Cool Season Perennial Grass and Grass-Clover Management

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COOL SEASON PERENNIAL grasses are commonly used in Alabama to furnish grazing for beef brood cow herds in winter and spring. Tall fescue, the most widely planted cool season perennial grass, is adapted to certain soils over the entire State.[1] Orchardgrass is best adapted to well-drained northern Alabama soils having good moisture relations and fertility. Legumes, mainly ladino or intermediate white clovers, are often planted with these grasses to improve forage quality and supply some of the nitrogen requirement of the grass.

The summer climate in Alabama differs considerably from that of the major cool season perennial grass areas farther north. The high summer temperature, combined with alternating periods of drought or excessively high rainfall, place considerable stress on these grasses and associated legumes. In central and southern Alabama, tall fescue often becomes semi-dormant and makes little growth in summer. Several parasitic disease organisms, primarily fungi, may also be a problem. Forage yields of these cool season perennial grass species are often low during the October to March period. On many farms grass stands thin after a few years and clover stands commonly persist only 1 to 2 years in grass-clover mixtures.

This publication summarizes research in Alabama on some factors that affect yield and stand persistence of cool season perennial grasses and legumes. In these experiments at five locations in the State, irrigation, nitrogen fertilization, frequency of cutting, stubble height, and seasonal resting were studied.

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[1] Hoveland, C. S., E. M. Evans, and D. A. Mays. 1969. Cool season perennial grass species for forage in Alabama. Auburn Univ. (Ala.) Agr. Exp. Sta. Bull. 397.

GENERAL PROCEDURES

In each experiment 5 x 20-foot plots, replicated four times, were clipped at 4 to 8-week intervals unless otherwise specified. Harvesting was by means of a sicklebar mower or a flail harvester at a height of 3 inches. Forage yields are expressed on the basis of oven dry forage per acre. All yield data were analyzed and only differences significant at $P<.05$ were considered real differences. Lime, phosphorus, and potassium were applied according to soil test. Nitrogen rates are noted for each experiment. Botanical composition estimates were made prior to each harvest. Several samples were separated by hand to check the accuracy of the estimates.

IRRIGATION OF GRASS-CLOVER MIXTURES AT TENNESSEE VALLEY SUBSTATION

Experiments were conducted for 3 years on Dewey clay loam, a red soil with good water holding capacity, and Humphries silt loam, a gray soil generally considered to be more droughty because it is underlain by cherty gravel. Grasses and legumes were planted the fall of 1955, the grass in 12-inch rows and the legume broadcast. Two inches of water was applied by sprinkler irrigation whenever a 2-inch net loss of water occurred by evaporation from an open pan.

Results

Irrigation did not significantly increase total forage yield on either soil when all species were considered. Tall fescue, smooth brome, and orchardgrass showed little or no total yield response to irrigation on either soil, Tables 1 and 2. In contrast, Kentucky bluegrass yields were increased about 50 per cent on both soils by irrigation. Reed canarygrass yields were increased 30 per cent on Dewey clay loam by additional water. However, both of these grasses were considerably less productive than tall fescue on Humphries silt loam.

Orchardgrass-ladino clover yield response to irrigation was 44 per cent on Dewey clay loam and 24 per cent on Humphries silt loam. Even so, the total yield was well below that of orchardgrass fertilized with nitrogen. Tall fescue-ladino clover response to irrigation was less than orchard-ladino on Dewey clay loam. On the Humphries soil, irrigation had no effect on yield of tall fescue-ladino.

TABLE 1. EFFECT OF IRRIGATION ON LATE WINTER-EARLY SPRING AND TOTAL FORAGE YIELD OF COOL SEASON PERENNIAL GRASSES AND GRASS-LEGUME MIXTURES ON DEWEY CLAY LOAM, TENNESSEE VALLEY SUBSTATION, 1956-58[1]

Species	N/A/yr.	March-mid-April production			Total annual production		
		Oven dry forage per acre		Effect of irrig. on yield	Oven dry forage per acre		Effect of irrig. on yield
		Irrig.	Not irrig.		Irrig.	Not irrig.	
	Lb.	*Lb.*	*Lb.*	*Pct.*	*Lb.*	*Lb.*	*Pct.*
Ky. 31 tall fescue	160	2,100	3,190	−34	8,000	7,320	9
Commer. orchardgr.	160	2,090	2,440	−14	7,220	6,480	11
Aub. reed canarygr.	160	2,370	2,600	− 9	8,340	6,400	30
Ky. bluegrass	160	1,590	1,100	44	6,340	4,020	58
Southland sm. bromegr.	160	1,950	2,270	−14	6,160	6,420	− 4
Ky. 31 tall fescue & ladino clover	0	1,440	1,690	−15	4,900	4,060	21
Orchardgrass & ladino clover	0	1,230	1,210	2	5,400	3,760	44
Reed canary & ladino clover	0	1,500	1,770	−15	4,660	4,480	4
Ky. bluegrass & ladino clover	0	1,060	1,100	− 4	2,980	3,040	− 2
Orchardgrass & alfalfa	0	550	1,370	−60	2,780	3,840	−28
Reed canary & alfalfa	0	1,120	1,430	−22	4,500	4,320	4
Smooth brome & alfalfa	0	710	1,200	−41	2,400	3,060	−22

[1] April through August rainfall for 1956, 1957, and 1958 was 19.5, 13.9, and 24.2 inches, respectively. Irrigation water applied for the 3 years was 10, 10, and 16 inches, respectively.

