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Cool Season Annual Pasture Mixtures as Affected by Autumn Irrigation and Nematicide in the Wiregrass Area

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COOL SEASON ANNUAL PASTURE MIXTURES as AFFECTED by AUTUMN IRRIGATION and NEMATICIDE in the WIREGRASS AREA

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COOL SEASON annual pastures, containing rye, ryegrass, and a legume are high in digestible energy and protein. Properly managed, these pastures have the potential for a 7-month grazing season, steer gains of 1.7 to 2.0 pounds per day, and per acre gains of 350 to 400 pounds of beef.

Autumn droughts combined with limited soil water storage capacity in the Wiregrass area of southeastern Alabama often result in little forage growth on cool season annual pastures until late November or December. Favorable temperatures and adequate sunlight in autumn suggest that irrigation should increase the dependability and quantity of forage on cool season annual pastures.

Irrigation of cool season perennial grasses in northern and central Alabama did not increase forage yields.[2] Although forage yields of Coastal bermuda and Pensacola bahiagrass were increased by additional water in northern and central Alabama, it was concluded that irrigation is usually not an economically sound practice on these grasses.[3] No irrigation experiments on forages have been conducted in the Wiregrass area. Autumn drought is usually more severe in the Wiregrass area than other parts of Alabama,[4] thus, irrigation during this critical period might be especially useful during establishment of cool season annual forages.

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[4] Ward, H. S., C. H. M. van Bavel, J. T. Cope, Jr., L. M. Ware, and H. Bouwer. 1959. Agricultural Drought in Alabama. Auburn Univ. (Ala.) Agr. Exp. Sta. Bull. 316.

Nematodes are a serious problem on row crops such as peanuts and corn in the Wiregrass area. However, no information is available concerning nematodes on cool season annual forages.

This circular summarizes the results of irrigation and nematicide experiments with various cool season annual mixtures in the Wiregrass area of southeastern Alabama. Experiments were planted September 20 in each of 3 years (1972, 1973, 1974) on Plinthic Paleudult (formerly Norfolk sandy loam) at the Wiregrass Substation near Headland. Variables in the experiment were irrigation in autumn vs no irrigation, nematicide vs no nematicide, harvesting forage to leave a 1.5 vs a 4-inch stubble, and four legume combinations with rye and ryegrass.

Irrigation water was applied by one-quarter circle sprinkler at the corner of each irrigated block. Soil water storage in the root zone was approximately 1 inch and evapotranspiration was 0.1 inch per day so water was applied once every 10 days unless rain fell. Rainfall was added to the water budget record up to a total of 1 inch.

Furadan 10G (carbofuran) was applied at 4 pounds (active ingredient) per acre and tilled into the soil on nematicide-treated plots before planting. On all plots, Wrens Abruzzi rye was seeded in 6-inch rows at the rate of 60 pounds per acre and Gulf ryegrass broadcast at 10 pounds per acre. Legume seeding rates of inoculated seed were: Florida 66 alfalfa 15 pounds per acre, Regal ladino clover 5 pounds per acre, Autauga crimson clover 15 pounds per acre, and Yuchi arrowleaf clover 8 pounds per acre.

The 4- x 20-foot plots, replicated four times, were harvested every 3 to 6 weeks with a flail harvester. Nitrogen was applied at 50 pounds per acre at planting, in November, and again in late January.

RESULTS AND DISCUSSION

Irrigation

Rainfall from late September through November was inadequate for satisfactory autumn forage growth in all 3 years, Table 1. October rainfall totaled 2.6 inches in 1972, 0.1 inch in 1973, and 1.7 inches in 1974. Rainfall from November 1-10 totaled 0.8 inch in 1972, 0.6 inch in 1973, and 0 in 1974. The autumn of 1973 was especially severe with only 0.9 inch rainfall in late September, only 0.1 inch in October, and 1.6 inches from Novem-

