grasses were the former predominant flora, but loblolly pine was seeding in. A moderately heavy stand of small wax myrtle (*Myrica cerifera*) on the area also indicated exclusion of wildfire for a considerable period. Surface soil is a fine sandy loam, slightly to medium acid. Carpetgrass was present in small patches and stands of bluestem grasses were poor to medium in thrift, indicating heavy free-range grazing pressure at test establishment.

Table 1 shows the precipitation pattern for 1949-54. The average annual precipitation for this area is approximately 54 inches. Most rainfall occurs during the winter, and subnormal patterns often prevail and result in prolonged drouth in late summer and fall.

TABLE 1. RAINFALL RECORDED FOR THE 1949-54 PERIOD AT U. S. WEATHER BUREAU STATION, KIRBYVILLE

Period	Inches Rainfall by Period						
Year	1949	1950	1951	1952	1953	1954	Normal[1]
January	6.51	.04	7.13	2.54	2.58	2.46	5.08
February	7.15	8.86	1.02	5.66	7.37	0.82	4.14
March	8.05	4.80	5.20	2.04	3.33	1.65	4.32
April	7.74	7.22	1.35	10.31	8.47	7.56	3.64
May	3.88	3.05	3.48	10.94	12.62	10.16	6.25
June	4.38	8.95	1.42	3.24	6.49	2.51	3.44
July	8.76	3.86	3.13	5.96	6.95	3.79	5.99
August	0.61	3.15	1.07	1.34	5.59	0.91	4.04
September	0.67	0	12.78	0	1.17	0.57	2.97
October	9.95	1.30	0.23	0	1.44	4.04	2.98
November	0.80	2.32	1.70	7.14	2.12	3.67	4.71
December	8.72	1.73	5.06	5.29	7.18	2.40	6.28
Total	67.22	45.28	43.57	54.46	65.31	40.54	53.84

[1]For 21-year period.

Research Procedure

The plots established in 1949 on Caddo soil were on an area subject to year-round free-range grazing by about 75 head of dairy and beef type cattle having access to approximately 1,000 acres of open range. The main fertilizer plots, 100 by 8 feet, were located between two plowed lanes planned but abandoned for a disked firebreak, Figures 2 and 3. The following rates of fertilizer per acre were used singly and in all combinations: 0 and 60 pounds of nitrogen (N); 0, 60 and 120 pounds of phosphoric acid (P_2O_5); and 0 and 60 pounds of potash (K_2O) [2]. One ton of lime per acre and the various fertilizers were lightly disked into the soil, using a disk with no set so as to provide the least disturbance of native grasses. Each treatment was replicated three times.

Half of each fertilizer plot was seeded in the spring of 1949 to a mixture of Dallis, carpet and Bermudagrass and common lespedeza. White, hop and Persian clover were seeded in the fall of 1949 on seeded plots.

Forage height and botanical composition were measured on three permanent 9.6 square feet subplots per treatment in July and November 1949 and 1950.

Plots established in 1951 on Bowie soil were on an area subject to year-round free-range grazing by about 45 head of dairy and beef type cattle having access to about 800 acres of open range. The main fertilizer plots were 50 by 50 feet. Each was split

[2]Standard expression of fertilizer elements and ratios, in pounds per acre of nitrogen, phosphoric acid and potash, respectively.

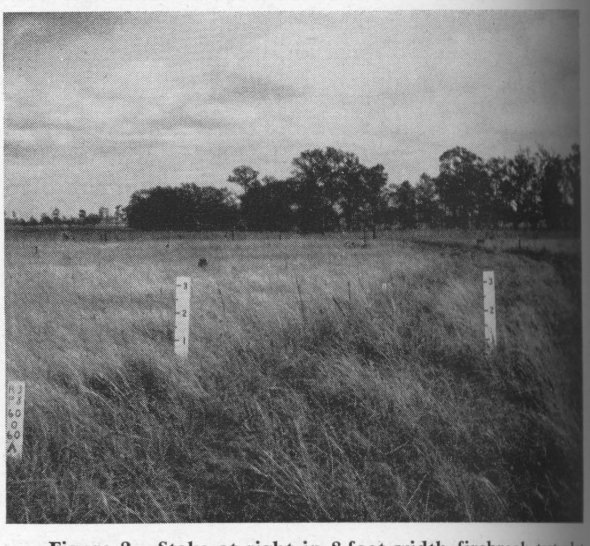

Figure 2. Stake at right in 8-foot width firebreak test plot fertilized at rate of 60 pounds per acre each of nitrogen and potash. Effect of fertilizer on free-choice grazing after first season.