TABLE 2. EFFECT OF IRRIGATION ON LATE WINTER-EARLY SPRING AND TOTAL FORAGE YIELD OF COOL SEASON PERENNIAL GRASSES AND GRASS-LEGUME MIXTURES ON HUMPHRIES SILT LOAM, TENNESSEE VALLEY SUBSTATION, 1956-58[1]

Species	N/A/yr.	March-mid-April production			Total annual production		
		Oven dry forage per acre		Effect of irrig. on yield	Oven dry forage per acre		Effect of irrig. on yield
		Irrig.	Not irrig.		Irrig.	Not irrig.	
	Lb.	*Lb.*	*Lb.*	*Pct.*	*Lb.*	*Lb.*	*Pct.*
Ky. 31 tall fescue	160	2,840	3,460	−18	7,840	8,040	− 3
Commer. orchardgr.	160	1,680	2,380	−29	5,060	5,400	− 6
Aub. reed canarygr.	160	1,600	1,490	7	5,600	4,780	17
Ky. bluegrass	160	1,420	1,340	6	4,700	3,260	44
Southland sm. bromegr.	160	1,100	2,140	−49	4,120	4,880	−16
Ky. 31 tall fescue & ladino clover	0	1,340	2,050	−35	4,600	4,760	− 3
Orchardgrass & ladino clover	0	910	1,190	−24	4,000	3,220	24
Reed canary & ladino clover	0	990	1,290	−23	3,740	3,380	11
Ky. bluegrass & ladino clover	0	920	1,160	−21	3,700	2,960	25
Orchardgrass & alfalfa	0	730	1,290	−43	3,740	3,880	− 4
Reed canary & alfalfa	0	720	1,060	−32	3,520	4,000	−12
Smooth brome & alfalfa	0	810	1,170	−31	2,480	3,540	−30

[1] April through August rainfall for 1956, 1957, and 1958 was 19.5, 13.9, and 24.2 inches, respectively. Irrigation water applied for the 3 years was 10, 10, and 14 inches, respectively.

Tall fescue, reed canary, orchard, and brome were the highest yielding grasses. Ladino clover-grass mixtures were generally more productive than those containing alfalfa. The most productive mixture on Humphries silt loam was Kentucky 31 tall fescue and ladino clover.

Irrigation generally reduced early season forage production of most grasses and grass-legume mixtures, Tables 1 and 2. Kentucky bluegrass was an exception in showing a 44 per cent increase in early season growth on irrigated Dewey clay loam; however, production was quite low. Crabgrass competition was stimulated by irrigation, reducing stands and vigor of most cool season forage species.

Ladino clover stands persisted much better with all grasses on Dewey clay loam than on the more droughty Humphries silt loam, Figures 1 and 2. By the third year, ladino clover made up only 10 to 17 per cent of the total forage in mixtures with tall fescue or orchardgrass on Humphries silt loam. Ladino clover stands persisted well in orchardgrass on Dewey clay loam the fourth year, Figure 3.

Irrigation reduced ladino clover persistence in all grasses on Humphries silt loam, Figures 1 and 2. On Dewey clay loam, ladino clover was reduced by irrigation in all grasses except Kentucky bluegrass.

Alfalfa stands were good the first year on both soils. However, by the end of the second harvest year stands had disappeared on Humphries silt loam. On Dewey clay loam, alfalfa stands were severely depleted by the third year. On both soils, alfalfa contributed little forage in any mixture the third year, Figures 1 and 2. Irrigation accelerated this trend.

Conclusions

Spring and summer irrigation did not increase total forage production appreciably in the Tennessee Valley area on either soil during any of the 3 years. Instead, winter and early spring forage yields were generally depressed. Severe summer weed competition under irrigation sharply decreased clover stands and virtually eliminated alfalfa.

The most productive grasses were Kentucky 31 tall fescue, Auburn reed canary, orchard, and Southland brome. The most productive mixtures on Dewey clay loam were those including ladino clover. On Humphries silt loam the most productive mixture was Kentucky 31 tall fescue and ladino clover. Grasses

