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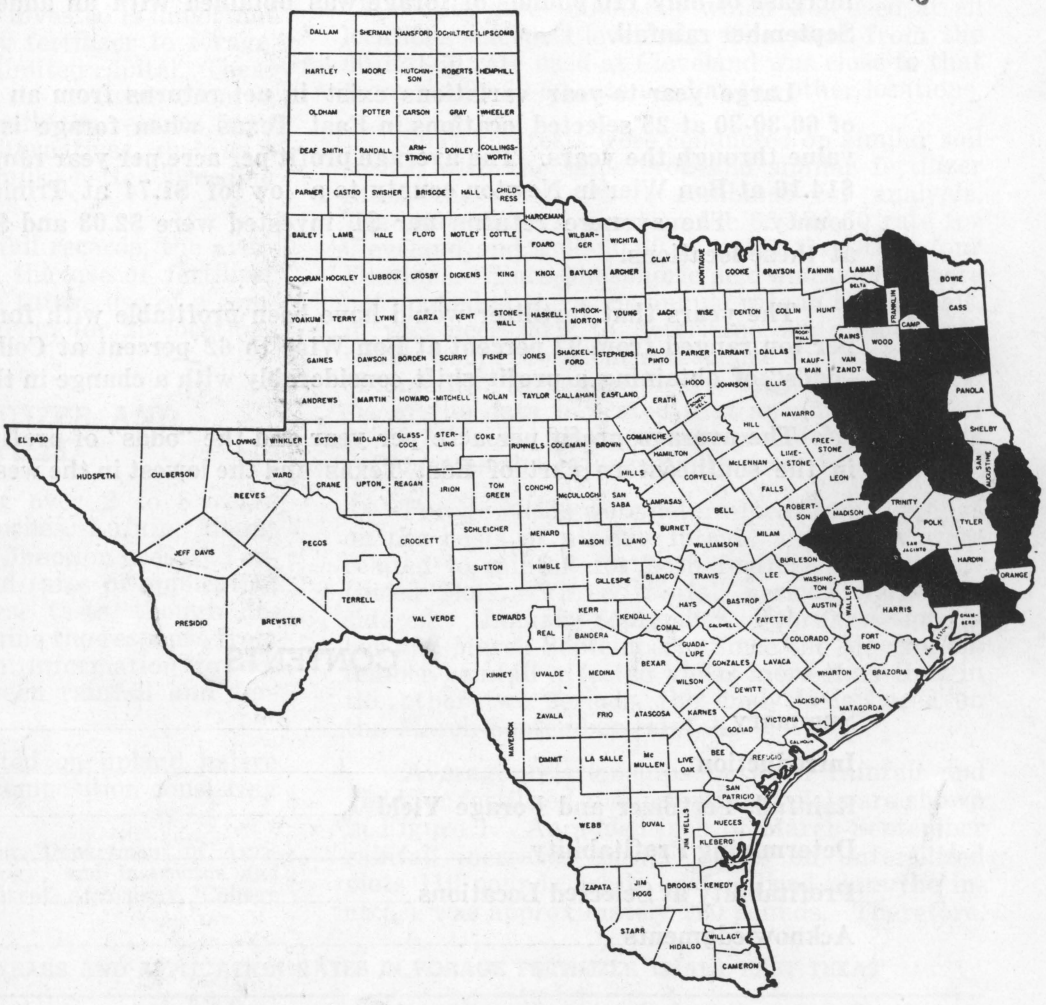
• Influence of Rainfall on Profits • from Fertilizer Applications • to East Texas Forage



Area in which weather stations used in this study are located.

TEXAS AGRICULTURAL EXPERIMENT STATION
R. D. LEWIS, DIRECTOR, COLLEGE STATION, TEXAS

SUMMARY

An added inch of March-September rainfall increased yields of forage by approximately 220 pounds per acre on plots fertilized at an annual rate of 60-30-30 in a series of experiments conducted in East Texas. On the unfertilized plots, an increase of only 110 pounds of forage was obtained with an added inch of March-September rainfall.

