

CORN VS. OATS AS AN ECONOMIC FEED CROP
FOR THE UPLAND COASTAL PLAINS
SOILS OF ARKANSAS

by

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INTRODUCTION

Economic Production of Grain Feed a Problem in Southern Agriculture

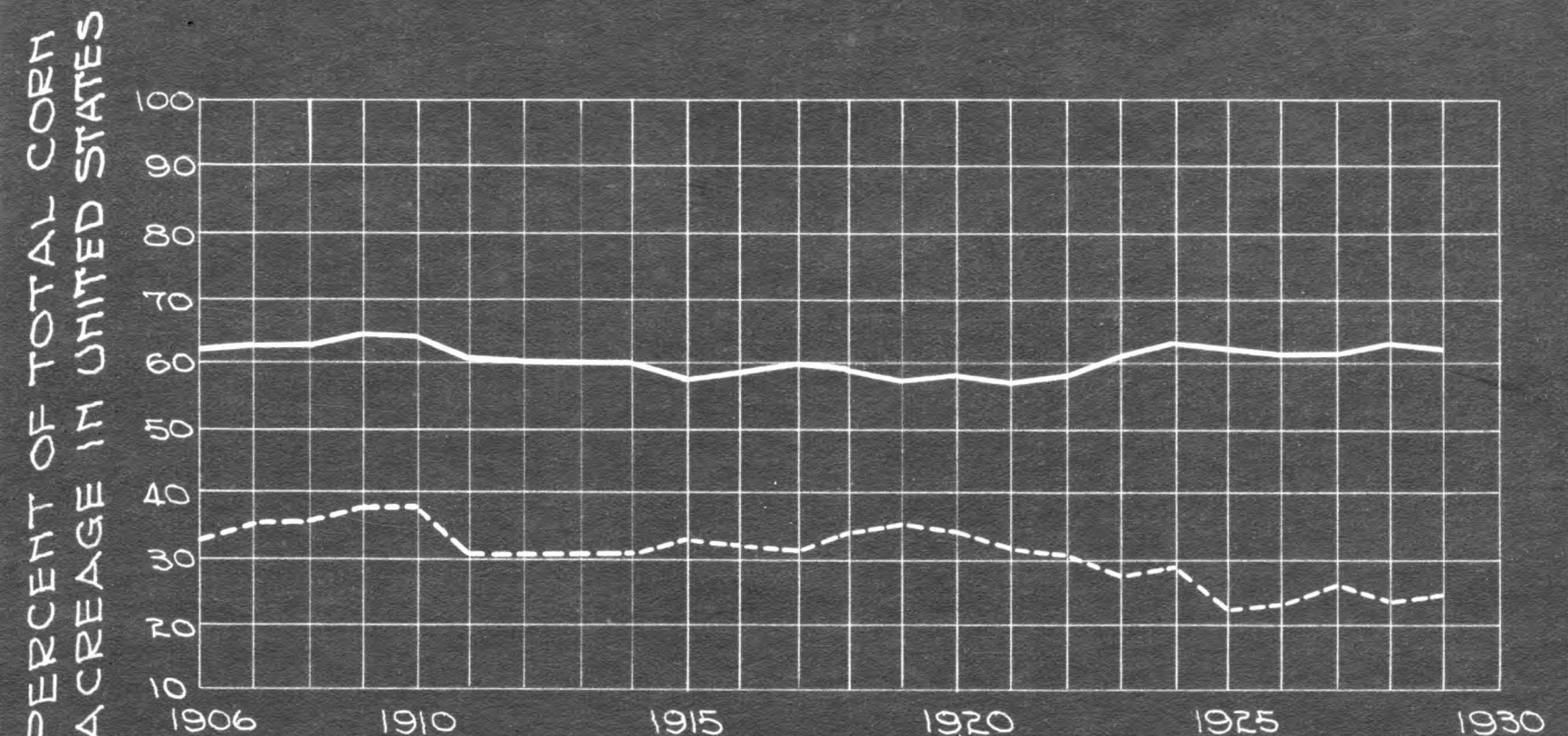
Average yields of corn in the southern states have been so low and apparent profits so small, that it is somewhat difficult to find a logical reason why it continues to occupy so important a place in the acreage of southern farm crops. Perhaps, because it is the "king" of American crops and, because the southern farmer was for so long dependent upon it for his food and feed, in early American history, corn has come to occupy a place in the sentiment of the agriculture of the South, which is not warranted by the economic returns now obtained from it.

Some of the factors which are responsible for the low average yields and small profits in corn production in the southern states are as follows:

- (1) General lack of organic matter in the soils.
- (2) Increasing damage by insect pests and diseases.
- (3) Frequent drouths in the crucial growing periods.
- (4) High cost of cultivation.

O. E. Baker⁽¹⁾ calls attention to the fact, that in the past decade corn growing is rapidly shifting more exclusively to the Corn Belt and that the acreage of cotton in the Cotton Belt is expanding to the exclusion of other less adaptable crops. Illustration of this trend, so far as the corn crop is concerned, is revealed by study of corn acreage statistics, comparing percentages of total acreage of corn in twelve Corn Belt states with those of twelve Cotton Belt states for the 24-year period, 1906-1929. Figure 1 shows that for the decade 1911-1920, there was only slight variation in the percentage of the total acreage of corn grown in the United States, by either the twelve Corn Belt states or the twelve Cotton Belt states. The average percentage grown by the Corn Belt states was maintained at around 60 per cent and about 35 per cent of the total United States corn acreage was grown in the twelve Cotton Belt states. Beginning with the year 1920 however, in the Cotton Belt

(1) Baker, O. E., Agricultural Economist, Bureau of Agricultural Economics, United States Department of Agriculture, address before extension Conference at University of Minnesota, Dec. 13, and 14, 1928, mimeographed by Bureau of Agricultural Economics.



TREND OF CORN ACREAGE IN CORN AND COTTON BELT STATES

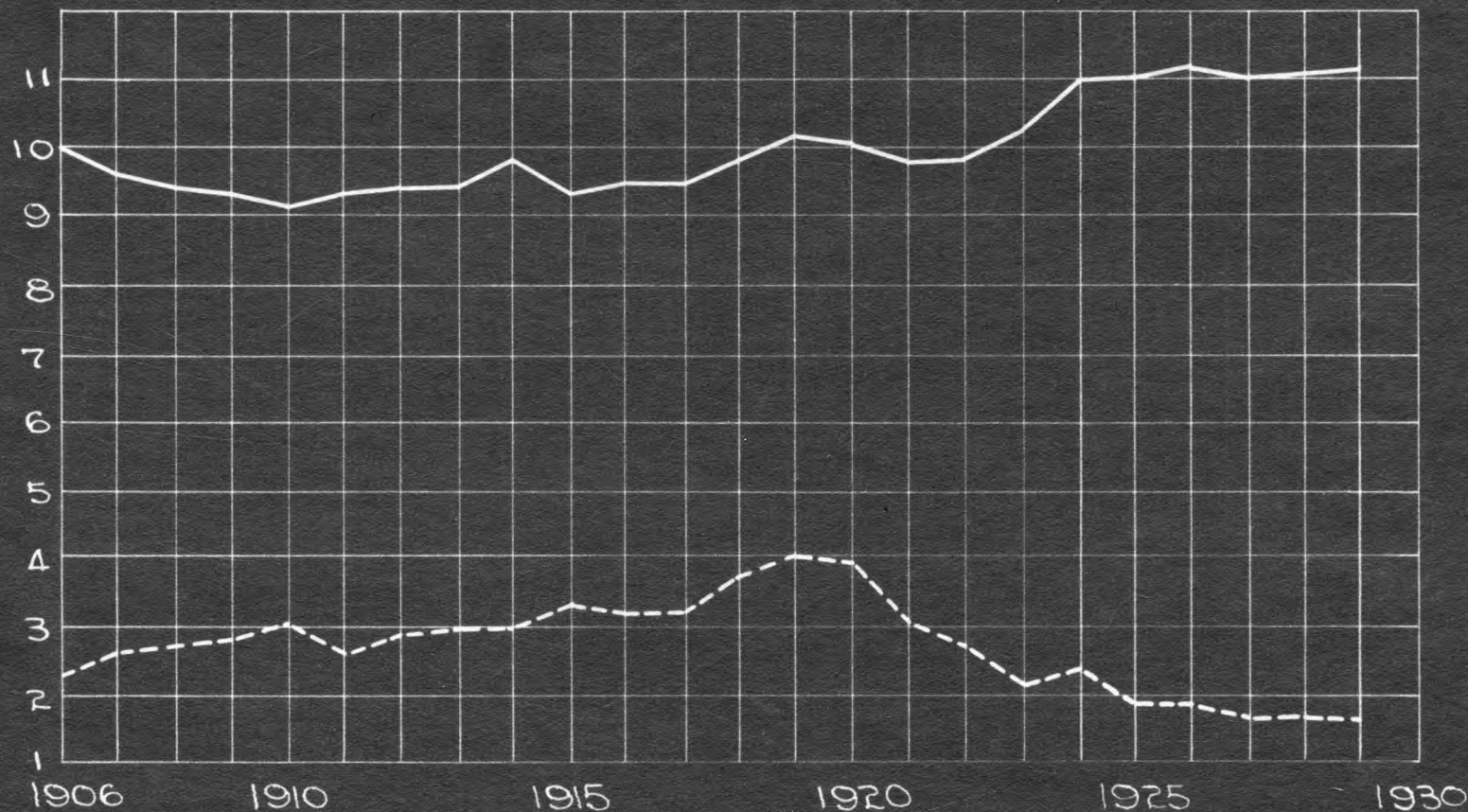
U.S.D.A. Yearbooks-1906 to 1929

— 12 CORN BELT STATES --- 12 COTTON BELT STATES

FIG. 1.