TABLE 1. AUTUMN RAINFALL AND IRRIGATION WATER APPLIED ON WINTER ANNUAL MIXTURES

Dates	1972		1973		1974	
	Rainfall	Irrigation	Rainfall	Irrigation	Rainfall	Irrigation
	In.	*In.*	*In.*	*In.*	*In.*	*In.*
Sept. 20-30	0	1.0	0.9	0.5	1.6	1.0
Oct. 1-10	1.1	0	0.1	1.0	0	0
Oct. 11-20	0	1.5	0	1.0	1.7	1.0
Oct. 21-31	1.5	0	0	1.0	0	1.0
Nov. 1-10	0.8	0	0.6	1.0	0	0
Nov. 11-20	3.6	0	0.4	1.0	1.5	1.0
Nov. 21-30	1.1	0	2.6	0	1.3	0
Total	8.1	2.5	4.6	5.5	6.1	4.0
Total rainfall and irrigation	10.6		10.1		10.1	

ber 1-22. Rainfall plus irrigation water totaled just over 10 inches for the September 20-November 30 period in each of the 3 years.

Even though moisture was accumulated from earlier September rains in fallowed soil, it is apparent that October and early November rainfall were inadequate to meet the calculated daily evapotranspiration losses of 0.1 inch or more per day. The low autumn rainfall obtained during the 3 years of these experiments are usual in southeastern Alabama.

Autumn irrigation increased forage yields an average of 175 percent during October-November (first two harvests each year) over the 3-year period, Table 2. Irrigation increased forage yields most in 1973, about 450 percent, and least in 1974, about 90 percent. The total amount of irrigation water applied varied from 2.5 inches in 1972 to 5.5 inches in 1973, Table 1. Several applications of water were soon followed by substantial rains such as the irrigations on September 27, 1972, October 11, 1974 and November 11, 1974.

TABLE 2. IRRIGATION EFFECT ON AUTUMN (OCTOBER-NOVEMBER) RYE FORAGE PRODUCTION

	Oven dry forage yield per acre			
	1972-73	1973-74	1974-75	3-year Average
	Lb.	*Lb.*	*Lb.*	*Lb.*
Irrigated	1,470 a*	1,380 a	940 a	1,260 a
Not irrigated	580 b	250 b	540 b	460 b

* Yield values within a year column not marked with the same letter are significantly different at 0.5 level.

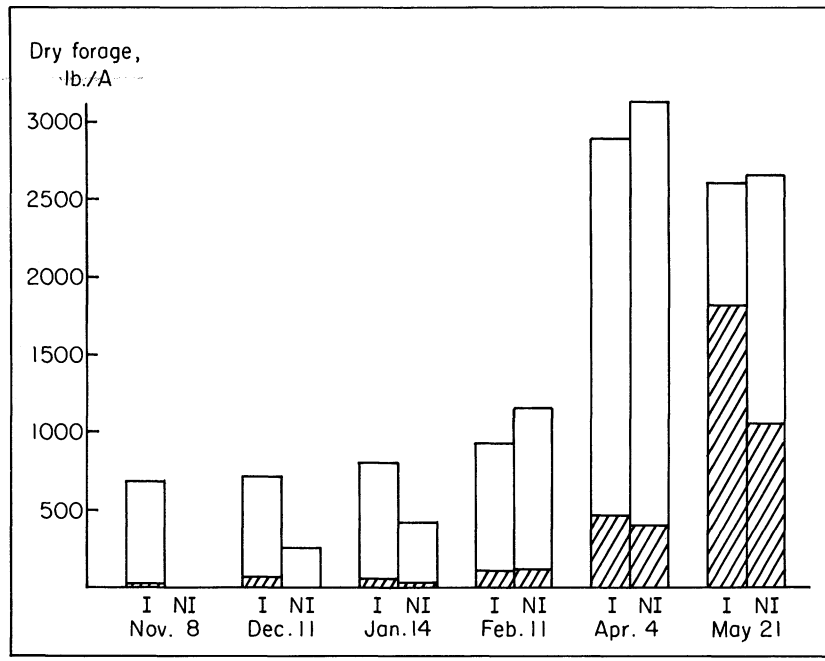

FIG. 1. Effect of irrigation (I) and no irrigation (NI) on seasonal distribution of forage and amount of clover (hatched area) in rye-ryegrass-Yuchi arrowleaf clover mixture, winter 1973-74.