Large year-to-year variations exist in net returns from an annual application of 60-30-30 at 25 selected locations in East Texas when forage is given a constant value through the years. The average profit per acre per year ranged from a high of $14.16 at Bon Wier in Newton county to a low of $1.74 at Trinidad in Henderson county. The average returns per $1 invested were $2.03 and $1.13, respectively, at these locations.

The years that fertilizer would have been profitable with forage valued at $20 per ton ranged from 97 percent at Bon Wier to 62 percent at College Station. The "odds" of obtaining a profit shift considerably with a change in the value of forage.

The average profit per acre per year and the "odds" of profit were the highest in the southeastern part of East Texas and the lowest in the western edge.

CONTENTS

Influence of Rainfall on Profits from Fertilizer Applications to East Texas Forage

R. J. HILDRETH, FLAKE L. FISHER and A. G. CALDWELL*

THE RESPONSE OF FORAGE TO FERTILIZER DEPENDS largely on how much rainfall is received during the growing season. By studying forage response in relation with past rainfall conditions and the current prices of fertilizer and forage, it is possible to calculate whether future fertilizer applications may be profitable.

The return on the dollar invested is important in deciding whether to apply fertilizer to forage, especially for farmers with limited capital. These farmers have to compare the returns from a dollar invested in fertilizer with the returns from a dollar invested in other alternatives, such as a bulk-handling system for milk, better breeding stock or better crop varieties.

Based on available rainfall records, the average profit and return from the use of fertilizer and the "odds" of profitable future use of a common rate of fertilizer are given for 25 locations in East Texas.

RAINFALL, FERTILIZER AND FORAGE YIELD

Fertilizer tests ranging over 2 to 5 years were conducted at Nacogdoches, Lufkin, Mount Pleasant, Cleveland and Call Junction in East Texas. The locations, years and rates of application are given in Table 1. These tests, though designed individually to determine the response from fertilizer, provide adequate information to develop the relationship between rainfall and fertilizer response.

The tests were conducted on upland native pastures with a vegetative composition consisting of Common Bermudagrass, brownseed paspalum, little bluestem and lespedeza. The soil series of the experimental pastures were Lufkin and Bowie, which are common throughout East Texas.

Analyses in this report are based on a treatment of 60 pounds of nitrogen (N), 60 pounds of phosphoric acid (P_2O_5) and 60 pounds of potash (K_2O) per acre (60-60-60) which was used at all locations except Cleveland. The yield from the 60-120-60 rate used at Cleveland was close to that from the 60-60-60 rate used at the other locations.

Since the tests were conducted on similar soil series, with the same crop and similar fertilizer rates, the results were combined for analysis. The analysis was based on the 60-120-60 rate for Cleveland and a 60-60-60 rate for the other four locations. Since phosphoric acid and potash were not applied at the same annual rate in these trials, it was necessary to determine an annual rate which would represent a response similar to those obtained in the experiments. Agronomic analysis of the data indicated that an annual rate of 60-30-30 would produce approximately the same response as the rates actually used.

Forage yields were determined from clippings on the basis of air-dry forage, and yields were related to rainfall for both fertilized and unfertilized plots. Three rainfall periods were considered: January-September, February-September and March-September. Since the March-September rainfall affected yields more than that in the other two periods, the analysis is based on the March-September rainfall.

Average relationships between rainfall and yield for fertilized and unfertilized plots are shown in Figure 1. An added inch of March-September rainfall increased forage yields on unfertilized plots 110 pounds, while on fertilized plots the increase was approximately 220 pounds. Therefore,

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TABLE 1. LOCATIONS, YEARS AND APPLICATION RATES IN FORAGE FERTILIZER TRIALS, EAST TEXAS[1]

Location	Year	Pounds of nitrogen applied per acre						Pounds of phosphoric acid applied per acre				Pounds of potash applied per acre		
		0	30	60	90	120	180	0	60	120	240	0	60	120
Nacogdoches	1949-51	X	X	X	X			X	X	X		X	X	
Lufkin	1949-53	X	X	X	X			X	X	X		X	X	
Mount Pleasant	1950-51	X	X	X	X			X	X	X		X	X	
Cleveland	1949-51	X		X		X	X	X		X	X	X	X	X
Call Junction	1950-51	X		X				X	X	X		X	X	

[1]Nitrogen was applied each year at all locations. Phosphoric acid and potash were applied each year at Lufkin, the first 2 years at Nacogdoches and only the first year at the other three locations.

the fertilized plots utilized 1 inch of March-September rainfall twice as efficiently as the unfertilized plots.