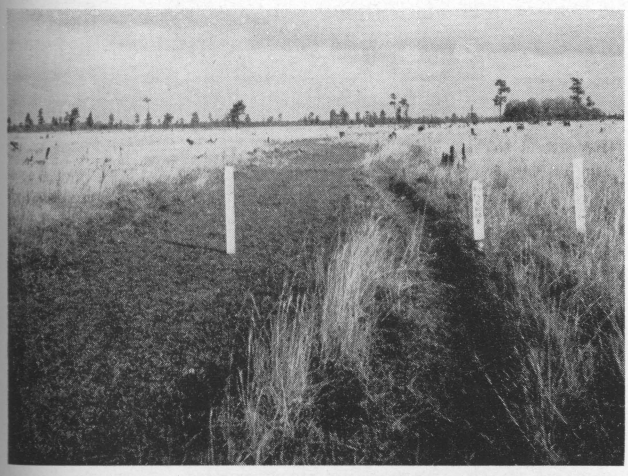

Figure 3. Stake at left in 8-foot width firebreak test plot fertilized at rate of 60 pounds per acre each of phosphoric acid and potash. Effect of fertilizer and seeded species on free-choice grazing after first season. Compare with Figure 2 for effect of phosphoric acid.

perpendicular to the slope into 50 by 25-foot plots, series A to receive a given fertilizer annually and series B to receive only the original application. This was to test the effect of fertilizer residual and needed frequency of application. The native grass rough was burned off prior to treatment. Annual fertilizer applications were made to the A series from 1951 through 1954. The following rates of fertilizer per acre were applied singly and in all combinations to main fertilizer plots; 0 and 60 pounds of nitrogen (N) and 0, 60 and 120 pounds of phosphoric acid (P_2O_5). In addition, treatments of 60-120-60 and 60-120-60 plus 1 ton of lime were tested. Fertilizers were lightly disked into the soil, using a disk with no set so as to provide the least disturbance of native grasses.

To test the effect of seeding on preferential grazing, one series of fertilizer plots was seeded in the spring of 1951 with common lespedeza and a mixture of Dallis and carpetgrass at normal seeding rates for pasture establishment. The other series of fertilizer plots was left unseeded. Both seeding and fertilizer treatments were replicated three times.

Seeded stands appeared to be limited considerably by late summer drouth. It was decided to reseed these plots in the spring of 1952. All plots, both seeded and unseeded, were fertilized at the scheduled rate, lightly disked, and the seeded series was reseeded.

By summer of 1952, wax myrtle had shown considerable development on the 1951 study and was beginning to limit normal grazing. Unused grass clumps were frequent where myrtle was a mechanical barrier to grazing. This brush was removed in a manner similar to that provided in pasture mowing and maintenance.

Forage height and botanical composition were measured on three permanent 9.6 square-foot subplots per treatment each fall, through 1954.

Tests of firebreak flammability were made October 21, 1952 at the end of a prolonged drouth. Native grass fuel on the windward edge of firebreak plots was fired with a steady-drip backfire torch to determine which plots might be adequate as backfiring points, even under the most extreme conditions. The October 21, 1952 flammability test was made after 61 days without rainfall, the longest period without precipitation during the 6 years of study, Table 1. Forest fuel moisture rating for longleaf pine-grass fuel was 2.5 percent. Relative humidity varied from 37 to 33 percent at time of firing test. Wind velocity was 3 miles per hour.

Results

PREFERENTIAL CATTLE GRAZING

Initial results of firebreak studies on Caddo soil were reported in 1950 (5). Data in Table 2 show forage height after one season of free-choice grazing as affected by fertilizers and by seeding. Highly significant sources of variation in forage height resulted from preferential grazing induced by treatments of phosphoric acid, nitrogen, seeding, seeding and nitrogen. Grazing reduced forage height on plots receiving nitrogen alone, but not enough to produce what is considered an effective firebreak. Phosphoric acid alone at 60 pounds per acre induced sufficient free-choice grazing to create a ground condition considered a satisfactory firebreak, Figure 3. There was no apparent advantage in heavier applications of phosphoric acid, and potash caused no significant effect.