Although the major effect of irrigation was to increase the autumn production of rye, it also improved stands and spring production of Yuchi arrowleaf clover, figures 1 and 2. Spring clover growth was improved even in 1973-74 when autumn yield response to irrigation was least. Late winter and spring production of Regal ladino clover was increased similarly and Autauga crimson clover to a lesser extent. Florida 66 alfalfa was not affected by irrigation.

Irrigation improved the dependability of high quality forage available for grazing in early autumn, Figure 3. In all 3 years of the experiment, forage would have been available for grazing by mid- to late October with irrigation but in 1972 and 1973 no forage was available on unirrigated plots for grazing before December. In the 1972-73 season, irrigation increased forage production into January, Figure 1, while in the 1974-75 season irrigation increased yields only into November, Figure 2.

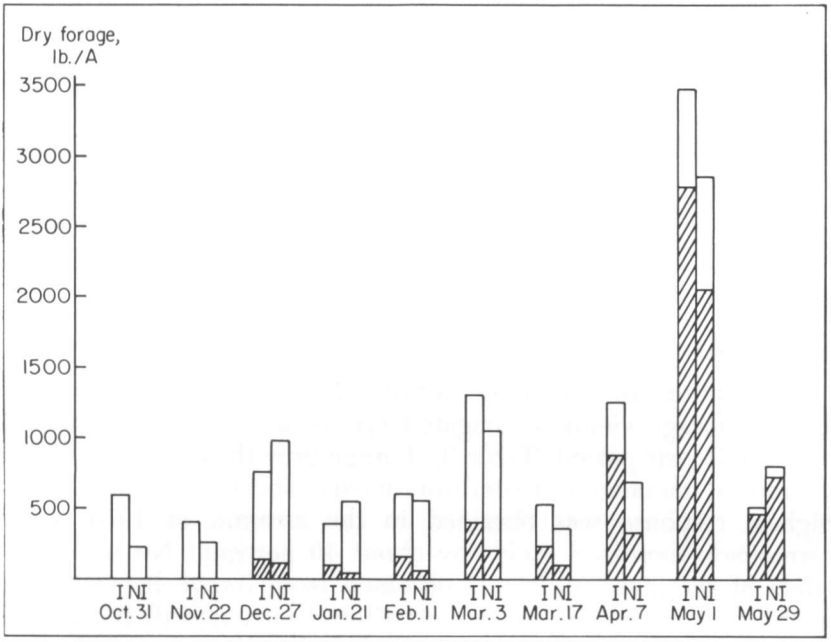

FIG. 2. Effect of irrigation (I) and no irrigation (NI) on seasonal distribution of forage and amount of clover (hatched area) in rye-ryegrass-Yuchi arrowleaf clover mixture, winter 1974-75.

FIG. 3. Rye-ryegrass-Yuchi arrowleaf clover not irrigated (left) and irrigated (right) one month after planting.

TABLE 3. FURADAN NEMATICIDE EFFECT ON IRRIGATED AUTUMN (OCTOBER-NOVEMBER) RYE FORAGE PRODUCTION

Soil treatment	Oven dry forage yield per acre			
	1972-73	1973-74	1974-75	3-year Average
	Lb.	*Lb.*	*Lb.*	*Lb.*
Furadan nematicide	1,690 a*	1,930 a	1,280 a	1,630 a
None	1,470 b	1,380 b	940 b	1,260 b

* Yield values within a year column not marked with the same letter are significantly different at 0.05 level.

Nematicide

Application of Furadan nematicide at planting increased autumn forage yields of irrigated rye an average of 29 percent over the 3-year period, Table 3. Forage growth was substantially greater on nematicide treated soil in early autumn, Figure 4. The highest response was obtained in the autumn of 1973 when nematicide increased yields by about 40 percent. No beneficial effect of the nematicide was obtained from forage harvested in winter and spring. Since rye constituted virtually all the forage harvested in autumn, it was concluded that the nematicide was effective mainly on rye.