states, a gradual diminution of the acreage devoted to corn appeared, going as low as 23 per cent of the total United States acreage in 1925 and ending with 25 per cent according to the report of 1929. At the same time, although somewhat less marked, there began in 1921, a gradual increase of corn acreage in the twelve Corn Belt states, going from 57 per cent in 1921 to 63 per cent in 1928, and ending with 62 per cent in 1929. It is true that during this 24-year period, in the Cotton Belt states of Texas and Oklahoma, the corn acreage increased rapidly, reaching its high point about 1910, but has since declined sharply, especially in Texas, due perhaps to the substitution of the grain sorghums in the semi-arid portions of the two states. This is responsible, to a great extent for the reduced acreage of corn in the Cotton Belt states since 1920 but not altogether as is shown by the corn acreage statistics of Mississippi, a more typical Cotton Belt state than either Texas or Oklahoma where rainfall is not a limiting factor in corn production. Of the Corn Belt states, Kansas has suffered a decline in corn acreage in the past decade, for the same reason as Texas and Oklahoma. Tennessee and Kentucky have also decreased their corn acreage, while Minnesota has greatly increased its corn acreage. Most of the other Corn Belt states have maintained their acreage or have had gradual increases. Selecting Iowa as a typical Corn Belt state and Mississippi as

PERCENT OF TOTAL CORN
ACREAGE IN UNITED STATES



TREND OF CORN ACREAGE IN IOWA AND MISSISSIPPI

U.S.D.A. Yearbooks-1906 to 1929

— IOWA

--- MISSISSIPPI

FIG. 2

a typical Cotton Belt state, graphic representation of their corn acreage statistics shows that in Iowa the rise in percentage of corn acreage has been above 1 per cent in the past decade, with the trend still going gradually upward in 1929. Mississippi, on the other hand, begins her downward trend from the high point of 4 per cent in 1919, reaching her lowest point for the 24-year period in 1929 with 1.7 per cent of total United States acreage devoted to corn. During the period 1918-1929, the soybean acreage increased in the Cotton Belt states from less than 100,000 acres in 1918 to approximately 500,000 acres in 1929. In the state of Illinois alone, the soybean acreage has increased in the same period to a larger acreage than was grown in all the twelve southern states. It would be expected that soybeans might be used rather extensively in the Cotton Belt to supplement and substitute for grain feeds, but the large expansion of soybean production is taking place in the Corn Belt states. This fact may be responsible largely for the slower increase in acreage of corn in the Corn Belt as compared to the more sharply decreasing acreage of corn in the Cotton Belt states. The fact that cotton is the most profitable crop that can be grown in the South explains largely the increase in the acreage of this crop from approximately 33,000,000 acres in 1919, to approximately 45,000,000 acres

in 1929, and, being coincident with the sharp reduction in percentage of corn acreage in the Cotton Belt, also explains that decline. It is likely that shifts in this direction may continue. Obviously, this shifting, if carried far enough, may harm the agricultural welfare in both regions, in that it may reduce the number of possible crops in the rotation.

The topography of most of the southern states is such that it is not likely that farm work animals will ever be replaced by tractor power to any such extent as may be possible in the Corn Belt and in the Great Plains Region. Feed for work animals is likely to continue in the future, as in the past, to be a rather important item of farm expense in the productive operations of the southern farms. Because of its high cost of production, together with the large annual importation of feeds from northern states, it seems highly desirable that some substitute feed crop be grown that will furnish feed at lower cost than corn and, that will fit into the rotation system, and still not be handicapped by the general disadvantages suffered by the corn crop.

The acreage of oats grown in the southern states, as compared to that of corn is relatively small. Average yields of oats, it is true, like corn, have not been startlingly high; but, statistics of oats yields in the South

are misleading for the following reasons:

(1) The oat crop is generally planted on the poorest soil of the farm.

(2) Little, if any, commercial fertilizer is applied.

(3) The oats crop is frequently referred to as the "scavenger" crop, meaning that after the choice lands of the farm have been planted to, or reserved for other crops, the oats, if any, are planted on such land as is left. Attention is called to this commonly prevailing practice to show that the comparative figures given for oats and corn production in the southern states are disadvantageous to oats so far as yield per acre is concerned.

Evidence is shown, by articles and reports in southern farm papers and the daily press, that there are farmers who have discovered the yielding possibilities of the oat crop. High yields and good profits are secured on land of medium and even low natural fertility. There appears to be a general belief among agricultural extension workers and editors of farm papers, that the farmer is overlooking one of his best means of insurance for a feed crop when he fails to plant a part, at least, of his feed crop acreage in oats. This fact is attested by their perennial campaigns through publications⁽²⁾ calling the farmers' attention to the practi-

(2) Nelson, M., Oats: A Good Feed Crop - Ark. Ext. Cir. 153, Jan. 8, 1924. "Planting of Fall Crops Suggested" - News article. The Arkansas Gazette, Sept. 29, 1929, Page 15.

cal certainty of the oat crop as compared to the rather frequent failure of the corn crop, due to the more or less prevalent summer drouths which occur ordinarily as the corn approaches the roasting-ear stage.

The rather outstanding success of fall-planted oats through seven years of trial on the college farm at Magnolia Agricultural and Mechanical College, Magnolia, Arkansas, has gained for it a wide-spread local reputation among the farmers of southwest Arkansas and northern Louisiana. Their attention has been attracted by the high yields, and the entire annual output of seed has been sold to them at premium prices.

If it can be shown that there are other grain feed crops more profitable than corn, which will fit in as well in the rotations and otherwise serve as a satisfactory substitute for corn, then the way is open for a possible improvement in the economic welfare of southern agriculture.

The Purpose of the Study

It is intended herein, to present data from which conclusions may be drawn, as to whether the present practice of growing corn as a feed crop almost to the exclusion of the oat crop, has a sounder economic basis than if the practice were changed to that of growing a larger acreage of oats.

It is not the purpose of this study to make any application of the data to the more fertile, bottom land soils of this region, which have proven their adaptability to corn production. The comparison is confined to soils of the upland coastal plains. The soils of Columbia County, Arkansas are described by the Bureau of Soils as follows:

"As the County lies within the Gulf Coastal Plain, the upland soils are of sedimentary origin. Including meadow, 27 soil types are mapped. The upland, sedimentary soils are classed in the Susquehanna, Ruston, Orangeburg, Norfolk, Caddo and Lufkin series and the stream-bottom alluvial soils in the Ocklocknee and Bibb series and Meadow on the first bottoms, or terraces."(3)

Seventy-five per cent or more of the area of the county is included in the upland series, the remainder being in the first or second bottom. Further description of Columbia County soils is given as follows:

"These materials in Columbia County have been classified geologically as the Wilcox and Sabine formations and undifferentiated materials of the Eocene Period. Besides the above formations, which comprise the upland, more recent deposits, in the form of alluvial materials have been made. Drainage waters have carried quantities of soil materials in suspension from the uplands and deposited them over the flood plains of the various streams. Some of the streams have cut their channels deeper than they were formerly and do not overflow former flood plains. The soils on these older terraces or second bottoms are regarded as distinct from those of the first bottoms------. The soils de-

(3) Lounsbury, Clarence, and Deeter, E. B., U. S. Dept. Agr.-Field Operations of the Bureau of Soils--1914--Sixteenth Report--Soil Survey of Columbia County, Ark.--Page 1371.

rived from these formations differ considerably, varying with the extent of the weathering, the degree of erosion, conditions of drainage, and oxidation of the component materials." (4)

Sources of Data

This study is the outgrowth of eight years experience in the supervision and keeping of records of the production of field crops on the Magnolia Agricultural and Mechanical College Farm at Magnolia, in the southwest corner of Arkansas, county seat of Columbia county. The soil of the farm is the light sandy type with moderately rolling topography, located about one-hundred and fifty miles south of the northern limit of the Coastal Plains Region. Several soils series are represented but the Norfolk is the most prevalent. The texture ranges from sandy loam to very fine sandy loam. It is low in natural fertility, having a mottled, yellowish-white subsoil of a very compact and crystalline nature, indicative of many years of weathering and leaching with consequent loss of much of its soluble mineral constituents. The land had been farmed for many years before the establishment of the School in 1910 and, at that time, according to reports from neighbors familiar with its history, had reached a point so

(4) Lounsbury, Clarence, and Deeter, E. B., U. S. Dept. Agr. Field Operations of the Bureau of Soils, 1914. Sixteenth Report, Soil Survey of Columbia County, Arkansas--Page 1371.

low in productive ability, that some of the fields had been abandoned for cultivation by the owners. Since then, the soil of parts of it has been built up in organic content and, by the use of commercial fertilizer, good yields are obtained. Much of it however, is still low in organic matter and, some of it, having poor drainage, will not grow cultivated crops profitably. Although it is poor soil, it is typical of perhaps a major portion of the soils of this region.