Data in Table 2 tie in with mineral deficiency and forage quality ratings listed by Fraps and Fudge

TABLE 2. FORAGE HEIGHT AFTER ONE SEASON OF FREE-CHOICE GRAZING AS AFFECTED BY FERTILIZERS AND BY SEEDING. TESTS LOCATED ON CADDO SOILS

Fertilizer treatments per acre[1]	Forage height, inches		
	Seeded plots	Native species	Average
No phosphoric acid			
No nitrogen	4.52	5.08	4.80
60 pounds nitrogen	3.83	3.43	3.63
Average	4.18	4.26	4.22
60 pounds phosphoric acid			
No nitrogen	1.69	2.80	2.25
60 pounds nitrogen	1.61	1.88	1.75
Average	1.65	2.34	2.00
120 pounds phosphoric acid			
No nitrogen	2.04	2.87	2.46
60 pounds nitrogen	1.31	1.63	1.47
Average	1.68	2.25	1.97
General average	2.50	2.95	
Effect of nitrogen			
No nitrogen with average phosphoric acid	2.75	3.58	3.17
60 pounds with average phosphoric acid	2.25	2.31	2.28

[1]Phosphoric acid, nitrogen, seeding and seeding by nitrogen are highly significant sources of variation in these data.

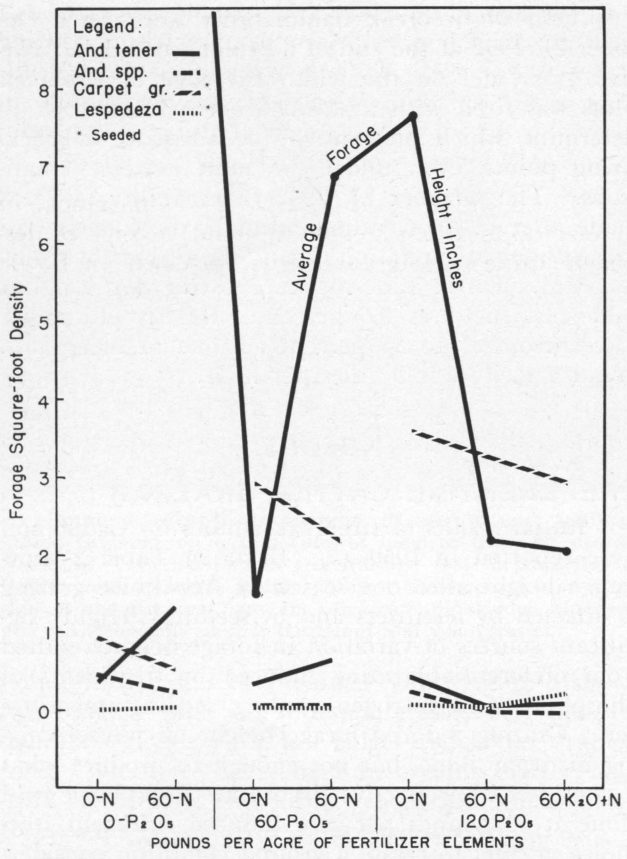

Figure 4. Average forage density and height of native and seeded species (growing in competition) following two seasons of free-choice grazing on plots receiving different fertilizer treatments. Call Junction location on Caddo soil.

(2), in 1940 and Campbell and Biswell (1) for similar sites in Louisiana. Fraps and Fudge indicate native grasses of East Texas appear to supply sufficient calcium to grazing animals but they generally do not supply enough phosphoric acid and at times, especially late summer and winter, do not supply enough protein to meet animal maintenance requirements. Thus, applications of phosphorus and nitrogen fertilizers apparently raise both the phosphoric acid and protein levels of treated forage. Cattle readily locate such treated areas and concentrate grazing in an apparent effort to obtain forage that will furnish nutrients needed for maintenance and gain.

Introduced forage species, and especially common lespedeza, similarly induce preferential grazing. Fraps and Fudge report average levels of protein, phosphoric acid and lime at 12.03, 0.43 and 1.07 percent, respectively, for mature common lespedeza plants grown on untreated land. Thus, forage from this plant exceeds nutritive levels of 9, 0.23 and 0.14 percent, respectively, for protein, phosphoric acid and lime, reported as minimum for body maintenance.