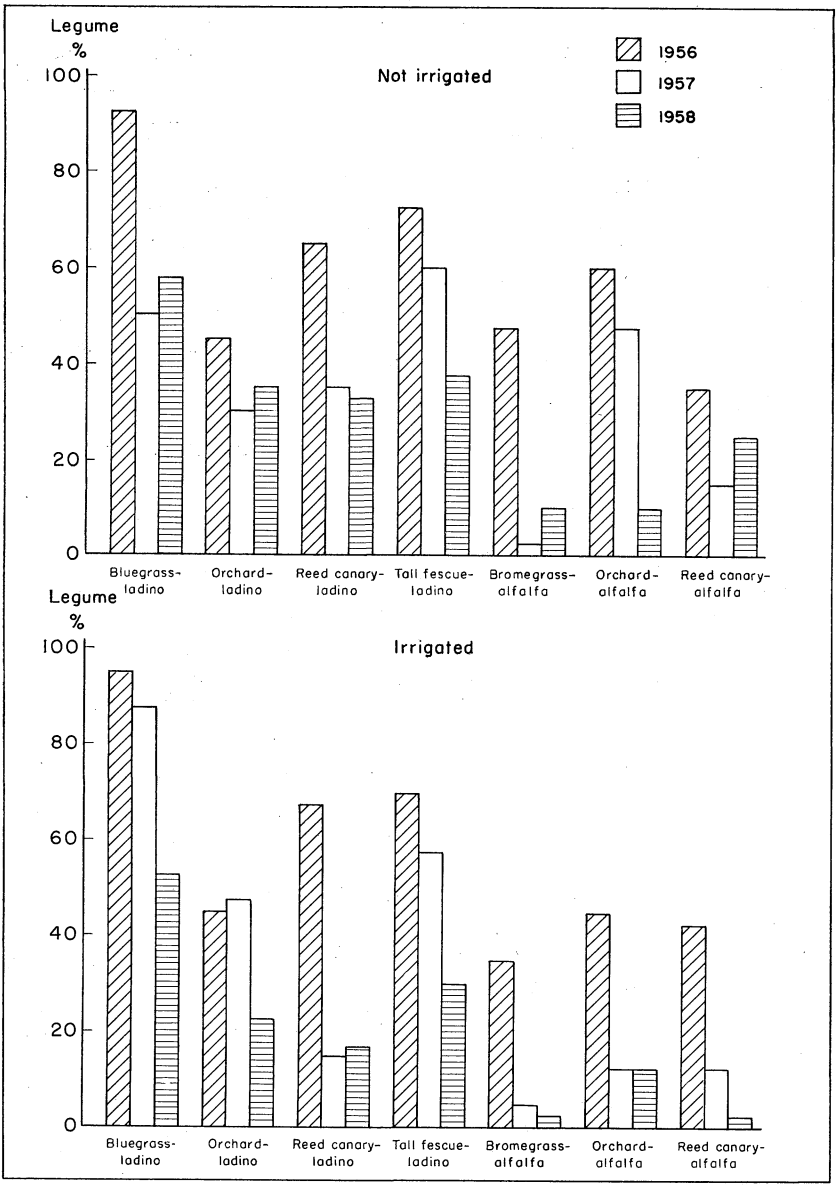

FIG. 1. Legume percentage in cool season perennial grass forage during May on Dewey clay loam at Tennessee Valley Substation.

fertilized with 160 pounds of nitrogen per acre generally made more late winter and annual production than grass-legume mixtures.

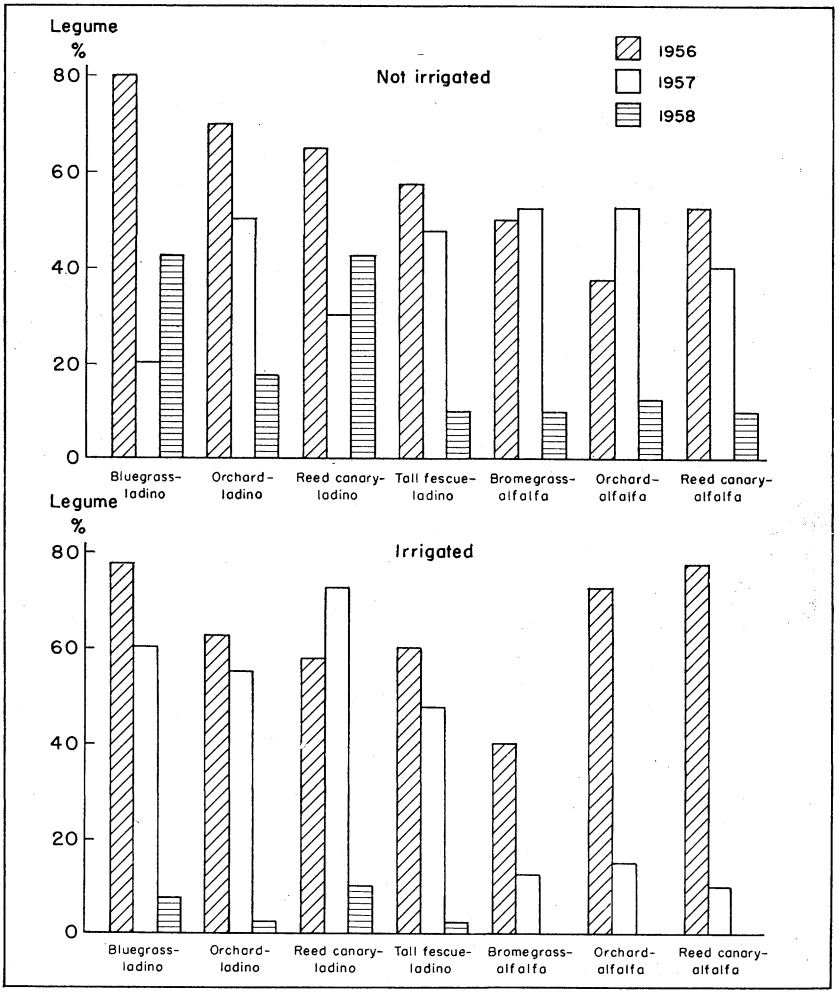

FIG. 2. Legume percentage in cool season perennial grass forage during May on Humphries silt loam at Tennessee Valley Substation.

IRRIGATION, STUBBLE HEIGHT, AND CUTTING FREQUENCY ON GRASS-CLOVER MIXTURES AT DAIRY RESEARCH UNIT, AUBURN

Three grasses and six grass-legume mixtures were studied for 3 years under four systems of cutting and two levels of moisture on Appling sandy loam at the Dairy Research Unit, Auburn, Alabama. Grasses and legumes were band seeded the fall of 1955 and the following harvesting treatments were started in