Seven years of comparative data have been secured by keeping records of cost of production, returns and net profits of corn and oats as the two crops have been grown in the regular rotation of the farm. Neither crop has been consciously favored as to the matter of choice of land, but the crops have followed each other in the rotation much in the same manner as would be practiced on an ordinary diversified farm. Probably the newer lands more recently brought under cultivation have been more generally devoted to corn growing, partly because of the stumps and partly because it is a generally recognized fact that the new lands are more suitable for corn production, being better supplied with organic matter. The crops naturally have received diverse treatment, according to the peculiar needs of each, as to cultural methods and fertilization. Due to the good showing of oats

and the rather consistently poor yields of corn, it must be admitted that perhaps it has, to some extent, unconsciously, resulted in a greater concentration of effort in the matter of increasing the yields of oats. The corn crops, however, have been cultivated, fertilized and generally handled, according to the best known practices of the region and using the best varieties obtainable. In the beginning, there was no definite attempt to make a direct comparison between the economic value of the two crops, but after the third year of the trials, the contrast became so striking, it was conceived to make the comparison the basis for research study. Since then, specific effort has been directed toward giving both crops a fair and, as far as possible, equal trial.

Other Data. Additional data have been obtained from the corn and oats statistics of the United States Department of Agriculture Yearbooks for 36 years, (1893-1928); Annual Reports of the Commissioner of Agriculture of Arkansas; United States Government and State Experiment Station records; Henry and Morrison's "Feeds and Feeding" and other miscellaneous comparisons and reports gathered from farm papers, bulletins, periodicals and correspondence.

Method of Treatment

The order of procedure in this study is as follows:

Introduction

Review of Literature

Description of Study and Presentation of Data

Summary and Conclusions

The review of literature contains a digest of all available references dealing with corn and oats production especially from the experiences of farmers in the South.

Under the description of study and presentation of data, interpretation of tables and figures are attempted where necessary. It includes discussion of practical applications of production methods from experience with the two crops at Magnolia Agricultural and Mechanical College as well as directing attention to why oats yields are so low in the South, lack of adequate farm machinery as a handicap in oats production and other factors having a bearing on the problem.

The summary and conclusions point out essential facts of the study, with recommendations as to possible changes in the matter of feed crop production where such are warranted by the data.

REVIEW OF LITERATURE

Comparative Acreages and Average Yields of Corn and Oats in the South

Although experiment station records and agricultural

literature in general are not pregnant with data showing direct comparisons of the yielding power of oats and corn on southern soils, there is considerable evidence to support the assumption that the oat crop has been a neglected one.

"For instance in 1915, the states of South Carolina, Georgia, Alabama, Mississippi and Louisiana, (more exclusive cotton states), had about 2 million acres more in corn than in cotton, and if Texas be included with this group of states the cotton acreage was 24,440,000 acres, while the acreage planted to corn was 23,685,000 acres, or a difference of about $3/4$ of a million acres in the six states. The acreage planted to cotton in these six states constituted nearly 80% of the entire acreage planted in 1915----- The next and most important question is whether corn is entitled to so large a place in our agriculture. Are the returns obtained sufficient to justify such a large acreage in corn, considered from the standpoint of its usefulness and its effect upon soil fertility.

"The average yield of corn in the Cotton Belt is less than 20 bushels per acre and probably nearer 18 bushels----- If the plant foods removed in a twenty bushel crop of corn are worth between \$4 and \$5, the rent of the land \$2 to \$3 and the cost of making and harvesting and producing, \$8 to \$10 an acre, it is apparent that a twenty bushel yield costs from \$14 to \$18, or too high a price for profitable farming.

"Oats, so generally used for feeding in sections where corn is not a surplus crop, are, owing to the low average yields, no more profitable than corn; but if double cropping is practiced, or a combination of oats and soybeans, or oats and corn, both crops in either combination may be made more profitable.

"At present we think fully one-half of the land now planted to corn should be planted in oats followed by soy beans."(5)

J. F. Duggar of Alabama points out significant facts as to comparative acreages and comparative yields in the following words:

(5) Butler, Tait, "Corn: Its Place in the Agriculture of the South"- The Progressive Farmer, June 10, 1916, Page 753.

"Official estimates credit Alabama with only 197,787 acres of oats in 1904, as compared with 2,791,181 acres of corn. Is there any adequate reason why the farmers of Alabama should plant only one acre of oats for every 14 acres of corn? For the ten-year period ending with 1904, the average yield of corn in Alabama was 12.7 bushels and the average yield of oats was 13.9 bushels. Reducing both to pounds, we have a yield of 714 pounds of shelled corn and 445 pounds of threshed oats per acre.

"The small production of oats per acre in Alabama would be sufficient reason for the neglect of this crop were no improvement in yield practicable. However, it is a comparatively easy matter to double or treble this yield, and at very slight expense, as indicated in experiments described in this bulletin-----We have seen from a preceding paragraph that corn and oats average respectively in Alabama 714 and 445 pounds per acre. This comparison is scarcely fair to oats for the reason that this crop is usually assigned to the poorest land on the farm and is seldom fertilized. To ascertain the relative yield of oats and corn on adjacent plots, a careful study has been made of the results of an unpublished rotation experiment that has been in progress on the station farm at Auburn during the past ten years. We were able to make a satisfactory comparison for three years when all conditions of fertilization season and time of sowing were normal or identical for the two crops.

"The average yield of oats from the fall sowing (October 15 being the average date of sowing), was 24.6 bushels per acre, as compared with 13.8 bushels of corn planted April 6 to 8 each year. No nitrate of soda was used."(6)

Why Oat Yields in the South are Low

From the many agricultural writers and practical farmers of the South who have apparently discovered the possibilities of highly profitable yields of oats, only a few are here quoted:

(6) Duggar, J. F., Ala. Exp't. Station Bul. 137, "Experiments with Oats", Pages 62, 63.

"The average yield per acre of oats in the Cotton Belt is from 15 to 18 bushels.----- The chief reasons for our low average yields are, in our opinion, as follows: poor lands and lack of fertilizers; spring or winter planting instead of fall planting; failure to use the best varieties; and, oat smut.-----For instance, at the Alabama Experiment Station, experiment for 13 years showed an average yield of fall seedings of 36.1 bushels per acre against only 16.5 bushels for spring seeding, or 126 per cent increase for the fall sowing.----- When the few rules here pointed out are looked to - when we learn to plant our oats on better land, better prepared and better fertilized; when we learn that fall plantings far outyield spring plantings; when we learn to prevent oat smut by an easy, simple means now available to any farmer; and when we, either individually or cooperatively, make the fullest use of modern harvesting machinery, there is no reason at all why oats should not be one of our very best paying crops."(7)

Again, additional advice is offered in the editorial columns of the Progressive Farmer:

"Land that yields twenty bushels of corn per acre will ordinarily yield 25 or 30 bushels of oats and the labor necessary to produce and harvest the oats is considerably less. Moreover, a legume hay or soil improving crop can follow the oat crop. In other words, rightly handled the oat crop can be made one of our best paying crops; but as a matter of fact, it is one of our poorest paying crops."(8)

Accompanying this editorial was a photograph of a 160 acre field of oats on the Miller Farm at Madison Station, Mississippi that averaged 47 bushels per acre. L. A. Niven, writing for the Progressive Farmer states the following opinion:

(7) Moss, B. L., "How to Make the Oat Crop Pay", Prog. Farmer, June 24, 1916, Page 806.

(8) Editorial, Progressive Farmer, August 19, 1916.

"The main reason why the northern farmers and western farmers grow more oats than our southern farmers is because they put the crop on better soil, on better prepared soil, and give it the proper attention."(9)

The study of oats and their fertilization in the South by C. G. Atwater and W. F. Dobbs brings them to the following conclusion as to why the southern farmer does not grow more oats:

"In the first place, a relatively insignificant valuation is placed on the oat crop by the cotton farmer. Second, the soil is depleted by adherence to the one-crop system. The Southern farmer, as a rule, gives the best land he has to cotton, and the next best to corn, sowing his poorest land to oats, without regard to the rotation of his crops, or the possibility of a profit on his oats. This attitude, we feel amply justified in asserting, is a mistaken one. The low average yields that have been cited above are the result of improper methods, and can easily be increased to the Northern average and above it. Careful preparation, good seed, and judicious fertilization will make oats a profitable crop. Furthermore, it is a crop that does not make a heavy drain on the soil, and one particularly desirable under Southern conditions because it provides a covering that prevents washing by the winter rains, and in addition the roots leave humus-forming matter in the soil, which our cotton soils greatly need. Because of the scarcity of cattle in the South, and the consequent dearth of barnyard manure, it is wise farm economy to plant oats and follow them with cowpeas in order to increase the humus in the soil and add to its fertility."(10)

The Oat Crop Profitable When Properly Handled

Accurate cost of production records showing net profits

- (9) Nivin, L. A., "How to Succeed with Oats in the Southeast", Progressive Farmer, August 17, 1918. Page 908-(8).
 (10) Atwater, C. G., and Dobbs, W. F., Bul. 61 - "Oats & Their Fertilization in the South", Issued by The Barrett Company, Agricultural Department, 521-2-3 Forsyth Bldg, Atlanta, Ga., Page 8.

for oats in the South are scarce, though there are plenty of reports from farmers and experimenters who in a general way, express their belief in oats as a rival of cotton in profit producing ability. Recent evidence of what agriculturists think of oats as a substitute for corn in Arkansas is published in the "Arkansas Gazette" as follows:

"The 1929 corn crop as pointed out by T. Roy Reid, Assistant Director in charge of the Extension Service, is ten million bushels less than the average for the last ten years, and nine million bushels below the yield of last year, which was thirty-six million bushels. This will bring about a serious dearth of feed for live-stock unless the deficiency is made up by crops of oats and rye and hairy vetch.