Figures 4 and 5 also relate the effect of various fertilizers to average forage height and density of native and introduced species as a result of induced preferential grazing. The 1949 fertilizer treatment of 0-60-0 provided the greatest preferential grazing at the end of the second year on Caddo soils, Figure 4.

Higher rates of fertilizer and combinations of nitrogen and phosphoric acid were necessary to induce considerable preferential grazing to obtain a closely grazed break the first year on well-drained Bowie soils, Figure 5. The general appearance of these breaks was more favorable than average-height figures indicate, however, since averages include ungrazed areas under wax myrtle bushes that were a mechanical barrier to grazing.

EFFECT OF FERTILIZER

The effect of fertilizer on preferential grazing is covered in the preceding paragraphs. Figures 4 and 5 bring out the relationship of fertilizer and induced grazing to forage composition, height and flammability.

Figure 4 shows estimated square-foot density of native grasses and seeded common lespedeza on Caddo soils at the end of the second season following fertilizer application and free-choice grazing. Although slender bluestem (*Andropogon tener*) and other native Andropogon species were of similar stand density on untreated areas, the interaction of fertilizer and induced grazing generally results in a reduction

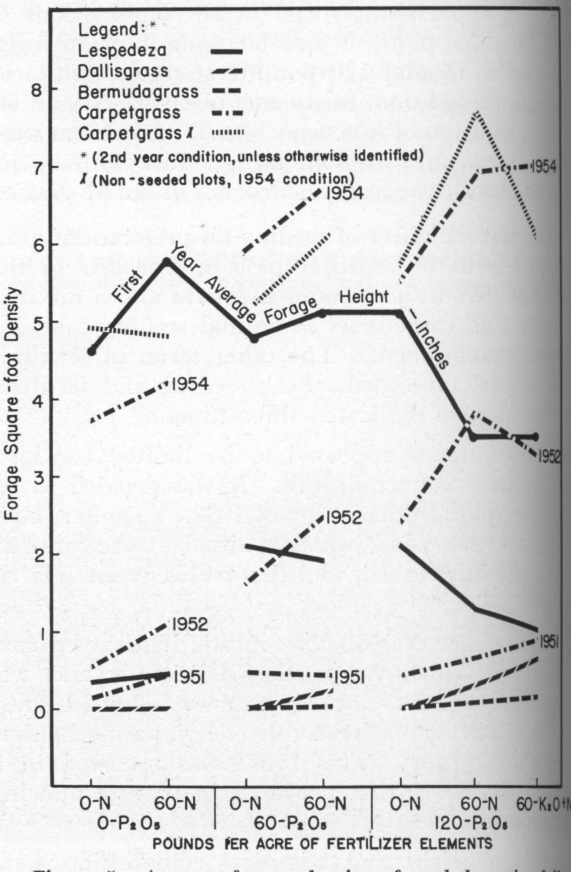

Figure 5. Average forage density of seeded species following two seasons of free-choice grazing on plots receiving different fertilizer treatments. Kirbyville location on Bowie soil.

of stand, especially where nitrogen and phosphoric acid or additions of potash are applied. Also, other Andropogon species, including big and little bluestem, show more reduction in stand density at given fertilizer and grazing levels than does slender bluestem. This suggests slender bluestem may be less palatable and/or more persistent under given grazing pressure than other Andropogon species. This indicates slender bluestem is a subclimax species and supports the view of Langdon, *et al.* that "slender bluestem withstands repeated burning (and/or grazing) better than pinehill bluestem" (4). Thus, its predominance on an untreated area may be useful as an indicator that the range is below its potential. Its presence also suggests that the more desirable bunchgrasses, including little and big bluestem, will come back only with some amendment in grazing intensity and/or fertility.

The density of seeded species depends largely on the interaction of amount and combination of fertilizer elements, site disturbance and reduction of native species through induced preferential grazing. Seeded carpetgrass density increased as combinations or amounts of phosphoric acid, nitrogen and potash were increased. However, plant density decreased with additions of nitrogen or nitrogen plus potash. The heaviest grazing and lowest average forage height for carpetgrass occurred where 60 pounds per acre of phosphoric acid, 60-120-0 or 60-120-60 treatments per acre were made.