Nematode populations of untreated soil were relatively low in both 1972 and 1974, Table 4. The data show an increase in the number of stubby root nematodes on untreated soil. This trend has been observed with other experiments in the State and may be a limiting factor in forage production. However, it is apparent that the nematicide reduced soil populations of meadow and stubby root nematodes. Had soil nematode populations been

TABLE 4. NEMATODE NUMBERS IN IRRIGATED SOIL GROWING WINTER ANNUAL MIXTURES ON PREPARED LAND AS AFFECTED BY FURADAN NEMATICIDE

Soil treatment	Legume in combination with rye and ryegrass	Nematodes per 50 cubic centimeters soil			
		Oct. 23, 1972			Jan. 9, 1974
		Meadow	Stubby	Ring	Stubby
Furadan	Yuchi arrowleaf clover	0	0	4	2
	Autauga crimson and Yuchi arrowleaf clover	0	0	0	2
	Regal ladino clover	0	0	4	0
	Florida 66 alfalfa	0	0	4	2
None	Yuchi arrowleaf clover	4	0	4	5
	Autauga crimson and Yuchi arrowleaf clover	18	18	4	6
	Regal ladino clovers	11	14	0	2
	Florida 66 alfalfa	4	16	9	5

FIG. 4. Superior growth of rye on nematicide-treated soil (right) one month after planting.

higher, it is possible that forage yields would have been lower on the untreated soil. Results obtained in this experiment indicate that it may be economically desirable to treat heavily nematode-infested soil to increase autumn production of rye under irrigation.

Stubble Height

Harvesting forage to a stubble height of 4 inches sharply reduced autumn forage yield as compared to a 1.5-inch stubble, Table 5. The 3-year average winter-spring production was not affected by stubble height. However, in the spring of 1974 the yields of mixtures having Yuchi arrowleaf clover were substantially greater when forage was cut at the 4 than 1.5-inch stubble height. The reason for this is primarily that the grass-clover mixture had not been cut since February 11 so that by April 4

TABLE 5. STUBBLE HEIGHT EFFECT ON FORAGE PRODUCTION OF WINTER ANNUAL MIXTURES

Stubble height	Oven dry forage yield per acre							
	1972-73		1973-74		1974-75		3-year Average	
	Autumn	Winter-Spring	Autumn	Winter-Spring	Autumn	Winter-Spring	Autumn	Winter-Spring
Inches	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1.5	1,470 a*	7,870 a	1,380 a	5,640 b	940 a	7,930 a	1,260 a	7,150 a
4	1,310 b	7,400 a	860 b	7,090 a	460 b	8,160 a	880 b	7,550 a

* Yield values within a column not marked with the same letter are significantly different at 0.05 level.

the clover was at hay stage, Figure 1. Previous research has shown that Yuchi arrowleaf clover at hay stage has few buds at base of the plant to regenerate new shoots. Under intensive grazing this problem does not occur as new buds continually produce new leaves into late spring.

Botanical composition of the forage was not substantially affected by stubble height. Ladino clover was reduced somewhat in late spring with high stubble. These results do not show any advantage in maintaining a high stubble on cool season annual mixtures. Grazing pasture rotationally to a short stubble should