"A bulletin now being distributed by the Extension Service warns that Arkansas Farmer's money will be going elsewhere next spring for feed unless steps are taken to balance the shortage of corn. 'Stop up the hole with oats', farmers are urged. They are assured that fall oats, properly planted are as safe from winter cold as corn is from summer

drouth. -----Feed in Arkansas is one of the prime necessities and oats is one of the best feeds for work stock that we can find, says a bulletin prepared by Martin Nelson, Agronomist and Vice-Director of the Extension Service. -----In 1918 Arkansas had one of the highest yields of oats, 25 $\frac{1}{2}$ bushels, and one of the lowest yields of corn, 13 bushels. In 1920 we had a high yield of oats and also a high yield of corn. In 1922, the average production of oats was 24 bushels and of corn, 19 $\frac{1}{4}$ bushels.

----- There are parts of Arkansas where the differences are very much more marked. In central and eastern Arkansas, and particularly in the rice belt, oats, on an average, produces more feed than corn. Eastern Arkansas often runs as high as 35 bushels of oats per acre in years when the average production of corn is about 20 bushels. This is for the reason that corn suffers from summer drouth, while the oat crop is out of the way and does not suffer.

The yield per acre is below what it should be generally. This is due mainly to the fact that poor land is put into oats. Oats is not yet recognized as an important feed crop. It is also due to bad preparation of the soil, too late planting in the fall, and late planting in the spring; too little seed planted on poor land and particularly uncleaned

seed with lots of weed seed mixed with it; planting of no particular variety, but just oats; using no fertilizer. Lack of care in harvesting, threshing and storage also are among the points that cause poor yields and unsatisfactory results with the crop in Arkansas." (11)

In a rather extensive article, the editor of "Successful Farming" compares corn and oats as profit producers in the Corn Belt states, and after pointing out the low cost of producing oats where special effort is made to produce high yields by the best practices, as is ordinarily given corn growing, reaches the following conclusion:

"Too many growers look upon oats as a filler in the crop rotation to be used for feed only and that any yield is acceptable. This is a mistake. Adapted varieties, treated for disease and sowed in suitably prepared soil, will overcome much of the bad reputation by which this crop is handicapped." (12)

Writing of Susquehanna fine sandy loam soils of the eastern portion of Columbia County, Arkansas, and discussing crops adapted to this type of soil, Clarence Lounsberry and E. B. Deeter say in part:

"Oats are not generally grown but this grain could well receive more attention both for the grain and as a winter cover crop. -----Oats are not commonly grown but should give good returns." (13)

(11) News article, Arkansas Gazette, Sept. 29, 1929, Page 15.

(12) Fox, Kirk, "Shall We Continue to Grow Oats", Successful Farming, March, 1926, Page 7.

(13) Lounsberry, Clarence, and Deeter, E. B., U. S. Dep't. Agr. - Field Operations of the Bureau of Soils, 1914, Sixteenth Report "Soil Survey of Columbia County, Arkansas, Pages 1374 and 1377.

An Alabama farmer gives the following record for the year 1916:

"Total yield on 70 acres	2240 bushels"
"Average yield per acre	32 bushels"
"Cost per acre	\$8.66"
"Value per acre	\$19.10"
"Profit per acre	\$10.44" (14)

In substantiation of the rather prevalent belief among Southern agriculturists that oats has been a much neglected crop and, that it responds well and profitably to fertilization, data are given from tests in Georgia by C. G. Atwater and W. F. Dobbs, working for the Agricultural Department of The Barrett Company, in the interest of promoting sales of ammonium sulphate as a top-dressing for oats. They say, in part:

"The accompanying fertilizer experiments with sulphate of ammonia on oats were carried out by our agriculturist in cooperation with the experimenter whose name is given, but under the complete control of the latter, and as a part of the regular operations of the farms, no special preparation or cultivation being attempted. While, therefore they may not be as accurate from the point of view of scientific agronomy as if conducted for a term of years under station conditions, they have the merit of being a part of regular and successful farm operations." (15)

The data compiled from the experiments mentioned in the preceding quotation and shown in Table I, were accumulated

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- (14) Taylor, R. B., "Ten Dollars an Acre Net Profit from Oats", The Progressive Farmer, August 19, 1916, Page 1002
 (15) Atwater, C. G., and Dobbs, W. F., Bul. No. 16, "Oats and Their Fertilization in the South", Issued by The Barrett Company, Agr. Dep't., Southern Office, 521-2-3 Forsyth Bldg., Atlanta, Ga., Page 14.

TABLE I. RESULTS OF TESTS WITH AMMONIUM SULPHATE ON OATS IN GEORGIA, CONDUCTED BY AGRICULTURAL DEPARTMENT OF THE BARRETT COMPANY

Experimenter	Quantity of Sulphate of Ammonia Applied Per Acre-Pounds	Yield		Increase Due to Sulphate of Ammonia Per Acre-Bu.	Cost of Sulphate of Ammonia Per Acre	Value of Increase at Dec. 1 Price	Increase in Value Per Acre Due to Sulphate of Ammonia	
		Without Sulphate of Ammonia - Bu.	With Sulphate of Ammonia - Bu.					
J. W. Cash, 1914	150	28	47	19	\$5.25	70¢	\$13.30	\$8.05
C. C. Wilson, 1916	150	30	70	40	5.25	79¢	31.60	26.35
W. H. Partee, 1912	150	22	44	22	5.25	65¢	14.30	9.05
H. A. Petty, 1916	100	36	50	14	3.50	79¢	11.06	7.57
J. L. Doolittle, 1914	150	16 1/4	38 3/4	22 1/2	5.25	70¢	15.75	10.50
W. H. Lasseter, 1916	100	14	28	14	3.50	79¢	11.06	7.56
T. G. Chestain, 1914	100	6 1/2	32 1/2	26	3.50	70¢	18.20	14.70
W. E. Brim, 1916	100	38	54	16	3.50	79¢	12.64	9.14
W. F. Peacock, 1916	150	14	32	18	5.25	79¢	14.22	8.97
W. J. Mathis, 1916	100	20	40	20	3.50	79¢	15.80	12.30
Average	125	22.48	43.63	21.02	4.38	74.9¢	15.793	11.419

Atwater, C. G., and Dobbs, W. F.- Oats and Their Fertilization in the South. Issued by The Barrett Company, Agricultural Department, Southern Office, 521-2-3 Forsyth Building, Atlanta, Ga. Page 14.

from various farms in Georgia under a variety of soil conditions and of different states of fertility, from some of the poorest to the most fertile. The tests included in this table extended over the five year period 1912-1916. The primary purpose of the experiments, of course, was to demonstrate the value of sulphate of ammonia as a fertilizer for oats. In a few of the tests from 250 to as much as 300 pounds of a basic complete fertilizer was applied to all plots at the time of planting the crop, but in most cases the comparison was made between non-fertilized plots and those fertilized with sulphate of ammonia alone. The significance of these data in this study points rather strongly to the fact that the oat crop in the South, even on poor land, responds well to commercial fertilizers. Here we have an average of 125 pounds of ammonium sulphate per acre applied to all the fertilized plots in the tests, producing an average yield of 43.63 bushels of oats per acre with a net profit per acre due to sulphate of ammonia, of \$11.41, the price of oats being an average of 74.9 cents per bushel and the average cost of sulphate of ammonia being \$4.38 per acre. The average yield of the plots in all the tests receiving no sulphate of ammonia was 22.48 bushels per acre or, 1.15 bushels per acre less than one-half as much as the average for the plots in the tests which were fertilized with sulphate of

ammonia. These results bear out the opinions of agricultural writers quoted freely in preceding pages of the study, i. e., that oats, properly fertilized, make profitable yields.

A statement is here quoted from a teacher of Magnolia Agricultural and Mechanical College, and who operates a farm as a sideline, which illustrates particularly the advantage of growing oats for feed, especially for the farmers whose operations are not extensive and scarcity of feed for work animals is apt to be one of the biggest problems. He says:

"In December, 1928, I had two acres of bermuda sod broken broadcast with a two-mule plow. In February following, I sowed five bushels of oats on these two acres and disced them in. Later, I top-dressed with 100 pounds of nitrate of soda.

"My other feeds being exhausted on June 1st, I began cutting and feeding green oats. When the oats were in good dough stage, I mowed and stored them. My crops were late and required late cultivation. From June 1st to August 15th, I fed nothing but oats from these two acres to my three head of plow stock and they were in good condition at laying-by time.

"Part of the stubble was planted to Mexican June corn and part to late sweet potatoes. Although it was an excessively dry season, I gathered some good corn and the hogs did well for three weeks grazing on the potatoes. At the price of feed stuff, I feel safe in saying that the oats with the corn and potatoes were worth from \$60.00 to \$70.00 to me." (16)

(16) Burns, Professor W. F., Teacher of Mathematics, A. & M. College, Magnolia, Arkansas, Written statement, Feb. 1, 1930.

DESCRIPTION OF STUDY AND PRESENTATION OF DATA

Comparative Costs of Production of Corn and Oats

Table II is compiled from statistics in the yearbooks of the United States Department of Agriculture. A 36-year period was felt to be sufficiently extensive for this study. The 12 Southern States include Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Oklahoma, Arkansas and Tennessee. Statistics for corn and oats are not available for Oklahoma prior to 1893.

Table II in every column shows an excess for corn over oats except in average yield per acre. The important thing in this study however, is the column under value per acre. Corn shows an excess value per acre in the United States as a whole, in the 12 Southern States and in Arkansas. The advantage is in favor of corn but it may be more apparent than real.