Figure 5 indicates that the greatest density of common lespedeza on Bowie soil occurred where phosphate fertilizer was applied. There was no apparent advantage in rates of 120 pounds per acre of phosphoric acid over 60 pounds. However, two successive yearly applications of 60 pounds per acre of phosphoric acid resulted in the greatest density of lespedeza and least relative density of carpetgrass on Bowie soils. Flammability tests the second year indicated such stands of lespedeza were as effective in limiting fire spread as areas initially receiving 60-120-60 plus lime, Figure 6. Both fertilizer levels were rated superior to other treatments in limiting fire spread, even under severe drouth conditions.

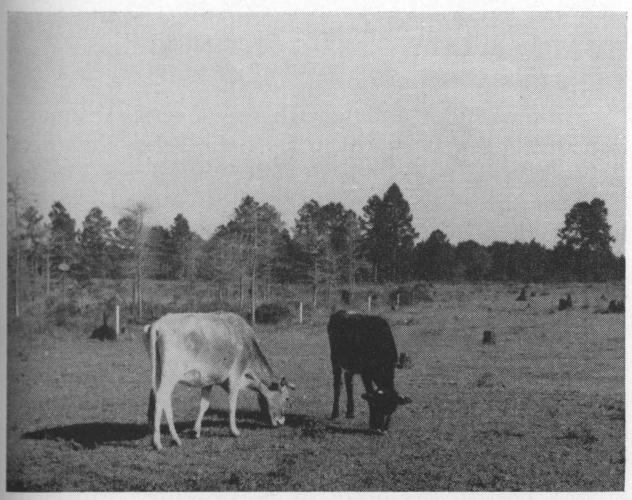

Figure 6. Second-year condition of seeded and fertilized firebreak on Bowie soil. Cattle on subplot treated with 60-120-60 fertilizer plus lime. Main forage is carpetgrass and common lespedeza.

The addition of nitrogen to phosphoric acid in annual applications depressed stand density of lespedeza while carpetgrass density increased on Bowie soils, Figure 5. Observations in 1958 indicated medium to good stands of lespedeza on the B series fertilized last in 1952 with 60-120-60 or 60-120-60 plus lime applications. Apparently, as the nitrogen is used or leaches into the subsoil, the residual effect of phosphoric acid builds up the lespedeza population. It appears that applications of 0-120-60 every fourth or fifth year should be considered on Bowie soils to maintain favorable stands of lespedeza and induce close preferential grazing. On Caddo soils an original fertilizer treatment of 0-60-0 followed every third year with similar treatment appears best to maintain seeded common lespedeza and maintain a closely grazed break.

On Caddo soils nitrogen and phosphoric acid applications resulted in the best establishment of carpet and Dallisgrass, and the combination was essential for the establishment of Bermudagrass. On Bowie soils slight increases in Dallis and Bermudagrass density were obtained with the addition of 60 pounds potash per acre to 60 and 120-pound applications of nitrogen and phosphoric acid, respectively. However, stands of Dallis and Bermudagrass after 2 years were not as heavy or uniform on Bowie soils as on Caddo soils with similar favorable fertilizer treatments. Best Bermudagrass stands were obtained where initial disking appeared to be heavier or where cattle trailing damage trampled out other species.

Acceptable stands of white, hop and Persian clover were obtained on plots given 60-60-60 or 60-120-60 fertilizer treatments on Caddo soils. Clover persisted and reseeded even under the heaviest grazing for 3 years, but it gradually dropped out, apparently as a result of lowered fertility and close grazing. The green forage available during the winter provided supplemental forage of high nutrient level and also lowered flammability rating. Its inclusion in seeding mixtures probably should be considered optional because of fertility investments.

First and second-year observations on Caddo soils indicated that greater induced preferential grazing and subsequent reduction in average forage height occurred on areas treated with 60 pounds of phosphoric acid. Comparable forage height reduction also was obtained on plots treated with 60-120-0 or 60-120-60 fertilizer applications.

