Research on

Forage Production in Conjunction with

Pecan Production

There is a period of several years following establishment of pecan trees before any economic returns are realized from nut production. During this time and subsequent years also hay production, pasture or a combination of hay and grazing in pecan orchards may provide dual use of the land. However, little or no information is available on the effects of undercover crop competition on tree development and on nut production. Also, no quantitative data are available on the effects of tree competition and shade on grass growth and quality. Research was initiated in 1966 and expanded in 1967 to develop information on the above points.

In order to obtain information on tree competition effects on grass production more rapidly, studies were started in orchards of varying ages and under both irrigated and dryland conditions. The sites, tree ages, and treatments are as follows:

Dryland orchard of 12 year old trees at A&M Plantation near College Station. Trees were established on 50-foot centers. The test consists of sudangrass, Coastal bermudagrass and fallow, each fertilized with 0, 100, 200 and 300 pounds of nitrogen per acre, replicated 4 times.

Dryland orchard of 19 year old trees at A&M Plantation near College Station. Trees were established on 50-foot centers. The test consists of Coastal bermudagrass fertilized at 100, 200, and 300 pounds of nitrogen per acre and fallow fertilized at 100 pounds of nitrogen per acre, replicated 4 times.

Irrigated orchard of 34-year old trees at the U.S. Pecan Field Station, Brownwood. Trees are spaced 35 x 70 feet. The test consists of Coastal bermudagrass, NK-37 bermudagrass and fallow.

Irrigated orchard of 5-6 year old trees at the U.S. Pecan Field Station, Brownwood. Trees are spaced 35 x 35 feet. The test consists of Coastal bermudagrass, NK-37 bermudagrass and fallow, each fertilized with 100 and 300 pounds of nitrogen per acre, replicated 4 times.

Irrigated orchard of 1 year old trees on H. L. Petty Farm near Mineral Wells, Texas. Trees are spaced 35 x 70 feet. The test consists of solid Coastal bermudagrass versus a 6-foot cultivated strip on each side of the row of trees. Three nitrogen levels are superimposed on each sod condition.

Evaluations: Data have been collected on forage production, light reduction and light quality and shade patterns. Data will also be collected on tree development, nut production and quality, grass stand density and forage quality.

RESULTS

In a dryland orchard of 12 year old trees at the A&M Plantation, a section approximately 30 feet in diameter surrounding each tree was shaded a part or all of the period between 10:00 a.m. and 3:00 p.m. This seems to be the most critical period of light for grass growth. The shade pattern is shown in Figure 1 in which it is apparent that major shade effects would occur on the north side of the tree. The trees average 28 feet high and have a canopy spread of 21 feet.

In the dryland orchard, Trudan I hybrid sudangrass yield ranged from 4300 to 6600 pounds of dry matter per acre depending on nitrogen level in 1967. Maximum yields were obtained with 200 pounds of nitrogen per acre (Table 1). Yields were less with 300 pounds of N than with 200

pounds. Yields were retarded because of a dry spring and slow establishment of the grass. Yields in the center of the plot were 22% below yields near the periphery of the 50 x 50-foot plots. The center shaded area represented approximately 36% of the entire plot. Thus, production of the entire area was reduced approximately 8%. In the center of the plot where all growth was reduced, yield on the north side of the tree where shade would be more continuous was 11% below that on the south side of the tree.

A slightly different growth pattern occurred in 1968 (Table 1) even though total yields and the effects of nitrogen were approximately the same as in 1967. Yields in the center of the plot were reduced only on the north side of the trees from shade and tree competition. A semi-circle 15 feet in diameter representing approximately 18% of the entire plot was reduced in yield approximately 30%. The semi-circle on the south side of the tree actually produced more forage than the periphery. The total effect was a reduction in the center 36% of the plot of only 5.4% due to shade. Thus, the overall effects of shade were negligible in 1968.

It appears from these data that in orchards of this age and tree spacing, shade affects only a limited portion of the total area and that sudangrass can be grown with relatively little reduction in total production. It should be pointed out that these estimates are based on samples from the most open areas within the orchard. Areas completely free of shade and tree root competition were not available for checks.

Dryland Coastal bermudagrass establishment in pecan orchards at the A&M Plantation was slow because of extended drouth periods. Because of variable stands, no effort was made to evaluate effects of shade on Coastal in the orchard of 12 year old trees in 1967. Relatively good dryland forage yields were obtained with 100 and 200 pounds of N per acre (Table 1). Yields were less with 300 pounds of N than with 200 pounds. If shade effects are on the same order as for sudangrass, these yields which were taken from the periphery of the plots should be reduced approximately 10% to estimate actual acre production.

Coastal bermudagrass yields ranged from 3700 to 5700 pounds in 1968 with the highest yields being with 200 pounds of nitrogen (Table 1). Shade effects were similar to those on sudangrass in 1967. Forage yields under the trees in a radius of 15 feet averaged 29% less than yields around the periphery of the plot. Shade effects were more severe on the north side of the tree where yields were 18% lower than on the south side of the tree. Production of the entire plot was reduced approximately 10% due to shade effects in the center of the plot. Thus, it seems likely that grass production is feasible in orchards of this age and tree size. Observations on the trees indicate that 100 pounds or more of nitrogen will be necessary where both trees and grass compete for nutrients.

In the dryland orchard of 19 year old trees, Coastal bermudagrass produced up to 7400 pounds of forage with 200 pounds of nitrogen per acre in 1967. Stands were not obtained in all plots and these data (Table 2) represent only the established plots. Production under the

trees was 43% below that around the periphery of the plots. The area of reduced production amounted to approximately 50% of the 50 x 50-foot area occupied by each tree. Thus, total production was reduced approximately 22%. However, yields even at the periphery of the plots were no doubt reduced due to tree root competition and shade part of the day. However, dryland yields of 3 to 4 tons are reasonably acceptable.