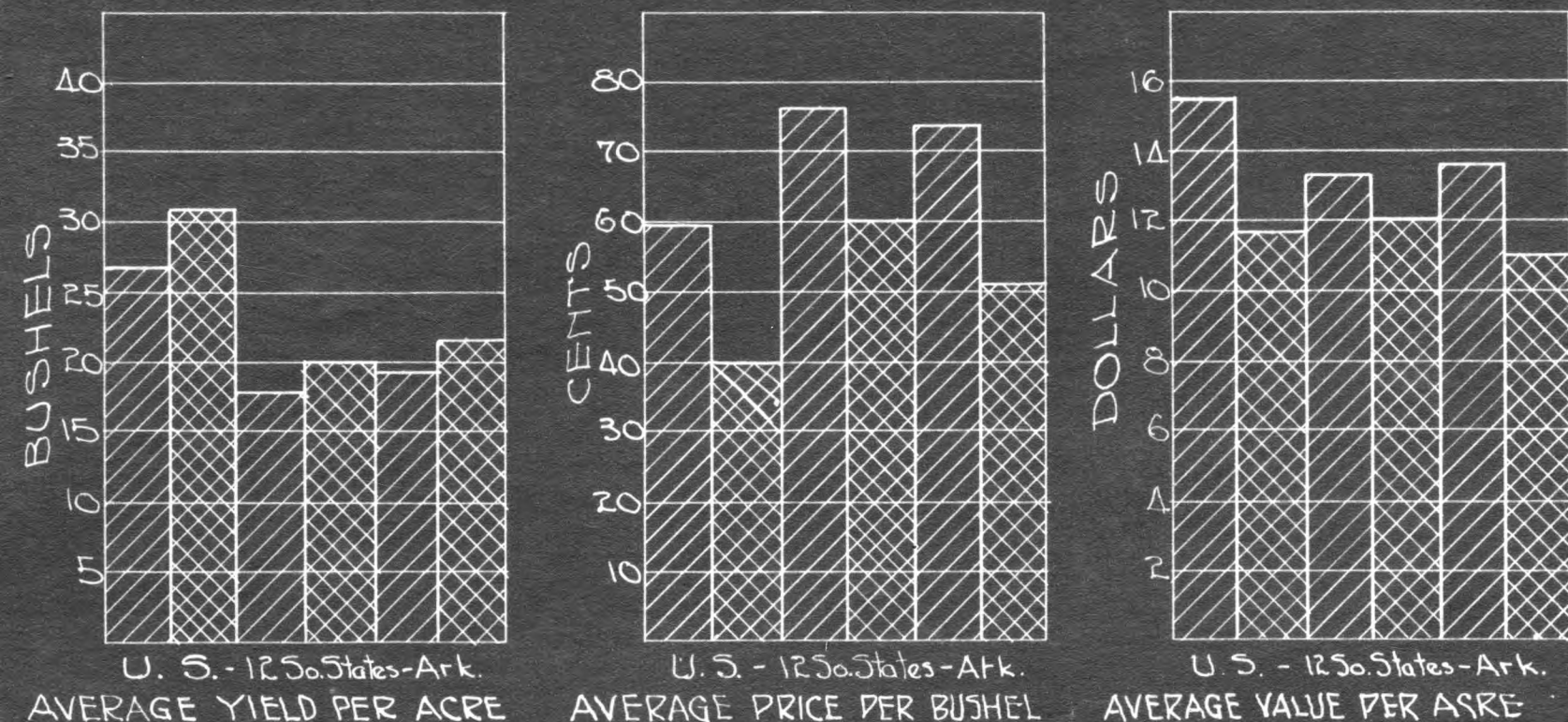
A study at the Ohio Agricultural Experiment Station of 25 farms in the vicinity of Cedarville and Jamestown, Greene County, Ohio, during the five years from 1920 to 1924, reveals the total average costs per acre of corn and oats as follows:

TABLE II. YIELDS PER ACRE, PRICE PER BUSHEL DECEMBER 1, VALUE PER ACRE OF CORN AND OATS IN UNITED STATES, TWELVE SOUTHERN STATES, AND ARKANSAS FOR THE 36-YEAR PERIOD 1893-1928, UNITED STATES DEPARTMENT OF AGRICULTURE YEARBOOKS

Year	Average Yield Per Acre (Bushels)						Average Farm Price Per Bushel						Average Value Per Acre (Dollars)					
	United States		12 So. States		Arkansas		United States		12 So. States		Arkansas		United States		12 So. States		Arkansas	
	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats
1893	22.5	23.4	13.9	16.0	16.2	19.3	0.365	0.294	0.535	0.444	0.45	0.39	8.21	6.88	7.22	7.03	7.29	7.53
1894	19.4	24.5	15.7	15.8	19.2	18.5	0.457	0.324	0.540	0.459	0.47	0.40	8.86	7.95	7.30	7.11	9.02	7.40
1895	26.2	29.6	17.4	16.8	21.5	25.4	0.253	0.199	0.375	0.390	0.32	0.32	6.64	5.87	6.26	7.02	6.88	8.13
1896	28.2	25.7	13.5	14.0	13.5	16.0	0.215	0.187	0.410	0.375	0.37	0.31	6.06	4.81	5.29	6.28	4.99	4.96
1897	23.8	27.2	14.3	14.5	16.0	17.0	0.263	0.212	0.441	0.380	0.40	0.33	6.26	5.75	6.16	5.13	6.40	5.61
1898	24.8	28.4	16.9	18.5	20.0	22.8	0.287	0.255	0.395	0.380	0.29	0.29	7.10	7.23	6.32	5.42	5.80	6.61
1899	25.31	30.23	15.0	13.8	20.0	19.0	0.302	0.248	0.443	0.407	0.39	0.34	7.66	7.52	6.48	6.88	7.60	6.46
1900	25.3	29.6	13.5	17.6	19.0	22.2	0.357	.258	0.539	0.417	0.43	0.35	9.02	7.63	7.03	6.10	8.17	7.77
1901	16.7	25.8	11.7	14.7	8.1	12.3	0.605	.399	0.759	0.583	0.81	0.57	10.09	10.29	8.66	8.57	6.56	7.01
1902	26.8	34.5	13.41	15.45	21.3	20.0	0.403	0.307	0.624	0.536	0.49	0.41	10.81	10.60	8.60	8.28	10.44	8.20
1903	25.5	28.4	18.90	16.84	20.9	18.6	0.425	0.341	0.583	0.50	0.51	0.44	10.82	9.68	10.96	8.42	10.56	8.18
1904	26.8	32.1	17.80	19.90	21.6	22.7	0.441	0.313	0.58	0.495	0.53	0.43	11.79	10.05	10.46	9.85	11.45	9.76
1905	28.8	34.0	16.8	21.5	17.3	20.3	0.288	0.291	0.58	0.485	0.55	0.42	11.88	9.88	9.43	9.25	9.51	8.53
1906	30.3	31.2	19.5	23.02	23.6	20.5	0.399	0.317	0.57	0.51	0.47	0.42	12.06	9.89	10.43	8.23	11.09	8.61
1907	25.9	23.7	18.3	19.1	17.2	19.5	0.516	0.443	0.69	0.65	0.68	0.54	13.38	10.51	12.11	11.42	11.70	10.53
1908	26.2	25.0	19.0	21.5	20.2	21.4	0.606	0.472	0.73	0.66	0.66	0.53	15.88	11.78	13.48	12.87	13.33	11.34
1909	25.5	30.3	17.1	21.5	18.0	22.8	0.596	0.405	0.76	0.676	0.72	0.59	15.20	12.29	13.69	13.18	12.96	13.45
1910	27.4	31.9	19.9	26.0	24.0	27.5	0.488	0.341	0.668	0.535	0.58	0.46	13.37	10.90	18.69	15.87	13.92	12.65
1911	23.9	24.4	18.92	21.43	20.8	20.0	0.618	0.45	1.04	0.735	0.72	0.53	14.77	10.98	16.69	15.87	14.97	10.60
1912	29.2	37.4	18.92	21.43	20.4	19.9	0.487	0.319	1.04	0.735	0.67	0.50	14.20	11.93	18.69	15.87	13.67	9.95
1913	23.1	29.2	18.92	21.43	19.0	26.5	0.681	0.392	1.04	0.735	0.78	0.53	15.99	11.45	18.69	15.87	14.82	14.04
1914	25.8	29.7	18.92	21.43	17.5	24.0	0.644	0.438	1.04	0.735	0.80	0.53	16.65	12.99	18.69	15.87	14.00	12.72
1915	28.2	37.8	18.92	21.43	23.0	27.0	0.575	0.361	1.04	0.735	0.64	0.52	16.21	13.62	18.69	15.87	14.72	14.04
1916	24.4	30.1	18.92	21.43	17.7	21.0	0.889	0.524	1.04	0.735	0.98	0.68	21.67	15.80	18.69	15.87	17.35	14.28
1917	26.4	36.4	18.92	21.43	24.0	28.0	1.283	0.669	1.04	0.735	1.40	0.75	33.85	24.36	18.69	15.87	33.60	21.00
1918	24.0	34.6	18.92	21.43	13.0	25.5	1.336	0.71	1.04	0.735	1.80	0.88	32.82	24.60	18.69	15.87	23.40	22.44
1919	28.6	29.4	18.92	21.43	18.0	22.0	1.349	0.717	1.04	0.735	1.64	0.88	38.54	21.12	18.69	15.87	29.52	19.36
1920	30.9	35.2	18.92	21.43	23.4	25.0	0.677	0.80	1.04	0.735	0.97	0.78	20.93	16.61	18.69	15.87	22.70	19.50
1921	29.7	23.7	17.1	21.95	22.0	22.0	0.423	0.303	0.914	0.687	0.57	0.45	12.54	7.17	15.63	15.07	12.54	9.90
1922	28.2	29.9	17.1	21.95	19.5	24.0	0.657	0.64	0.914	0.687	0.85	0.57	18.55	11.76	15.63	15.07	16.58	13.68
1923	29.3	31.3	17.1	21.95	19.5	23.0	0.727	0.415	0.914	0.687	0.01	0.62	21.33	11.74	15.63	15.07	19.70	14.25
1924	23.2	36.3	17.1	21.95	16.5	20.0	0.987	0.48	0.914	0.687	1.07	0.64	22.91	17.42	15.63	15.07	17.66	12.80
1925	28.8	33.3	17.1	21.95	14.0	16.0	0.674	0.381	0.914	0.687	0.97	0.58	19.20	12.68	15.63	15.07	13.58	9.28
1926	27.0	28.2	20.6	25.00	20.5	22.0	0.642	0.398	0.784	0.594	0.80	0.52	17.33	11.33	16.15	14.85	16.40	11.44
1927	28.1	28.2	20.0	19.10	19.0	20.0	0.723	0.45	0.85	0.65	0.87	0.58	20.31	12.69	17.00	12.41	16.53	11.60
1928	28.2	34.7	16.9	22.07	16.5	22.0	0.751	0.409	0.964	0.695	0.91	0.59	21.17	14.19	16.29	15.33	15.01	12.98
Average	26.17	31.14	17.34	19.9	18.94	21.49	0.595	0.401	0.771	0.60	0.738	0.518	15.66	11.72	13.40	12.04	13.73	11.29
	+4.97		+2.56		+2.45		+0.194		+0.171		+0.220		+3.94		+1.36		+2.44	