Table 3 indicates that on Bowie soil, both nitrogen and phosphoric acid at 60 and 120 pounds per acre, respectively, were necessary to induce close graz-

TABLE 3. FORAGE HEIGHT FOLLOWING FREE-CHOICE GRAZING AS AFFECTED BY FERTILIZERS AND SEEDING, KIRBYVILLE LOCATION ON BOWIE SOIL.

Fertilizer treatments per acre		Average forage height, inches			
		1951		1954	
		A[1]	B[2]	A	B
0-0-0	Seeded	4.6	4.7	3.0	3.6
	nonseeded	4.9	6.1	4.7	4.9
60-0-0	Seeded	5.8	5.1	3.4	3.9
	nonseeded	6.0	4.5	4.7	4.2
60-60-0	Seeded	5.1	4.9	3.5	4.1
	nonseeded	3.8	3.3	2.6	3.0
0-60-0	Seeded	4.8	5.3	3.9	3.1
	nonseeded	5.4	4.4	5.0	4.2
0-120-0	Seeded	5.1	5.2	2.8	4.6
	nonseeded	6.2	6.1	4.7	4.9
60-120-0	Seeded	3.5	2.8	2.4	4.9
	nonseeded	2.2	2.9	2.1	3.5
60-120-60	Seeded	3.5	3.5	2.2	3.5
	nonseeded	3.5	3.9	2.6	3.9
60-120-60 + 1 ton lime	Seeded	3.5	3.9	2.4	2.3
	nonseeded	3.9	3.8	3.3	3.0

[1]A-Fertilized annually
[2]B-Last fertilized 1952

ing and effect the most satisfactory break the first year. Either nitrogen or phosphoric acid used in combination with potash and lime had the same result. However, tests the second year showed flammability was not related directly to forage height reduction alone, but was also affected by plant composition and density. Plots receiving two successive annual applications of 60 pounds per acre phosphoric acid had the greatest density of common lespedeza and the least relative stands of carpetgrass. These second-year stands were as effective in limiting fire spread as the plots with 60-120-60 or 60-120-60 plus lime, Figure 6. Lespedeza had the lowest flammability and carpetgrass the highest. Since dormant or drouth-killed carpetgrass still will carry fire under extreme weather conditions, treatments should be used that encourage the smallest amount of carpetgrass while providing the heaviest continuous stands of lespedeza.

TABLE 4. TOTAL SQUARE FOOT DENSITY[1] OF GRAZED FIREBREAKS ON BOWIE SOIL, BY FERTILIZER AND SEEDING TREATMENT.

Fertilizer treatments per acre		Average square foot density			
		1951		1954	
		A[2]	B[3]	A	B
0-0-0	Seeded	2.5	2.7	4.8	5.4
	nonseeded	2.6	3.0	5.9	6.1
60-0-0	Seeded	2.8	2.9	5.7	6.4
	nonseeded	3.3	3.1	5.9	5.9
60-60-0	Seeded	3.6	3.3	7.5	6.7
	nonseeded	3.0	3.3	7.7	6.3
0-60-0	Seeded	3.3	3.6	6.5	6.4
	nonseeded	3.3	3.3	6.1	5.5
0-120-0	Seeded	3.8	3.7	6.8	6.9
	nonseeded	3.5	3.6	5.6	4.8
60-120-0	Seeded	3.2	3.2	7.6	6.8
	nonseeded	3.4	3.3	8.5	7.7
60-120-60	Seeded	3.9	3.7	7.6	7.2
	nonseeded	3.3	3.3	7.3	5.9
60-120-60 + 1 ton lime	Seeded	3.4	2.9	7.7	6.0
	nonseeded	3.7	3.7	8.1	6.2

[1]Average square foot ground cover, of 100 percent density, on 9.6 square foot plots.
[2]A—Fertilized annually
[3]B—Last fertilized 1952

Data indicate that more effective firebreaks seem possible at lower establishment and maintenance investments on Caddo soils than on Bowie. Therefore, breaks should be laid out on Caddo soils, where possible. Data suggest desirable alternates would be to use Bowie soils where necessary, and treat as follows: (1) Seed with common lespedeza, fertilize with two successive annual applications of 60 pounds phosphoric acid per acre, maintain with 60 pounds every 2 years thereafter, or with 0-60-30 as may be justified periodically to maintain lespedeza, or (2) seed with common lespedeza, fertilize with 60-120-60 or combination with lime, and apply 0-120-60 every fourth or fifth year thereafter.