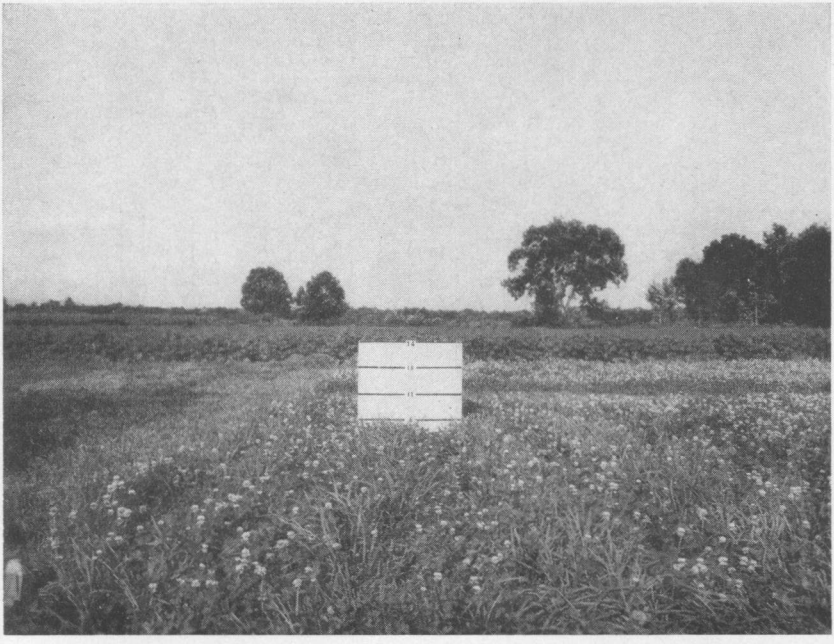

FIG. 3 Ladino clover in non-irrigated orchardgrass on Dewey clay loam at Tennessee Valley Substation, 4th year.

1956: (a) cut at 3-inches every 6 weeks from September to June; (b) cut at 1½ inches every 6 weeks from September to June; (c) cut at 1½ inches every 14 days from September to June; and (d) cut at 1½ inches every 14 days all year. Natural rainfall and irrigation by perforated pipe provided the two levels of soil moisture. Irrigated plots were watered to field capacity when soil moisture declined to less than 50 per cent of the available water holding capacity as determined by soil sampling.

Results

Yields of grasses fertilized with nitrogen were higher than grass-legume mixtures, Table 3. Also, grass-legume mixtures made less winter and early spring growth than grass fertilized with nitrogen. Forage yields were considerably lower at this location than at the Tennessee Valley Substation, Tables 1, 2, and 3. Climatic conditions were probably less favorable for cool season perennial species in central than in northern Alabama.

Tall fescue and reed canarygrass were generally more productive than orchardgrass. Tall fescue was especially resistant to weed encroachment and orchardgrass was the poorest in this

TABLE 3. EFFECT OF IRRIGATION, STUBBLE HEIGHT, AND FREQUENCY OF CLIPPING ON FORAGE YIELD OF COOL SEASON PERENNIAL GRASSES AND GRASS-LEGUME MIXTURES AT DAIRY RESEARCH UNIT, AUBURN, ALABAMA, 1956-58

Species	Irrigation[1]	Dry forage per acre: Clipped at 3 in. every 6 wks. Sept.-June	Clipped at 1½ in. every 6 wks. Sept.-June	Clipped at 1½ in. every 2 wks. Sept.-June	Clipped at 1½ in. every 2 wks. all year
		Lb.	*Lb.*	*Lb.*	*Lb.*
Ky. 31 tall fescue[2]	None	3,440	4,930	3,490	2,660
Ky. 31 tall fescue[2]	Irrig.	4,340	5,790	4,700	4,080
Commercial orchardgrass[2]	None	3,000	3,320	2,800	2,770
Commercial orchardgrass[2]	Irrig.	2,380	3,500	3,530	2,640
Auburn reed canarygrass[2]	None	4,160	4,710	3,660	2,550
Auburn reed canarygrass[2]	Irrig.	3,710	4,660	4,590	2,590
Average	None	3,530	4,320	3,320	2,660
	Irrig.	3,480	4,650	4,270	3,100
Tall fescue-ladino clover[3]	None	1,920	2,640	2,130	1,660
Tall fescue-ladino clover[3]	Irrig.	2,500	3,900	3,950	2,910
Orchard-ladino clover[3]	None	1,580	2,420	2,030	2,120
Orchard-ladino clover[3]	Irrig.	1,610	2,820	3,270	3,340
Reed canary-ladino clover[3]	None	1,910	3,240	1,870	1,880
Reed canary-ladino clover[3]	Irrig.	2,340	4,200	4,050	2,460
Average	None	1,800	2,770	2,010	1,890
	Irrig.	2,150	3,640	3,760	2,900
Tall fescue-alfalfa[3]	None	1,320	2,080	1,190	860
Tall fescue-alfalfa[3]	Irrig.	1,230	2,260	2,140	1,810
Orchard-alfalfa[3]	None	1,190	1,700	1,440	1,440
Orchard-alfalfa[3]	Irrig.	1,290	1,885	1,720	1,500
Reed canary-alfalfa[3]	None	1,620	2,120	1,550	1,350
Reed canary-alfalfa[3]	Irrig.	1,560	2,600	2,260	1,440
Average	None	1,380	1,970	1,390	1,220
	Irrig.	1,360	2,250	2,040	1,580

[1] Irrigation water applied May to September, 1956, 1957, and 1958 was 7.5, 12.0, and 12.0 inches, respectively.
[2] Received 200 lb. N/A annually.
[3] No N applied.

respect. Orchardgrass produced substantial yields during spring while tall fescue was productive over much of the year. Reed canarygrass made little growth in early spring but was quite productive in summer if adequate moisture was provided.

Clipping at 1½ inches every 2 weeks all year, to simulate continuous hard grazing, generally resulted in the lowest forage yields, poorest legume stands, and most weeds. This treatment resulted in significantly lower yields of grass alone than when harvested every 2 weeks from September to June. Highest yields of tall fescue and reed canary were usually obtained when clipped at 1½ inches every 6 weeks from September to June. Orchard-

grass responded similarly the first year but in succeeding years production on all treatments was similar and low. There was no advantage for any species in leaving a 3-inch as compared to a 1½-inch stubble as yields were highest on the latter treatment. Irrigation increased forage yields of tall fescue fertilized with nitrogen 17 per cent and tall fescue-ladino clover 47 per cent when both were clipped at 1½ inches every 6 weeks from September to June. Grass-clover mixtures were generally more responsive to irrigation than grass alone. However, it is unlikely that the value of increased forage would pay for the cost of irrigation. Reed canary and orchardgrass gave little or no response to irrigation. Weeds, mainly crabgrass (*Digitaria sanguinalis*) and annual fleabane (*Erigeron annuus*) increased with irrigation, particularly under frequent cutting.