Note: Under heading "12 So. States" for Average Yields per acre of corn and oats and for average farm price per bushel of corn and oats, ten-year averages are shown for years 1911-1920, and five-year averages are shown for years 1921-1925.

Under heading "12 So. States" for average value per acre for corn and oats, eleven-year averages are shown for the years 1910-1920 and five-year averages for 1921-1925.



COMPARISON OF OATS AND CORN

36 Year Average 1893-1928

Graphical Representation of Table II.

 OATS

CORN 

FIG. 3

Corn (Av. 25 farms 1920-1924)	\$20.55
Oats (Av. 25 farms 1920-1924)	<u>15.82</u>
Excess in cost of corn over oat crop	\$ 4.73 (17)

Table II shows the average value per acre of corn grown in the United States for the 36 year period, 1893-1928, to be \$15.66, and for oats, \$11.72 or, a difference of \$3.94 per acre excess value for the corn crop. In the 12 Southern States, the figures for this period are, \$13.40 for corn, and \$12.04 for oats or, a difference of \$1.36 in favor of the corn crop, while Arkansas, for the same period shows the per acre value of corn to be \$13.73 against \$11.29 for oats. There is no reliable method of getting at the per acre cost of production of these two crops in the whole United States, the 12 Southern States and in Arkansas for this 36 year period, so that a comparison of profits per acre could be determined. However, if the Ohio Station figures quoted above could fairly be used as a criterion of per acre cost of production of corn and oats, the advantage is in favor of the oat crop, since the corn cost \$4.73 more per acre to produce than to produce the oats. In percentage figures, it means that the cost of production of oats is only

(17) Falconer, J. I., and Dowler, J. F., "Variations in Costs of Producing Corn, Wheat, and other Crops in Greene County, Ohio". Bulletin 396, Ohio Agricultural Experiment Station, Issued September, 1926, Pages 243-262.

76.9 per cent as much as the cost of production of corn. Thus, the difference in the value per acre of corn and oats as shown by Table II would be reduced. Over the whole United States the table shows an increase of 33.6 per cent in value per acre for corn over the per acre value of oats. In the 12 Southern States, the difference is only 11.29 per cent in favor of corn, while in Arkansas the value per acre of corn is 21.61 per cent more than that of oats.

Again, Table III, which gives data from Experiment Station records shows the average cost of production per acre to be \$20.14 for corn and \$14.06 for oats or, a 35.2 per cent excess in cost of corn production over oats. The average cost per acre of producing oats as determined by J. A. Hodges in Jackson and McPherson Counties, Kansas for the 5 year period, 1920-1924, was \$16.73.⁽¹⁸⁾

Data from Circular 340, United States Department of Agriculture,⁽¹⁹⁾ for the years 1922 and 1923, (Table IV) in the South Atlantic and in South Central States show the aver-

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- (18) Hodges, J. A., "Cost of Producing One Acre of Oats", Jackson County, Kansas, and McPherson County, Kansas 1920-1924. Kansas Agricultural Experiment Station, Department of Agr. Econ. in coop. Bureau of Economics, U.S.D.A., mimeographed, Manhattan, Kan. March, 1926.
- (19) Cooper, M. R., and Hawley, C. R., Cost of Production of Oats and Corn, Circular No. 340, U.S.D.A.

age cost per acre of corn to be \$22.78 and for oats \$17.36. An experiment conducted in Hempstead County, Arkansas in 1923 shows the net cost per acre of producing corn to be \$22.30 per acre and \$16.87 per acre for oats. The cost of production figures for the seven years data at Magnolia as shown in Table V are somewhat contrary to those shown in the foregoing, showing a cost of \$13.28 per acre for corn against \$17.87 per acre for oats, exclusive of land rental for both crops. There are circumstances connected with this unusually high cost of oats in this case which will be explained in later discussion of this table.

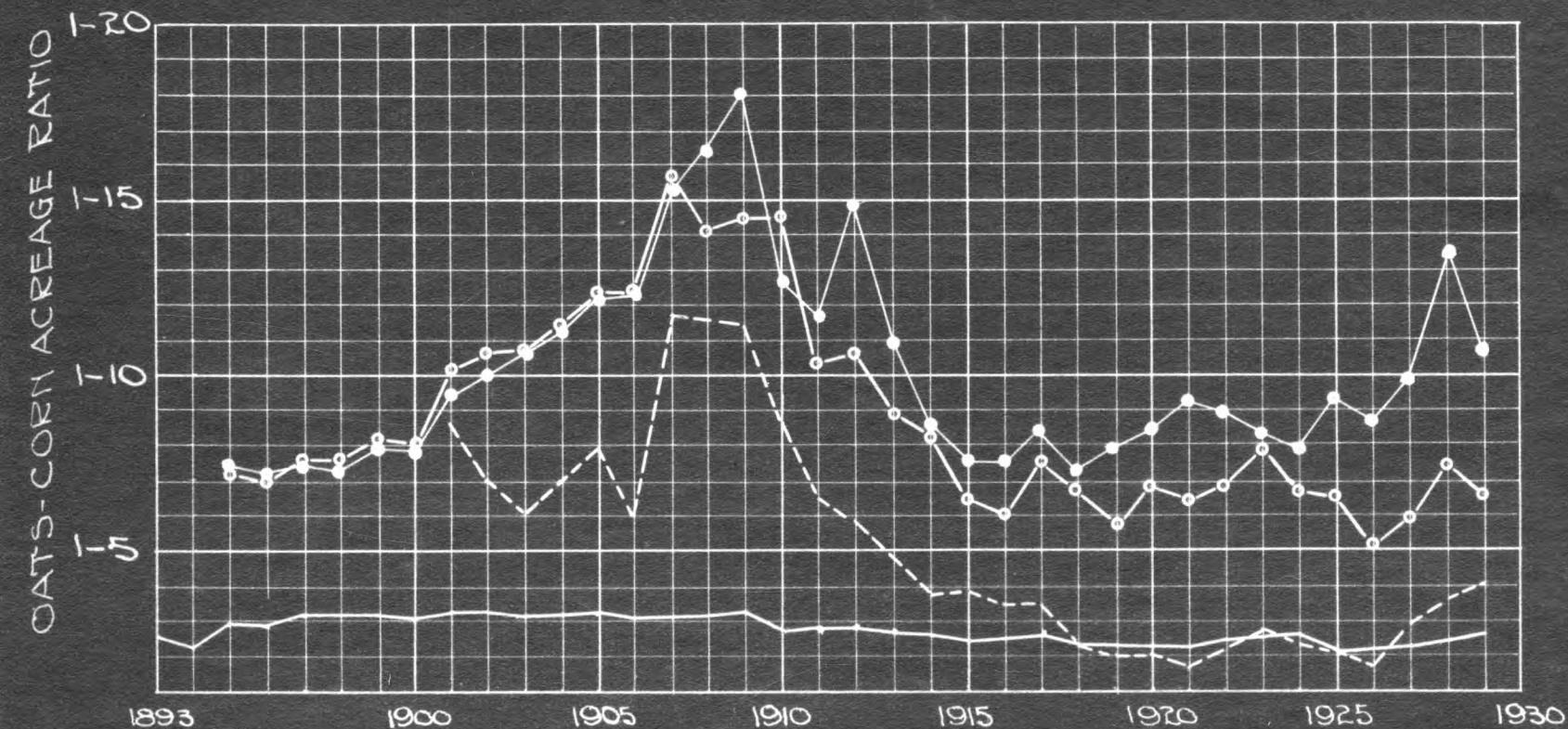
While, therefore, the average of the figures in the value per acre column in Table II does show an advantage in favor of corn, yet if cost of production is taken into account, the advantage would be decidedly in favor of oats in the 12 Southern States, and in Arkansas.