Fertilized plots also utilized rainfall more efficiently in low rainfall years. Thus, during drouths fertilizer makes possible a more effective use of the small amount of moisture that does fall. In extremely low rainfall years, the application of fertilizer may not pay off, but it will not reduce the yield if applied at a reasonable rate and time.

The effect of fertilizer on efficiency of moisture utilization also has implications for farmers using irrigation. The application of fertilizer reduces irrigation costs per ton of forage produced.

DETERMINING PROFITABILITY

The profitability of annual applications of 60-30-30 can be calculated for other East Texas locations from the relationship discovered between forage yield and rainfall on the test plots. To determine profitability, the value of the difference in forage production per acre between the fertilized and unfertilized test plots is compared with the cost of the fertilizer at a designated March-September rainfall level.

The following prices of fertilizer were used to arrive at the cost of an annual rate of 60-30-30: nitrogen, 13 cents per pound; phosphoric acid, 8 cents per pound; and potash, 5 cents per pound. It was assumed that two applications of fertilizer would be made during a growing season, and an allowance of $1 per acre for each application was made in calculating the total cost of $13.70 per acre.

The actual cost of this rate varies considerably among farmers. Nitrogen obtained from anhydrous ammonia may cost less than the price assumed. Nitrogen obtained from a low analysis fertilizer may be higher. The application cost also may vary considerably, depending on the number of acres over which the distributor is used. Since distributors have a short life, high annual use reduces the per-acre cost.

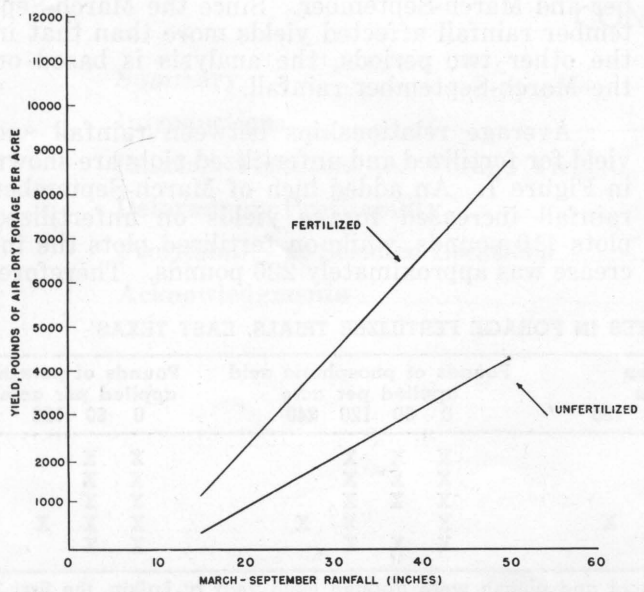

Figure 1. Relationship between rainfall and forage yield.

Forage was valued at $15, $20 and $25 per ton of air-dry forage. The value of forage depends to a large extent on market prices, which change from year to year and from one farmer's situation to another's. If the farmer is selling forage, his net price from the increased yield due to fertilizer is the market price of hay less transportation to the market. If the increase in yield replaces purchased hay, the increased yield is worth the market price of the hay plus transportation charges.

PROFITABILITY AT SELECTED LOCATIONS

Future profit from annual applications of fertilizer at the rate of 60-30-30 was investigated for 25 locations in East Texas. Locations were chosen in counties with adequate rainfall records. See front cover. Number of years of weather data for the various locations ranged from 65 at Huntsville to 21 at Tyler, which is long enough to include any existing short-time cycles, but not long enough to take into account any longtime patterns of weather fluctuation.

Year-to-year profits and losses obtained from fertilizer applications at the rate of 60-30-30 were calculated on the basis of past rainfall records. The yearly profits and losses, based on a forage value of $20 per ton for College Station and Nacogdoches, are shown in Figures 2 and 3.