Fourth-year data on nonseeded plots, fertilized either once or annualy, showed as much or more square foot density for carpetgrass as plots seeded with this and other species, Table 4. Unfertilized check plots showed about the same carpetgrass density as plots receiving 60-pound applications of nitrogen or phosphoric acid. Thus, it is apparent carpetgrass will invade, whether seeded or not, wherever bunchgrasses are overgrazed and reduced in stand. It may then be concluded that carpetgrass seeding is not necessary. Actually, as previously stated, it is highly undesirable since dormant forage or forage killed by drouth has one of the highest flammability ratings.

The heavy invasion of carpetgrass on unseeded check plots is evidence of "line" grazing; that is, forage use was higher than normal by reason of proximity to other preferred grazing areas. Apparently considerable forage was taken "mechanically" as animals passed across check plots.

ADAPTABILITY AND CONTINUITY OF SPECIES

Development and persistence of seeded common lespedeza have been covered in the foregoing. The advantages of lespedeza include: relatively low fertility requirement, ease of establishment, persistence by reseeding, low flammability and high palatability and nutritive rating. A possible disadvantage is an occasional relatively high seed price.

Good stands of Dallisgrass were established the first year from spring seedings where nitrogen and phosphoric acid were applied on Caddo soils. Plants produced seed even under the heaviest grazing, and stands increased. Plants remained green year-round. There was no apparent mortality, even following extreme drouth.

On well-drained Bowie soils only fair stands of Dallisgrass were obtained, even when the highest fer-

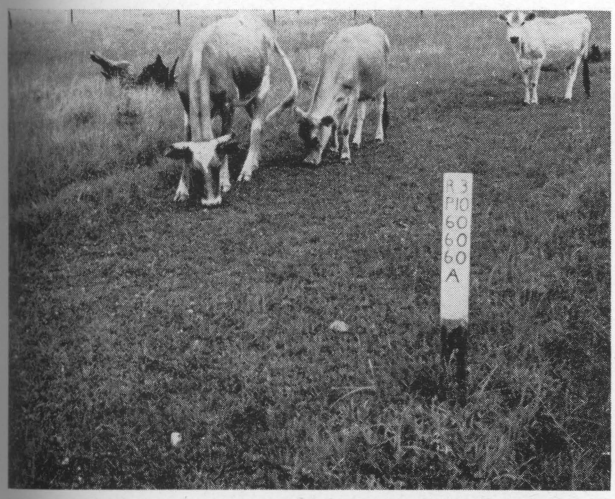

Figure 7. Condition (May 15, 1950) at edge of seeded firebreak fertilized May 1949 with 60 pounds per acre each of nitrogen, phosphoric acid and potash, plus 1 ton of lime. Note white seedheads of favorable stand of Louisiana White clover persisting under free-range grazing.

tilizer levels were used. Plants evidenced good thrift even under extreme drouth, but stands increased slowly. The comparatively poor showing is considered partially caused by subnormal rainfall for 1951, whereas Caddo sites seeded in 1949 received 67 inches rainfall, or 13.4 inches above normal.

Good stands were obtained where white, hop and Persian clovers were seeded on Caddo soils treated with 1 ton of lime per acre plus one application of 60-60-60 or 60-120-60 fertilizer. These species reseeded 2 years even under the close grazing shown in Figure 7. The third-year stand was weak, apparently as a result of both lowered fertility and close grazing. Their development during the winter-spring period provides green forage that limits or prevents firecreep among dormant grass and also provides supplemental forage of high nutritive value.

Seedings of Common Bermudagrass showed relatively poor development on both Caddo and Bowie soils. Best stands were obtained where disking provided the most site disturbance or where cattle trailing trampled out other species. Although Bermudagrass was closely grazed, withstood heavy grazing pressure and had a relatively low flammability rating, it would seem questionable to include it in seeding treatments. Advantages of this species do not seem sufficient to offset site preparation and fertilizer investments required to obtain and maintain stands.

Management of Grazed Firebreaks

The most important grazed firebreak management considerations include: frequency, rate and cost of fertilizer application to maintain desired species and close preferential grazing; season and intensity of use; and prevention of damage and maintenance of desirable range and forest conditions in adjacent areas. Additional factors to consider include limitation of unpalatable weeds, trampling damage to young forest plants, and limitation or prevention of fire-creep in fire-break lines when carpetgrass is dormant or has been killed during extreme drouth periods of September through November.