The Oats-Corn Acreage Ratio Variation 1893-1929

Figure 4 compares the variation of the acreage ratio of oats and corn for the 36 year period, 1893 to 1928 for the United States as a whole, for the twelve Southern States and for Arkansas. The curve for the twelve Southern States is based on figures taken at ten-year intervals. These curves reveal that the acreage-ratio of oats and corn has varied

for the whole United States from 1 acre of oats to 2.2 acres of corn, to a ratio of 1 acre of oats to 3.2 acres of corn, or for the entire 36 year period the variation in acreage ratio has been not more than one acre. The curve presents practically a straight line for the whole period. This would seem to indicate that taking the country as a whole, the oats crop has not grown less important, so far as acreage devoted to it is concerned, when compared to corn.

The curves for the Southern States and Arkansas are in marked contrast to that of the United States as a whole. The significant feature of these curves as compared to the United States curve, is the extreme variation which occurs. For Arkansas, there is a minimum oats-corn acreage ratio of 1 to 16.8 in 1909 against a maximum of 1 to 6.8 in 1918 with almost all possible ratios shown between these extremes throughout the balance of the period. The sharp upward trend of this line for Arkansas for the past two years, 1927 and 1928, would tend to show that the oat crop in comparison to corn is at present taking a place of lesser importance than it held throughout the preceding decade. In 1929, the curves show oats acreage increasing again in Arkansas and the Southern States, but still declining in Oklahoma relative to the corn acreage. It will be observed that the curve for Oklahoma shows the same general trend as that for Arkansas,



VARIATION IN THE OATS-CORN ACREAGE RATIO
FOR THE
UNITED STATES, TWELVE SOUTHERN STATES, OKLAHOMA AND ARKANSAS
36 Year Period 1893-1928
U.S.D.A. Yearbooks

UNITED STATES

TWELVE SOUTHERN STATES

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FIG. 4

OKLAHOMA

ARKANSAS

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with the exception perhaps that Oklahoma seems to have a better holding power for its oats acreage. This may be partly explained by the replacing of part of the loss of corn acreage by oats; the corn crop acreage having diminished because of the limited rainfall and other unfavorable climatic conditions which prevail in the western half of Oklahoma, particularly.

These curves indicate that oats growing has not reached a point of stability in the South and that, apparently, southern farmers are undecided as to whether it deserves a permanent place of importance in their agriculture, and that oats production has been spasmodic to a considerable degree. Apparently, no great proportion of farmers are convinced, unshakeably, that oats deserve a permanent place as a regular feed crop in Southern Agriculture.

Comparative Results with Oats and Corn as Shown by Data
from Experiment Station Records

Table III is a compilation of all available data throughout the United States where oats and corn have been compared, using experiment station methods to determine relative profits per acre from the two crops. The data show the period of duration of the tests, the State, cost per acre, cost per bushel, yield per acre, value per acre and profit per acre for each crop.

It is assumed that, in these experiments, the test plots were selected with a view to eliminating variations which might occur because of differences in soil characteristics, and that both crops had equal chances so far as cultivation, fertilization, etc., are concerned and that the usual care was given to all phases of handling the crops so that the results obtained would be a fair representation of the profit-producing ability of the two crops under the soil and climatic conditions which prevailed at the places of the various experiments. Unfortunately, in most cases the experiments were carried on for only one year, so in these cases, definite conclusions could not be drawn as to which is the most profitable crop, corn or oats, for they were not extended over a sufficient length of time to complete the climatic cycle so that fair comparative averages could be obtained.

The averages for all the experiments indicate a profit per acre for corn of \$1.95 and for oats a loss of \$.58 or, a difference of \$2.53 per acre in favor of corn. All the corn belt states represented show a decided gain for corn over oats, except for the state of Missouri in the years 1921 and 1925 which show a gain for oats of \$.55 and \$2.71 respectively. The North Dakota test of 1921-1923 shows a

TABLE III. CORN VS. OATS
(Comparative Cost of Production Data-Experiment Station Records)

Period	State	Cost Per A. Dollars		Cost Per Bu. Dollars		Yield Per A. Bushels		Value Per A. Dollars		Profit Per A. Dollars	
		Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats
1. 1892	Nebr.	7.63	6.15	0.335	0.177	42.86	34.48	12.85	9.92	5.22	3.77
2. 1896	Ill.	8.72	6.59	0.161	0.178	54.00	34.00	24.57	6.80	15.85	0.21
3. 1906-1912	N.D.	9.25	8.50	0.57	0.25	17.22	32.47	16.59	12.48	6.39	3.98
4. 1915	Mo.	13.52	10.87	0.45	0.41	29.50	26.00	16.82	9.88	3.30	-0.99
5. 1918	S.C.	18.50	8.66	1.00	0.433	18.50	20.00	17.02	14.20	-1.48	5.54
6. 1910-1917	Mo.	15.98	11.11	0.57	0.42	27.80	26.20	21.10	12.28	5.12	1.17
7. 1921	Mo.	19.05	12.50	0.62	0.63	30.75	20.00	12.00	6.00	-7.05	-6.50
8. 1914-1920	N.Y.	57.48	34.29	1.62	0.90	30.40	35.30	34.53	23.65	-14.26	-6.70
9. 1922	U.S.	23.01	17.40	0.66	0.53	35.00	33.00	25.55	15.84	2.54	-1.56
10. 1923	U.S.	23.75	18.08	0.68	0.52	35.00	35.00	28.35	17.15	4.60	-0.93
11. 1924	Mo.	17.13	13.67	0.65	0.49	26.50	28.10	25.44	14.33	8.31	0.66
12. 1921-1923	N.D.	18.75	13.15	0.59	0.45	28.10	28.70	12.92	7.17	-5.83	-5.97
13. 1925	Miss.	12.49	5.15	0.75	0.41	16.70	12.50	15.69	9.75	3.20	4.60
14. 1925	Mo.	19.76	13.78	0.67	0.52	29.50	26.50	20.35	11.66	-0.59	2.12
15. 1923-1925	Ill.	28.58	23.20	0.54	0.38	51.32	54.10	35.28	21.74	6.70	-1.46
16. 1926	Ill.	28.65	21.95	0.52	0.52	53.80	38.30	27.44	14.52	-1.21	-7.33
Average		20.14	14.06	0.678	0.519	32.93	30.29	21.15	12.95	1.95	-0.58

1. Nebr. Agr. Expt. Sta. Bul. 29. Distr. Apr. 15, 1893. The Cost of Farm Crops. C. L. Ingersoll and S. W. Perrin, Tables I and II, Pages 39 and 40.
2. Ill. Expt. Sta. Bul. 50. The Cost of Production of Corn and Oats in Ill. in 1896. Nathan H. Weston. Tables 1 and 2, Pages 70, 71, 72 and 73.
3. N. Dak. Agr. Expt. Sta. Bul. 104. Cost of Producing Farm Crops. W. R. Porter, 1913. Tables I and XIII.
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6. Mo. Agr. Expt. Sta. Bul. 165. Cost of Prod. Some Mo. Farm Crops. O. R. Johnson and R. M. Green. Tables 2 and 4, Pages 9 and 12.
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8. Cornell Univ. Agr. Expt. Sta. Bul. 414. Cost Accounts for Six Years on Some Successful New York Farms. G. F. Warren, Van B. Hart, W. S. Myers, R. S. Gillett, C. V. Noble and others. Table 89, Pages 133 to 137.
9. U.S.D.A. Dept. Cir. 340. Cost of Producing Field Crops, 1923, by M. R. Cooper and C. R. Hawley. Table 1, Page 4.
10. U.S.D.A. Dept. Cir. 340. Cost of Producing Field Crops, 1923, by M. R. Cooper and C. R. Hawley. Tables 2 and 10. Pages 5, 6, 17, and 18.
11. Mo. Agr. Expt. Sta. Bul. 336. Some New Developments in Agr. Science. One Year's Work, Agricultural Experiment Station. Report of the Director, July 1, 1924 to June 30, 1925. Page 68.
12. Cost of Producing Crops in North Dak. Rex. E. Willard, Agr. Expt. Bul. 199. Tables 3, 4, Page 15.
13. Miss. Agr. Expt. Bul. 237, Progress Report on Cost of Production Route in Choctaw County, Miss. Lewis E. Long and H. W. Reynolds. Tables 5, 6, Pages 9 and 11.
15. Ill. Agr. Expt. Station Report, 1927. Cost of Production and Profitableness of Crops, by H. C. M. Case, R. H. Wilcox, H. A. Berg, and J. B. Andrews. Pages 183 and 187.
16. Ill. Agr. Expt. Sta. Report, 1926. Cost of Production by H. C. M. Case, R. H. Wilcox, and H. A. Berg. Pages 97-120.