TABLE 2. ODDS THAT AN ANNUAL FERTILIZER RATE OF 60-30-30 WILL BE PROFITABLE

Location	Forage at $20 per ton		
	Percent years, profit	Percent years, loss	"Odds" of profit, years
Anderson	74	26	3 out of 4
Beaumont	85	15	6 out of 7
Bon Wier	97	3	19 out of 20
Bronson	83	17	5 out of 6
Clarksville	83	17	5 out of 6
College Station	60	40	3 out of 5
Conroe	66	34	6 out of 9
Crockett	73	27	5 out of 7
Dialville	82	18	5 out of 6
Gilmer	77	23	7 out of 9
Henderson	67	33	2 out of 3
Huntsville	79	21	8 out of 10
Jefferson	79	21	8 out of 10
Liberty	90	10	9 out of 10
Longview	72	28	5 out of 7
Lufkin	88	12	8 out of 9
Marshall	69	31	7 out of 10
Mount Pleasant	71	29	5 out of 7
Nacogdoches	82	18	5 out of 6
Naples	83	17	5 out of 6
Palestine	74	26	5 out of 6
Rockland	82	18	5 out of 6
Sulphur Springs	69	31	7 out of 10
Trinidad	62	38	5 out of 8
Tyler	76	24	3 out of 4

Large year-to-year variations exist when calculations are based on a constant forage value through the years. The net income at College Station ranged from a profit of $23.74 per acre in 1900 to a loss of $10.10 in 1925 when forage is valued at a constant of $20 per ton. Net income at Nacogdoches ranged from a loss of $10.10 per acre in 1925 to a profit of $26.56 in 1953. The actual variations in the profitability over the years probably were less than those indicated in Figures 2 and 3. During years of low rainfall, forage generally is scarce and would be higher than $20 per ton. Therefore, it does not take as much response to pay for the fertilizer as when forage is worth only $20 per ton. During years of high rainfall, forage generally is plentiful and the price lower than $20 per ton. It then would take more forage to pay for the fertilizer than when forage is $20 per ton.

The percentage of years in which fertilizer applied at the rate of 60-30-30 would have been profitable is shown for the 25 locations in Table 2. Although the net income from a fertilizer application fluctuates widely from year to year, the chances are good for making a profit from its application. Based on a forage value of $20 per ton. a profit would have been made in 82 percent of the years at Nacogdoches; therefore, a profit may be expected in 5 out of 6 years in the future.

Bon Wier, in Newton county, had the highest "odds" for profit when forage was valued at $20 per ton. Based on past rainfall records, 19 out of 20 years were profitable. Other locations with more than 85 percent of the years showing a profit were Liberty. Liberty county; Lufkin, Angelina county; and Beaumont, Jefferson county. These locations are in the southeastern part of East Texas.

TABLE 3. PERCENT OF YEARS AN ANNUAL FERTILIZER RATE OF 60-30-30 WILL BE PROFITABLE

Location	Price of forage		
	$15 per ton	$20 per ton	$25 per ton
	— — — — Percent years — — — —		
Anderson	49	74	83
Beaumont	74	85	94
Bon Wier	83	97	97
Bronson	60	83	90
Clarksville	58	83	96
College Station	35	60	82
Conroe	56	66	86
Crockett	51	73	88
Dialville	59	82	94
Gilmer	50	77	87
Henderson	50	67	85
Huntsville	51	79	89
Jefferson	57	79	90
Liberty	69	90	96
Longview	54	72	87
Lufkin	58	88	95
Marshall	58	69	80
Mount Pleasant	58	71	87
Nacogdoches	58	82	93
Naples	52	83	87
Palestine	35	74	82
Rockland	66	82	88
Sulphur Springs	52	69	87
Trinidad	28	62	80
Tyler	62	76	95

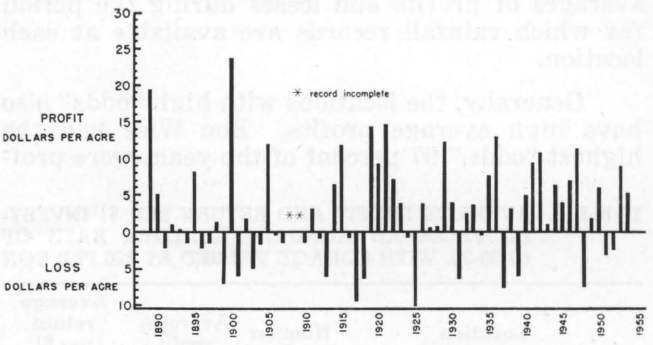

Figure 2. Profit and loss from fertilizer application of 60-30-30, forage valued at $20 per ton, College Station.