Alfalfa stands persisted only 2 years, regardless of clipping treatment or irrigation. Ladino clover persisted better than alfalfa and maintained better stands in combination with orchardgrass and reed canarygrass than with tall fescue. However, in a pasture it is likely that the low palatability of reed canarygrass would result in selective grazing of ladino clover and eventual loss of clover stands.

Conclusions

Irrigation of cool season perennial grasses in central Alabama during summer resulted in only a modest increase in forage yield but caused heavy growth of summer weeds, particularly under frequent clipping. Results of this experiment indicate the importance of "resting" or not grazing cool season perennial grasses during summer. Grasses fertilized with nitrogen made higher winter-early spring and total production than grass-legume mixtures.

NITROGEN FERTILIZATION OF GRASS-LEGUME MIXTURES AT THE PIEDMONT SUBSTATION

Nine cool season grasses and grass-legume mixtures were band seeded the fall of 1955 on Lloyd clay at the Piedmont Substation. Each species was fertilized with 0 or 150 pounds nitrogen per acre applied in four applications. Plots were clipped monthly throughout the year.

Results

Tall fescue was more productive than orchard, reed canary, or Kentucky bluegrass, Table 4. Nitrogen application generally

tripled forage yields over that of grass with no nitrogen fertilizer. The sharp declines in yields the third year were probably a result of monthly clipping throughout the summer, suggesting the need for a summer rest period.

Alfalfa in combination with tall fescue, reed canary, or orchardgrass with no nitrogen fertilizer was quite productive the first 2 years and yields generally equalled or exceeded the grasses alone with 150 pounds of nitrogen per acre. Nitrogen did not affect stands of alfalfa. However, the third year alfalfa stands virtually disappeared, probably a result of the severe monthly cutting treatment.

Ladino clover-grass mixtures were less productive but persisted longer than alfalfa-grass mixtures. Nitrogen fertilizer decreased stands of ladino clover, particularly in tall fescue. Although yields were low the third year, ladino clover-grass mixtures were more productive than the grasses with 150 pounds of nitrogen per acre.

Late winter-early spring (February to mid-April) production of grass-clover mixtures was low without nitrogen fertilizer, Figure 4. Grasses alone made virtually no growth during this period without nitrogen. When fertilized with nitrogen, tall fescue, tall

TABLE 4. EFFECT OF NITROGEN FERTILIZER ON FORAGE YIELD OF COOL SEASON PERENNIAL GRASSES AND GRASS-LEGUME MIXTURES AT PIEDMONT SUBSTATION, 1956-58

Species	Nitrogen per acre	Oven dry forage per acre			
		1956	1957	1958	3-yr. av.
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Ky. 31 tall fescue	0	1,690	480	540	900
	150	5,850	5,410	2,100	4,450
Commercial orchardgrass	0	1,840	490	230	850
	150	4,400	4,210	1,150	3,250
Auburn reed canarygrass	0	1,790	1,030	140	990
	150	3,420	4,490	1,920	3,280
Kentucky bluegrass	0	910	260	510	560
	150	1,040	4,150	2,050	2,410
Tall fescue-ladino clover	0	2,400	3,980	3,290	3,220
	150	5,140	5,650	3,330	4,710
Orchardgrass-ladino clover	0	1,570	2,840	3,260	2,560
	150	3,570	4,910	3,490	3,990
Tall fescue-alfalfa	0	4,420	4,730	2,540	3,900
	150	7,330	5,760	2,620	5,240
Orchardgrass-alfalfa	0	4,350	4,910	2,640	3,970
	150	5,330	5,840	3,250	4,810
Reed canary-alfalfa	0	3,990	5,090	2,930	4,000
	150	5,120	6,490	2,690	4,770

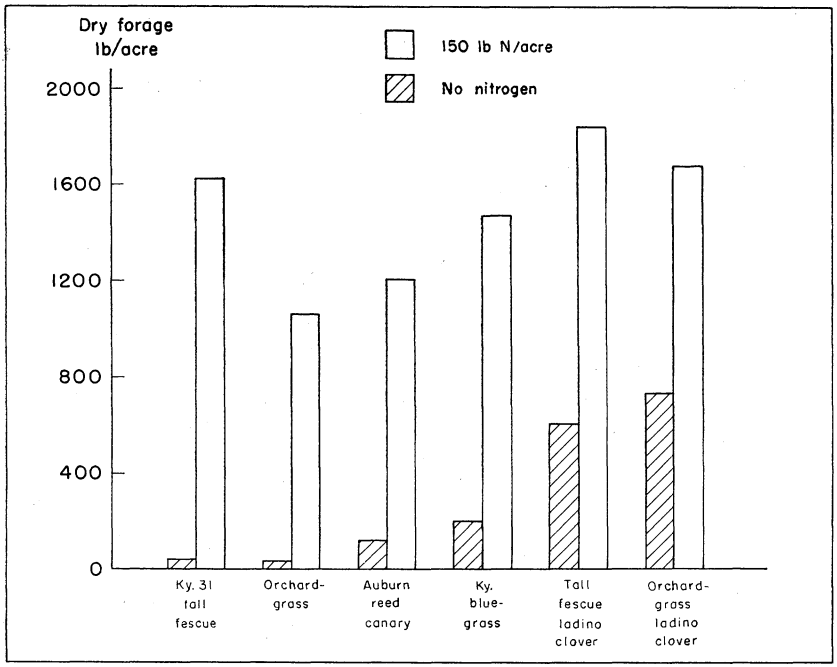

FIG. 4. February to mid-April forage production of cool season perennial species at Piedmont Substation, 1957-58 average.

fescue-ladino clover, and orchardgrass-ladino clover were the most productive species from February to mid-April.