Yields in this orchard in 1968 were extremely poor (Table 2). The stands were thin under the trees and unsatisfactory for harvest. There was no apparent location effect among samples, with one exception, all of which were taken around the periphery of the plot. Samples from the northeast corner of plots were approximately 25% below others in yield for which there is no apparent reason. The 1968 results indicate that sustained production of Coastal bermudagrass is not feasible in a dryland orchard of well developed pecan trees.

Coastal bermudagrass production in a young pecan orchard was not affected by the trees except where grass competition was reduced by cultivation as indicated by the high yields in 1967 (Table 3). Yield in excess of 9 tons was provided with 200 pounds of nitrogen per acre and only an additional ton with up to 600 pounds of nitrogen. The competitive effect of the grass on young pecan trees is likely more critical and will be evaluated.

Only three cuttings were made in 1968 and one of these was lost in the commercial hay operation. Yield from the two remaining cuttings totaled 9230, 9640 and 9130 pounds per acre respectively with 200, 400 and 600 pounds of nitrogen per acre. Obviously the response to

nitrogen above 200 pounds was limited. Yields in plots with a cultivated strip amounted to 7650, 7990, and 7570 for the three nitrogen levels.

Coastal and NK-37 bermudagrass were established in a young irrigated pecan orchard at Brownwood in mid-summer, 1967. It was not anticipated that shade and tree competition would be significant factors since the trees were young and small. NK-37 became established rapidly and made excellent growth in the fall of the first year. Coastal did not produce a complete ground cover until after growth was initiated in 1968.

Excellent forage yields were obtained with good response to applied nitrogen (Table 4). Coastal produced from 1700 to 2400 pounds more forage than NK-37. NK-37 was showing signs of loss of density by early fall. If NK-37 persists, it would have excellent potential because of ease and economy of establishment and the type of sod produced.

Work at Brownwood has shown that bermudagrass production is not possible with mature pecan trees on a 35 x 70 spacing. NK-37 and Coastal bermudagrass survived only in areas which received direct sunlight during most or all of the time between 10:30 a.m. and 2:00 p.m. Growth even in these areas was attenuated with narrow leaves and showed no tendency to produce runners and rhizomes during the first year. Yields were not determined, but would have been nil, and approximately 50 percent of the area was completely bare. Both Coastal and NK-37 bermudagrasses survived in the more open areas and increased

in density in 1967 and 1968. Growth approximately 10 inches high was present in August, 1968 with an estimated production of 1000 pounds per acre.

Mature pecan tree shade reduced light energy at the ground level as much as 90%. Even the most shade tolerant grasses evaluated in other studies will not tolerate continuous light reductions of this degree. Light reduction in the shade of young pecan trees is not as great as with mature trees apparently because of reflected light. Light reduction amounted to 45% in the shade of young trees and the area represented at any one time during the critical period was relatively small. Thus shade effects in young orchards would be expected to be small.

Table 1. The effect of tree competition and nitrogen level on dryland sudangrass and Coastal bermudagrass production, A&M Plantation, 1967 (10-12 year old trees).

Nitrogen (lbs./ac)	Pounds of dry forage per acre					
	1967			1968		
	Underneath tree	Periphery of plot	Weighted total	Underneath tree	Periphery of plot	Weighted total
			Sudangrass			
0	3160	4820	4300 b	3195	3270	3240
100	3730	5150	4630 b	4180	5340	4920
200	6360	7780	7280 a	5710	6295	6080
300	5760	7140	6640 a	5715	6840	6440
			Coastal bermudagrass			
0		2160[1/]		2910	4170	3720
100		5390		4340	5720	5220
200		7540		4340	6540	5750
300		6590		4405	6145	5520

[1/] Because of variable stand underneath trees, samples were taken only around the periphery of the plot area.
Yields with a common letter designation do not differ significantly.

Table 2. The effect of tree competition (19 year old trees) and nitrogen level on dryland Coastal bermudagrass production A&M Plantation.

Nitrogen (lbs./acre)	Pounds of dry forage per acre		
	Underneath tree	Periphery of plot	Weighted total
	1967		
100	4480	7960	6230
200	5800	9060	7430
300	4800	9310	7080
	1968		
100		2600	
200		3430	
300		3880	

Table 3. The effect of nitrogen and cultivation on irrigated Coastal bermudagrass production in second - year pecan orchard, H. L. Petty Farm, Mineral Wells, 1967.

Nitrogen Lbs./acre	Pounds of forage per acre				
	May 12	June 22	August 4	October 6	Total
			Solid Sod		
200	2690	5210	5340	5720	18,960 b
400	4020	5160	5940	5520	20,640 a
600	4390	5410	5460	5460	20,720 a
			12-foot cultivated strip		
200	2230	4320	4430	4750	15,730 b
400	3340	4280	4940	4580	17,140 a
600	3640	4490	4530	4530	17,190 a

Table 4. Forage yield of grasses in young pecan orchard, Brownwood, 1968.

Variety	Lbs. N/ Acre	Pounds dry forage per acre					
		May 30	June 29	Aug. 9	Sept. 10	Oct. 29	Total
Coastal	100	2650	1470	2510	2250	1180	10060
	300	3120	2120	3650	3200	1720	13810
NK-37	100	2220	1120	1760	1590	600	7290
	300	2940	1570	3010	2470	1460	11450