TABLE 6. FORAGE YIELD OF RYE-RYEGRASS-LEGUME MIXTURES AS AFFECTED BY LEGUME SPECIES

Autumn Irrigation	Stubble height	Soil Nematicide	Legume in mixture	Oven dry forage per acre		
				Autumn	Winter-Spring	Total
	Inches			*Lb.*	*Lb.*	*Lb.*
None	1.5	None	Yuchi arrowleaf clover	460	8,160	8,620
			Autauga crimson and Yuchi arrowleaf clovers	400	7,900	8,300
			Regal ladino clover	500	6,570	7,070
			Florida 66 alfalfa	470	6,300	6,770
Irrigated	1.5	Furadan	Yuchi arrowleaf clover	1,570	7,820	9,390
			Autauga crimson and Yuchi arrowleaf clovers	1,680	7,900	9,580
			Regal ladino clover	1,660	7,240	8,900
			Florida 66 alfalfa	1,610	6,340	7,950
Irrigated	1.5	None	Yuchi arrowleaf clover	1,280	8,240	9,520
			Autauga crimson and Yuchi arrowleaf clovers	1,230	7,270	8,500
			Regal ladino clover	1,230	6,670	7,900
			Florida 66 alfalfa	1,330	6,390	7,720
Irrigated	4	None	Yuchi arrowleaf clover	930	8,690	9,620
			Autauga crimson and Yuchi arrowleaf clovers	890	8,250	9,140
			Regal ladino clover	840	6,900	7,740
			Florida 66 alfalfa	850	6,350	7,200

give optimum forage yields and maintain legumes.

Legume Species

Rye-ryegrass-Yuchi arrowleaf clover was the most productive mixture under both irrigated and unirrigated conditions, Table 6. Rye-ryegrass-Autauga crimson clover-Yuchi arrowleaf clover furnished nearly as much production but had more winter legume growth. Growth of Autauga crimson in some cases depressed the growth of Yuchi arrowleaf clover in late spring. It is doubtful if the additional winter clover growth was worth the cost of the crimson clover seed.

Under drought stress in late spring, Yuchi arrowleaf furnished more legume growth than other species in the test. Regal ladino clover was outstanding during the wet May and June of 1975 but under the more normal drought during the previous two springs, it contributed little late spring forage. The mixture containing Florida 66 alfalfa was the lowest yielding in the test. Alfalfa does not tolerate frequent defoliation. Thus, it would not be a desirable legume in a pasture mixture unless rotationally grazed.

Rye furnished virtually all of the forage in the mixtures until December. Ryegrass comprised 30 to 40 percent of the forage from December until May in most years. Rye growth ceased by April. Yuchi arrowleaf comprised 5 to 25 percent of the total forage from December through February, increasing to 30 to 50 percent in March, and even more in late spring, figures 1 and 2.

More frequent cutting, Figure 2, resulted in a higher percentage of clover in the forage throughout the season than where fewer harvests were made, Figure 1. Thus, with under-grazing where large amounts of forage accumulate, grasses will dominate whereas under heavier grazing pressure where forage is utilized, clovers will be more abundant in the forage.

SUMMARY AND CONCLUSION

Replicated small-plot experiments were planted September 20 for 3 years (1972, 1973, 1974) on Norfolk sandy loam soil at the Wiregrass Substation to study the effect of irrigation, nematicide, and harvest stubble height on forage production of rye and ryegrass in mixtures with four legume species. All mixtures were fertilized with a total of 150 pounds of N per acre in three applications.

1. Autumn irrigation of 2.5 to 5.5 inches water increased 3-year average forage yields 174 percent. October and November dry forage production averaged 1,260 pounds with irrigation as compared to 460 pounds on dryland. Irrigation improved stands and spring production of Yuchi arrowleaf clover.

2. Furadan 10G (carbofuran) nematicide at 4 pounds (active ingredient) per acre increased autumn rye forage production 29 percent over a 3-year period. Meadow and stubby root nematode populations were relatively low in untreated soil and virtually eliminated in nematicide-treated soil.

3. Harvesting forage at a 4-inch stubble height reduced autumn forage yields as compared to 1.5-inch stubble. Winter-spring production was generally not affected by stubble height.

4. Rye-ryegrass-Yuchi arrowleaf clover was the most productive mixture under both irrigated and unirrigated conditions. Total annual production averaged 9,520 pounds dry forage per acre when irrigated and 8,620 pounds per acre when not irrigated. Rye-ryegrass-crimson-arrowleaf was somewhat less productive but furnished more legume growth in winter. Ladino clover and alfalfa were the least productive legumes in mixtures with rye and ryegrass.