Conclusions

When fertilized with nitrogen, cool season perennial grasses such as tall fescue alone or in combination with ladino clover furnished grazing over a considerable period of the year in the Piedmont area. Late winter-early spring production was low unless nitrogen was applied. Persistence and productivity declined the third year, probably caused by continued cutting throughout the summer. Other results reported in this circular show that sustained production over a number of years would be more successful if the grasses were not grazed during the summer.

EFFECT OF CUTTING FREQUENCY ON PRODUCTIVITY AND PERSISTENCE OF CLOVER IN GRASS AT ALEXANDRIA EXPERIMENT FIELD

Goar tall fescue and Boone orchardgrass were each planted alone and in combination with Orbit red or Regal ladino clover

on Taft silt loam in September 1967, at Alexandria Experiment Field (located near Anniston in north Alabama but now closed). Each grass or grass-clover combination was harvested under two systems: simulated pasture (cut every 3 to 4 weeks), and hay (cut every 6 to 8 weeks). Grasses were not cut during the May-June heading period. Nitrogen was applied annually at the rate of 150 pounds per acre on grass alone and 50 pounds per acre on grass-clover mixtures.

Results

Total annual forage yields over the 2-year period were highest for tall fescue alone or in combination with red clover cut at the hay stage, Table 5. Yields of tall fescue-red clover were sharply reduced and tall fescue alone to a lesser extent by cutting more frequently. Tall fescue-ladino clover cut at the hay stage yielded about the same as orchardgrass or orchardgrass-clover cut at hay stage. Only a small yield reduction occurred with orchardgrass under the pasture system as compared with hay cutting.

TABLE 5. FORAGE YIELD OF COOL SEASON PERENNIAL GRASSES AND GRASS-CLOVER MIXTURES AS AFFECTED BY FREQUENCY OF CLIPPING AT ALEXANDRIA EXPERIMENT FIELD, 1968-69

Species	Nitrogen applied per acre annually	Dry forage per acre		
		Clipped frequently simulated pasture		Clipped at hay stage
		Jan.-early April	Total	Total
	Lb.	*Lb.*	*Lb.*	*Lb.*
Goar tall fescue	150	1,360	5,760	6,720
Goar tall fescue & red clover	50	850	4,770	6,470
Goar tall fescue & ladino clover	50	1,150	5,810	5,710
Boone orchardgrass	150	990	4,780	5,510
Boone orchardgrass & red clover	50	590	4,380	5,520
Boone orchardgrass & ladino clover	50	870	4,910	5,470

Late winter-early spring forage yield was highest with tall fescue alone, Table 5. Yields would normally be higher but the 2-year average includes the establishment year. Orchardgrass alone or with clover was less productive than tall fescue in late winter-spring. Ladino clover was more productive than red clover during this season.

The grass species and system of management had a marked effect on persistence and amount of clover present in the forage, Figure 5. Both clovers generally persisted better with orchard-

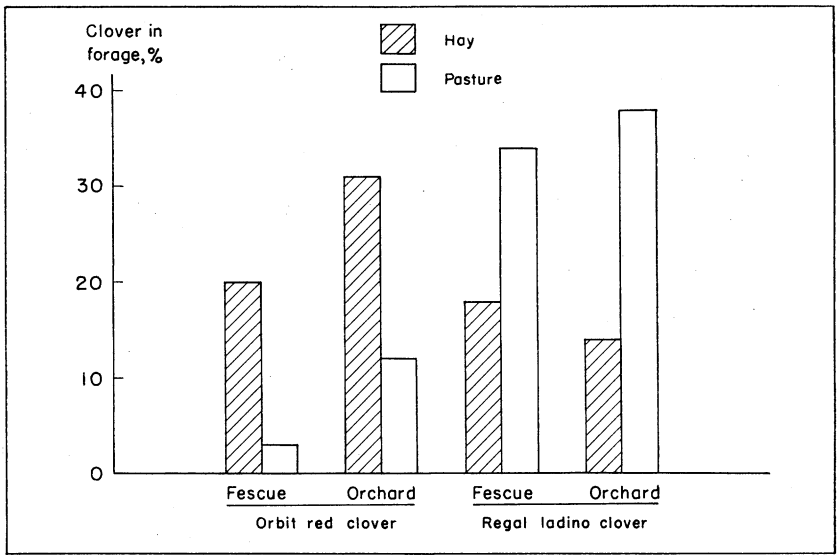

FIG. 5. Effect of pasture (frequent) clipping and hay cutting on per cent clover in forage at Alexandria Experiment Field. Data collected April 29 of second season.

grass than with tall fescue. Under pasture management, red clover stands declined sharply in orchardgrass and were virtually eliminated in tall fescue. Ladino clover, in contrast, was favored by frequent cutting. The different response of the two clovers to cutting management is illustrated in Figure 6. Ladino clover, having leaves close to the ground and many stolons for reserve food storage, tolerates frequent close cutting as in grazing while red clover, an erect-growing plant, can be more easily overgrazed. Differences in persistence between the two clovers would likely have been even more striking by the third year had it not been necessary to terminate the experiment because of closing Alexandria Experiment Field.

Conclusions

The type of cutting or grazing system had a marked effect on clover persistence and growth. Under simulated grazing, ladino clover was productive in both Goar tall fescue and Boone orchardgrass on Taft silt loam. Red clover, in contrast, was productive when cut in the hay stage but did not persist under simulated grazing. Tall fescue, alone or with clover, furnished more winter-early spring production than orchardgrass.