The lowest "odds" were at College Station, in Brazos county, where 60 percent of the years were profitable, and at Trinidad, in Henderson county, where 62 percent of the years were profitable. These locations are on the western edge of East Texas.

The number of years a profit would have been obtained from fertilizer use varies considerably with a shift in the price of forage. For example, 67 percent of the years were profitable at Henderson with forage valued at $20 per ton, Table 3. With a drop to $15 per ton, only 50 percent of the years were profitable. At $25 per ton, 85 percent of the years were profitable. The amount of March-September rainfall required to break-even or show no loss is 24.3 inches when forage is valued at $15 per ton. With forage valued at $20 per ton, 19.9 inches are needed to break-even and 17.3 inches with forage valued at $25 per ton.

It is important to know the average profit as well as the "odds" for profit when deciding whether to apply fertilizer to forage. The average profit per acre per year with forage valued at $20 per ton was determined for the 25 locations, Table 4. These figures are the

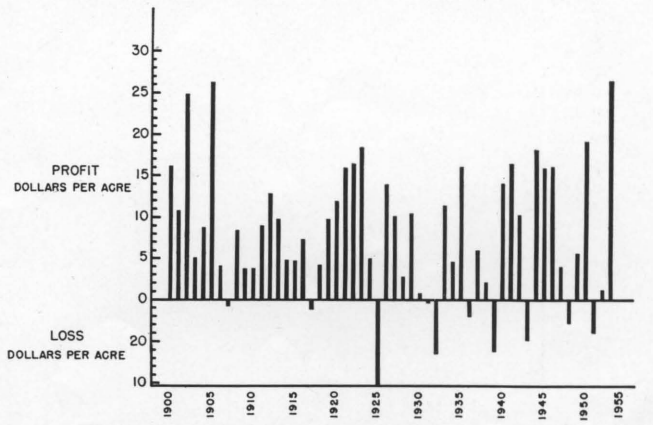

Figure 3. Profit and loss from fertilizer application of 60-30-30, forage valued at $20 per ton, Nacogdoches.

averages of profits and losses during the period for which rainfall records are available at each location.

Generally, the locations with high "odds" also have high average profits. Bon Wier had the highest "odds," 97 percent of the years were profitable with forage at $20 per ton, and the highest average profit, $14.16. Trinidad had the lowest average profit, $1.74, but not the lowest "odds." The "odds" at College Station were lower. Only two locations had higher "odds" than Lufkin, but it is tenth on the list in average profits.

TABLE 4. AVERAGE PROFIT AND RETURN PER $1 INVESTED FROM AN ANNUAL FERTILIZER RATE OF 60-30-30, WITH FORAGE VALUED AT $20 PER TON

Location		Number years, rainfall records	Average profit per acre per year, dollars	Average return per $1 invested per acre per year, dollars
City	County			
Anderson	Grimes	39	5.11	1.37
Beaumont	Jefferson	61	12.89	1.94
Bon Wier	Newton	37	14.16	2.03
Bronson	Sabine	30	8.43	1.62
Clarksville	Red River	46	8.05	1.59
College Station	Brazos	63	2.61	1.19
Conroe	Montgomery	29	7.64	1.56
Crockett	Houston	26	4.61	1.34
Dialville	Cherokee	49	6.00	1.44
Gilmer	Upshur	22	5.96	1.44
Henderson	Rusk	46	5.07	1.37
Huntsville	Walker	65	6.30	1.46
Jefferson	Marion	42	6.34	1.46
Liberty	Liberty	51	10.24	1.74
Longview	Gregg	61	5.56	1.41
Lufkin	Angelina	40	6.66	1.49
Marshall	Harrison	45	6.17	1.45
Mount Pleasant	Titus	31	4.57	1.33
Nacogdoches	Nacogdoches	54	7.62	1.56
Naples	Morris	23	6.64	1.48
Palestine	Anderson	69	3.06	1.22
Rockland	Jasper	50	8.35	1.61
Sulphur Springs	Hopkins	29	5.09	1.37
Trinidad	Henderson	39	1.74	1.13
Tyler	Smith	21	7.20	1.53