On Caddo soils an application of 0-60-0 every second year, or periodic applications of 0-60-30 should be considered to maintain good stands of common lespedeza. Maintenance costs for fertilizer and application would thus average approximately $2 per acre (or per mile of 8-foot-width break) per year. This compares favorably with average plowed or disked lane maintenance costs for the vicinity.

Tests on Bowie soils indicate two alternatives for establishment and maintenance. These are listed in the following order of preference: (1) establish breaks with seeding of common lespedeza on the area treated with 1 ton of lime plus 60-120-60 fertilizer per acre, and maintained with 0-120-0 every fourth or fifth year thereafter; or (2) establish with seeding of common lespedeza on the area treated with two successive yearly applications of 0-60-0 fertilizer and maintain with 0-60-0 treatment every 2 years thereafter, or with 0-60-30 as may be justified periodically to maintain lespedeza. The lighter successive applications of phosphoric acid considered in the second alternative are guided by closer and more uniform grazing obtained on such areas in comparison with the areas treated with 0-120-0 rates on both Bowie and Caddo soils. Maintenance costs for fertilizer and application for the two alternatives would run approximately $3 and $2 per acre per year, respectively.

Period, season and intensity of use of grazed lanes should be considered. It is preferable to avoid lane establishment around or adjacent to either young native pine reproduction or plantations small enough to be ridden down by browsing cattle. Disked or plowed lanes are preferred to protect such forest investments until they have obtained size and are not subject to browse damage. Such lanes could then be converted to fertilized and seeded strips.

Seedings of common lespedeza and Dallisgrass apparently do not need to be protected in the seedling stage since both showed favorable establishment even under the most intense grazing on Caddo sites. Young clover seedlings would be assisted by short-term grazing deferment, especially in wet weather when subject to trampling.

Aggregate acreage of fertilized firebreak plots on Caddo soils was approximately one-half acre. Those on Bowie soils aggregated nearly 3 acres. Averages of 75 and 45 head of cattle had free-choice grazing access to these fertilized strips and adjacent open range, respectively. The fertilized strips soon became main lines of travel to and from the used portion of the free range. Although grazing was ex-

tremely heavy, none of the favored seeded species evidenced mortality as a direct or indirect effect of heavy grazing. Only carpetgrass showed some late summer dieback as a result of prolonged drouth.

Good stands of seeded species generally prevented development of tall weeds that would add to the fire hazard. At the close of the fourth year on Caddo soils, a pronounced weed invasion was noted on non-seeded plots receiving the more desirable fertilizer treatments. Plaintain (*Plantago purshii*) and winter annuals, mostly cudweed (*Gnaphalium spp.*), predominated and were accompanied by a few bitterweed (*Actinea odorata*). Annual fertilizer applications on Bowie soils also limited weed development. Plaintain and cudweed density increased at the end of the fourth year, however, on the areas that had been given only the initial desirable fertilizer application. Apparently the density increase of these species may serve as an indicator of a drop in fertility level and the need for additional fertilizer.

The more effective fertilizer and seeding combinations provided a closely grazed break that would serve as an effective backfiring point or as a fire barrier all seasons of the year except during the September through November period of drouth years or for lesser limited periods of 3 weeks or more without rain. Two supplemental treatments may be considered means to make such firebreaks effective the year-round: (1) establish or rework a single-disk plowline on the risk side of such breaks as drouth periods justify the need, or (2) where supplemental winter forage needs justify it, lightly disk firebreak strip to break continuity of dry carpetgrass fuel and fertilize with 200 pounds per acre of 16-20-0 fertilizer and then seed in early fall with common or Coastal ryegrass. The latter treament would provide supplemental late-winter and spring forage of high quality and some residual carryover of phosphoric acid to aid maintenance of lespedeza for the next growing season.

Both the 8 and 50-foot-width firebreak strips tested would appear adequate as year-round backfiring points with either of the two supplemental treatments considered earlier. It is expected that strip width might be varied according to the needs of the fuel type, degree of risk and area needed or justified for supplemental forage production.

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