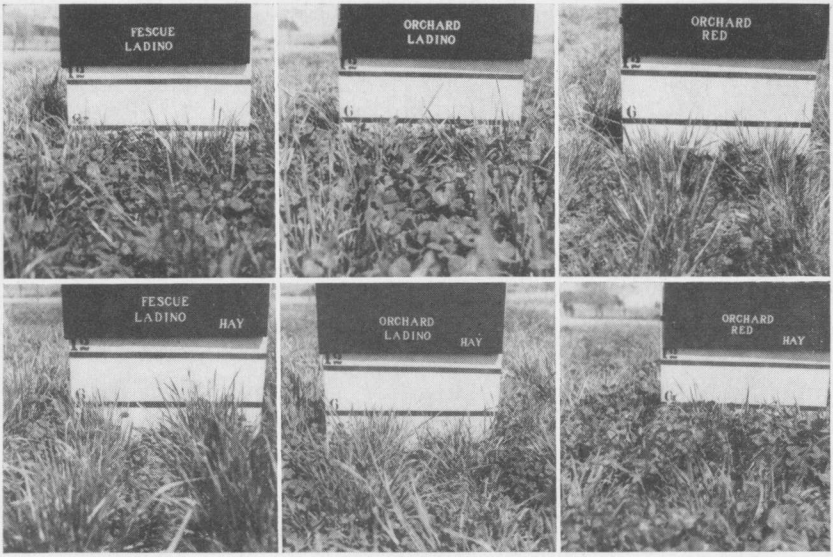

FIG. 6. Effect of pasture (frequent) clipping and hay cutting on persistence of clover in orchardgrass and tall fescue at Alexandria Experiment Field, 2nd year.

SUMMER MANAGEMENT STUDIES ON TALL FESCUE, HARDING, AND KOLEAGRASS AT PLANT BREEDING UNIT

Established stands of Goar and Kentucky 31 tall fescue, hardinggrass, and koleagrass on Cahaba fine sandy loam at the Plant Breeding Unit, located at Tallassee in central Alabama, were used to study the effect of summer clipping on autumn-winter forage production. The entire experimental area was cut during autumn, winter, and spring, with the last harvest in late April. Four summer clipping treatments were compared in the years of testing: (a) not clipped from early May to September; (b) clipped in early June; (c) clipped in mid-July; and (d) clipped in June and July.

All plots were cut to leave a 3-inch stubble. Old grass residue was cut and discarded in early September each year. Nitrogen was added in four applications at 40 pounds per acre, making a total of 160 pounds of nitrogen per acre.

Results

Autumn-winter (October through February) forage yields were significantly increased 32 per cent when Kentucky 31 tall fescue was not clipped in July, Table 6. Removing forage in

TABLE 6. FORAGE YIELD DISTRIBUTION OF KENTUCKY 31 AND GOAR TALL FESCUE AS AFFECTED BY SUMMER CLIPPING, TALLASSEE, ALABAMA

Treatment	Oven dry forage per acre[1]			
	Kentucky 31		Goar	
	Oct.-Feb.	Oct.-April	Oct.-Feb.	Oct.-April
	Lb.	*Lb.*	*Lb.*	*Lb.*
No clipping from early May to September	2,620	6,450	2,990	6,990
Clipped in early June	2,580	6,930	2,400	6,590
Clipped in mid-July	1,980	6,150	2,620	6,760
Clipped in June and July	2,340	6,630	2,350	6,590

[1] Two-year averages.

June did not reduce yields. However, when clipped in both June and July, there was a significant loss in yield the following autumn-winter. In this experiment, Kentucky 31 produced an average of 6,500 pounds of dry forage per acre during the cool season, which was similar to Goar production.

Analyses for available carbohydrates showed that food reserves are stored in the stem bases of tall fescue plants after maturity (May-June). Because of the nature of this grass, food reserves will be low if forage is removed during late spring or early summer. Such removal results in slower fall growth. In addition, quality of fescue forage is usually low in mid-summer.

Autumn and winter yields of Kentucky 31 were not reduced when forage was removed in mid-June. This indicates that grazing can be continued until seed have matured without reducing fall forage production in central Alabama.

The data in Table 6 show that removing forage of Goar tall fescue during summer significantly decreased yields in autumn and winter. Clipping in June reduced yields 24 per cent below production of that getting summer rest. Yields were decreased 14 per cent when cutting was delayed until July. Yield reduc-

TABLE 7. SEASONAL FORAGE DISTRIBUTION OF GOAR TALL FESCUE AS AFFECTED BY SUMMER CLIPPING, SECOND SEASON, TALLASSEE, ALABAMA

Treatment	Oven dry forage per acre					
	Oct.	Dec.	Feb.	March	April	Total Oct.-April
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
No clipping early May to September	1,050	690	710	1,050	4,370	7,870
Clipped in early June	640	490	380	1,180	4,670	7,360
Clipped in mid-July	980	630	630	1,240	4,420	7,900
Clipped in June and July	680	370	410	1,150	4,550	7,160

tions from summer clipping were even greater the second season, indicating a cumulative effect when tall fescue pastures were grazed in summer year after year, Table 7.

Summer growth of Goar is much slower than that of Kentucky 31. As a result, it appears that Goar cut in June does not build up sufficient food reserves for rapid fall growth[2]. Goar requires a longer rest period for maximum autumn and winter yields than does the Kentucky 31 variety. Fall and winter yields of Goar are reduced if any forage is removed from booting until late summer in central Alabama.