The difference in the relationship of the locations to the "odds" and average profit is caused by variations in the distribution of March-September rainfall. For example, Lufkin has many years of rainfall just high enough to cause a high percentage of the years to be profitable in comparison with other locations. Profits in these years are not much above the average and the average profit is low in comparison with other locations.

The southeastern part of East Texas had the highest average profits as well as the highest "odds" for profitable fertilizer use. The lowest average profits were obtained along the western edge of East Texas.

Since the amount invested in fertilizer applications per acre per year, $13.70, is constant for each location, the return per dollar invested depends on the average profit per acre per year. The return per dollar invested per acre per year ranges from $2.03 at Bon Wier to $1.13 at Trinidad, Table 4.

ACKNOWLEDGMENTS

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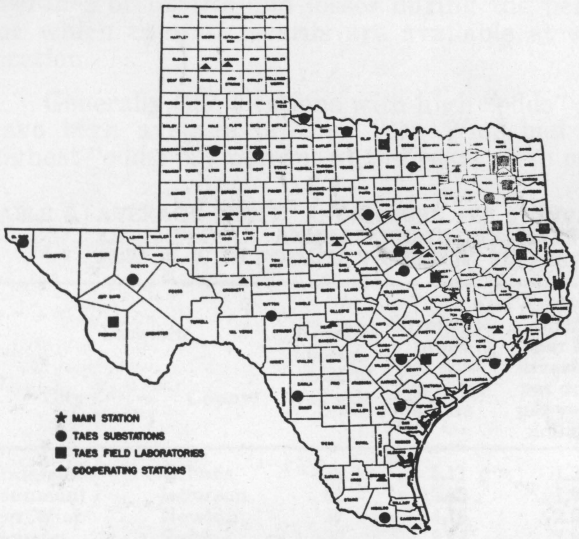

Location of field research units in Texas maintained by the Texas Agricultural Experiment Station and cooperating agencies

State-wide Research

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The Texas Agricultural Experiment Station is the public agricultural research agency of the State of Texas, and is one of nine parts of the Texas A&M College System

IN THE MAIN STATION, with headquarters at College Station, are 16 subject-matter departments, 2 service departments, 3 regulatory services and the administrative staff. Located out in the major agricultural areas of Texas are 21 substations and 9 field laboratories. In addition, there are 14 cooperating stations owned by other agencies, including the Texas Forest Service, the Game and Fish Commission of Texas, the U. S. Department of Agriculture, University of Texas, Texas Technological College and the King Ranch. Some experiments are conducted on farms and ranches and in rural homes.

RESEARCH BY THE TEXAS STATION is organized by programs and projects. A program of research represents a coordinated effort to solve the many problems relating to a common objective or situation. A research project represents the procedures for attacking a specific problem within a program.

THE TEXAS STATION is conducting about 350 active research projects, grouped in 25 programs which include all phases of agriculture in Texas. Among these are: conservation and improvement of soils; conservation and use of water in agriculture; grasses and legumes for pastures, ranges, hay, conservation and improvement of soils; grain crops; cotton and other fiber crops; vegetable crops; citrus and other subtropical fruits, fruits and nuts; oil seed crops—other than cotton; ornamental plants—including turf; brush and weeds; insects; plant diseases; beef cattle; dairy cattle; sheep and goats; swine; chickens and turkeys; animal diseases and parasites fish and game on farms and ranches; farm and ranch engineering; farm and ranch business; marketing agricultural products; rural home economics; and rural agricultural economics. Two additional programs are maintenance and upkeep, and central services.

RESEARCH RESULTS are carried to Texas farm and ranch owners and homemakers by specialists and county agents of the Texas Agricultural Extension Service.