Harding and koleagrass are palatable cool season perennial grasses which make more winter growth than tall fescue in central and south Alabama. Both grasses have been planted experimentally in Alabama. Summer survival has been a problem, particularly with hardinggrass. In this experiment, clipping in summer drastically reduced forage yields in autumn and early winter, Table 8. Summer clipping reduced yields even more the second season. Crabgrass growth was heavy in kolea, hardinggrass, and tall fescue when the grasses were clipped in summer, Figure 7. Continued summer clipping or grazing of these grasses can be expected to weaken stands and reduce productivity. Summer clipping depleted food reserves in grass storage organs. This may explain the usual loss of stand and poor growth of hardinggrass pasture plantings in Alabama. New growth in autumn is dependent on stored food in the plant.[2] Thus, if these grasses are

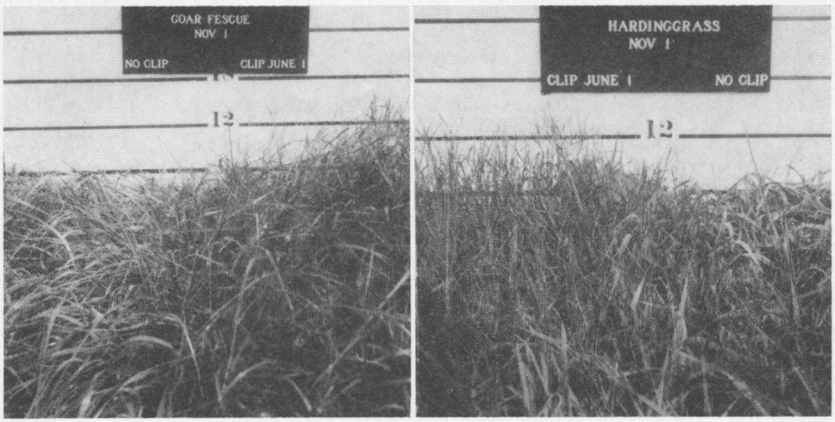

FIG. 7. Goar tall fescue and hardinggrass remained weed free and made good fall growth when not clipped during summer.

[2] Berry, R. F. and C. S. Hoveland. 1969. Summer defoliation and autumn-winter production of *Phalaris* species and tall fescue varieties. Agron. J. 61:493-497.

TABLE 8. FORAGE YIELD DISTRIBUTION OF HARDINGGRASS AND KOLEAGRASS AS AFFECTED BY SUMMER DEFOLIATION, TALLASSEE, ALABAMA

Treatment	Oven dry forage per acre[1]			
	Hardinggrass		Koleagrass	
	Oct.-Feb.	Oct.-April	Oct.-Feb.	Oct.-April
	Lb.	*Lb.*	*Lb.*	*Lb.*
No clipping early May to September	2,640	7,080	3,140	6,430
Clipped in early June	1,280	5,900	1,890	5,390
Clipped in mid-July	1,450	6,020	2,080	5,460
Clipped in June and July	1,190	5,520	1,660	4,900

[1]Two-year averages.

to be successfully grown in Alabama, they must be rested during and after heading in late spring and early summer when food storage occurs in underground plant parts.

Conclusions

Cool season perennial grasses, particularly in central and south Alabama, require a period of "resting" or minimal grazing from time of seedstalk emergence throughout the summer months if they are to persist and be productive during autumn and early winter. The beneficial effect of summer resting may be attributed to accumulation of food reserves in stem bases or underground storage organs, maintaining buds in a dormant state by shading of seedstalk and leaves, and less weed competition in the sod.

SUMMARY

Experiments were conducted at five locations in Alabama to study the effects of irrigation, nitrogen, frequency of cutting, stubble height, and summer resting on persistence and productivity of several cool season perennial grasses and grass-legume mixtures.

1. Irrigation did not increase total annual forage yields of most grasses. Kentucky bluegrass and reed canarygrass responded well to irrigation but yields were below that of tall fescue. Orchardgrass-ladino clover was the only grass-legume mixture to give a good response to irrigation but yields were below that of tall fescue fertilized with 160 pounds of nitrogen per acre.

2. Irrigation decreased early spring forage yields, increased weed competition, sharply decreased clover stands, and together with frequent clipping virtually eliminated alfalfa within 2 years.

3. Ladino clover stands persisted longer than alfalfa in association with cool season perennial grasses.

4. When grown with tall fescue and orchardgrass, ladino clover was tolerant of frequent clipping (simulated grazing) but red clover persisted only when cut at hay stage.

5. None of the grass-legume mixtures were as productive as tall fescue fertilized with 150 pounds of nitrogen per acre.

6. Cool season perennial grasses in central and south Alabama required a period of rest or minimal grazing from time of seedstalk emergence throughout the summer months for persistence and maximum productivity during autumn and early winter.

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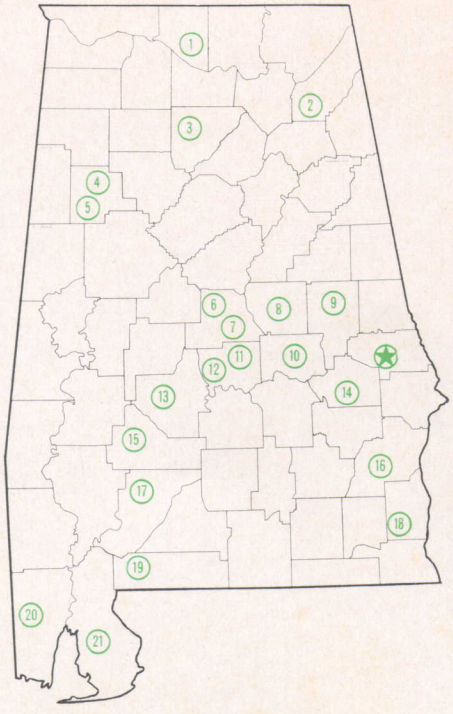

Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.