\$.14 advantage for corn over oats. The seven-year test in New York state 1914-1920 registered an average loss per acre for corn of \$14.26 against a loss of \$6.70 per acre for oats or an advantage of \$7.56 per acre for oats. Only two Southern states conducted experiments of this kind, South Carolina and Mississippi, and these for only one year each. The results of the test in South Carolina for the year 1914 show a profit of \$5.54 per acre for oats against a loss of \$1.48 per acre for corn. The test in Mississippi for the year 1925 resulted in a profit of \$4.60 per acre for oats against a profit of \$3.20 per acre for corn. In the first case (South Carolina), the gain is \$7.02 in favor of oats, in the second, (Mississippi), the gain is \$1.40 for oats against corn. Much more extensive experimental work of this kind in Southern states would be necessary before any justifiable conclusions could be drawn as to the comparative value of corn and oats as profitable crops. However, attention is directed to the fact that in Table IV the averages for the seven-year test at Magnolia show a profit of \$4.20 per acre for oats against a loss of \$1.10 per acre for corn or, a difference of \$5.30 per acre in favor of oats. Although comparative tests are scanty in Southern States, the results at Agricultural and Mechanical College, Magnolia, Arkansas, are consistent with those of such tests as have been made, in

that they show oats to be the more profitable crop.

Comparative Results with Corn at Agricultural and
Mechanical College, Magnolia, 1923-1929

Table IV presents data comparing results with oats and corn for the seven year period, 1923-1929 at Agricultural and Mechanical College, Magnolia, Arkansas. Since it is the figures here presented upon which the basis for the study rests, it is felt that a rather detailed explanation and interpretation is desirable.

Under yield per acre, grain alone is considered, taking no account of stover or fodder for corn or of straw for oats. No credit is given for companion crops which are usually grown with corn nor for catch crops which follow oats. In the cases of both corn and oats for each of these seven years the grain was weighed on standard, accurate wagon scales, allowing 72 pounds per bushel for slip-shucked ear corn and 32 pounds per bushel of threshed grain for oats, both of which are the legal weights for Arkansas. The price allowed is based on the December 1st price in the Yearbooks of the United States Department of Agriculture. Table V shows the actual returns for the oats crops for these years, including sales of straw but the records are not sufficiently complete to show the corresponding figures for the corn

TABLE IV. COMPARISON - CORN AND OATS, MAGNOLIA AGRICULTURAL AND MECHANICAL COLLEGE FARM, 1923-1929

Year	Yield		Arkansas Price Per		Cost		Value		Cost		Profit	
	Per Acre Bu		Bu. Dec. 1		Per Bushel		Per Acre		Per Acre		Per Acre	
	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats
1923	13.33	25.0	1.01	0.62	.648	.52	13.46	15.50	8.65	13.01	4.81	2.49
1924	21.30	40.1	1.07	0.64	.86	.436	22.79	25.66	18.41	17.50	4.38	8.16
1925	22.2	42.6	0.97	0.58	.673	.572	21.60	24.70	14.97	24.38	6.63	0.32
1926	8.13	52.8	0.80	0.52	1.225	.396	6.50	27.45	9.96	20.94	-3.46	6.51
1927	9.26	28.8	0.87	0.58	1.46	.645	8.05	16.70	13.06	18.58	-5.01	-1.88
1928	8.61	25.0	0.91	0.59	1.41	.602	7.83	14.75	14.04	15.05	-6.21	-0.30
1929	12.12	48.0	0.95	0.62	1.148	.326	11.51	29.76	13.91	15.66	-2.40	14.10
Average	13.56	37.47	0.94	0.592	1.066	.499	11.67	22.07	13.28	17.87	-0.18	4.20
<hr/>												
Colum- bia Co. Avg.	1923 to 1928	(1920, 24, 27)		0.94	0.592		10.86	11.96				
Arkan- sas Average	1923 to 1928	11.56	20.21	0.94	0.592		10.86	11.96				
Arkan- sas Average	1866 to 1915	17.66	20.6	0.94	0.592		16.60	12.19				
All South- ern States	1866 to 1915	20.9		0.562			11.59					
		17.64		0.574			10.06					

Bouton, Charles S. Agricultural Statistician, U. S. Dept. of Agr., Bureau of Agricultural Economics,
 Little Rock, Ark., 344, State House, by letter, Jan. 20, 1930.
 U. S. D. A. Yearbooks.
 Estabrook, Leon M. U. S. Dept. Agr. Bul. No. 515. Corn, Yields per Acre and Prices by States,
 50 years, 1866-1916. (Figures compiled from tabulations), P. 3. Contribution from the Bureau
 of Crop Estimates.

TABLE V. ACTUAL RETURNS FROM OAT CROPS, AGRICULTURAL AND MECHANICAL COLLEGE, MAGNOLIA, ARKANSAS, YEARS 1923-1929. ALL COSTS INCLUDED EXCEPT RENT. RETURNS INCLUDE GRAIN AND STRAW

Year	Acres	Fertilizer Per Acre Pounds	Fertilizer Formula P---N---K	Total Yield.Bu.	Yield Per Acre Bu.	Total Returns	Total Cost	Cost Per Acre	Total Profit	Profit Per Acre	Total Re- turns Per Bushel	Total Cost Per Bu.	Total Profit Per Bushel
1923	16	350	9.14-6.4-0	450	25	292.00	208.16	13.01	83.84	5.24	.648	.462	.186
1924	17	500	6.4-6-2.8	681.7	40.1	541.84	297.50	17.50	244.34	14.37	.793	.421	.372
1925	25	600	8-5-2.33	1050	42.6	1033.25	609.50	24.38	423.74	16.95	.984	.58	.404
1926	50	500	6.4-6-2.8	2640	52.8	2098.24	1047.00	20.94	1051.24	21.02	.794	.391	.403
1927	30	500	6.4-6-2.8	864	28.8	934.81	557.40	18.58	377.41	12.58	1.081	.645	.436
1928	18	500	8-7-6	450	25	464.70	270.90	15.05	193.80	10.76	1.032	.602	.43
1929	30	400	6.5-9-5.6	1440	48	1368.85	469.80	15.66	899.05	29.96	.95	.326	.624
Aver- age	26.55	478.55			37.47			17.87		15.84	.897	.489	.408

crops. The following cost items are included in the cost per bushel and cost per acre; (1) Seed, (2) fertilizers, (3) man labor, (4) mule labor, (5) farm machinery expense. Interest on investment or rent is not included. Profit per acre is arrived at, of course, by balancing the cost of the crops against the market value of them as feed crops on December 1st in Arkansas. As Table V shows, the commercial fertilizers applied to the oats crops range from 350 pounds to 600 pounds per acre, the average being 478.55 pounds per acre for the seven year period. In most of these years the high quantities of fertilizers applied have placed the fertilizer costs up beyond the point of diminishing returns. As best it has been determined, about 400 pounds of commercial fertilizer per acre has been settled upon as the most profitable quantity to apply on the class of land used in these tests. Not more than 400 pounds of commercial fertilizer per acre has been used on corn in any year. One of these years was in 1928, which Table V shows, resulted in a yield of 8.61 bushels per acre, next to the lowest yield of the whole series. Experience has shown that there is a considerable element of risk in using more than 200 to 300 pounds of commercial fertilizer per acre on corn on this class of land. According to a corn fertilizer test conducted in the year 1928, on the College farm, in which commercial

fertilizers ranging from 250 pounds to 515 pounds per acre were used on 1/20 acre plots in replica of three series, it was found that the point of diminishing returns was reached with the application of 290 pounds of fertilizer per acre. This year (1928) was unseasonable for corn in Columbia County. No doubt, with an ideal season for corn, more fertilizers could have been used before the point of diminishing returns set in. Even under ideal seasonal conditions however, it does not appear, in view of past experiences, that not more than 400 pounds of commercial fertilizer per acre could be applied to this class of land, with maximum profits. In fact, since the seven year test shows an average loss of \$0.18 per acre for corn, there is no conclusive indication that there is anything at all to be gained by application of fertilizers on corn on this kind of soil. Reasons for this condition will be brought out later under discussion of Figure 4, and under discussion of insect pests and diseases of corn. It will be noted that the average cost per acre for the production of oats shown in Table IV is \$17.87 against a cost of \$13.28 per acre for corn or, a difference of \$4.59 per acre in favor of corn. This excessive cost for oats is partly explained by the larger quantities of fertilizers used on oats and partly by the excessive cost of farm machinery for oats over corn as it occurs under the conditions attend-

ant on these tests. Since few oats are grown in this section, it is necessary for the College to own its own thrasher and binder, using them only to take care of the oats crops grown on the College farm. Furthermore, the rolling topography of the land, to some extent, increases the cost of farm machinery.

The average farmer of Columbia County who has not given much thought to what it is costing him to grow his corn would no doubt, express considerable surprise at the disappointingly low average yield of 13.56 bushels of corn per acre as shown in the seven year period at the Agricultural and Mechanical College farm. He would probably maintain that these results are below that of the average Columbia County farmer, yet the average yield of corn for Columbia County for the six-year period 1923-1928 was exactly two bushels below the 1923-1929 average for the Agricultural and Mechanical College farm. This average was raised slightly by the 1929 average of 13 bushels per acre for the county. The average yield of corn for the state for 1929, however, was only 14 bushels, whereas the average yield of oats for the state for 1929 was 26 bushels. This gives the 1929 crop of oats a per acre value of \$16.12 which was superior to the value per acre of corn which was under \$14.00. Even in this banner oat year for Arkansas, it is interesting to note that

the yield of oats at Magnolia was 48 bushels per acre, or, nearly twice that of the average for the state, whereas the corn yield at Magnolia was slightly under the state average.

Arkansas' average yield per acre of corn for the 45 year period 1866-1915 was 20.9 bushels. The arkansas average for the period 1923-1928, the period encompassed by the comparative tests at Magnolia, was 17.66 bushels per acre or, approximately the 45 year average (1866-1915) for all Southern States. Thus it might be said that the period covered by the Magnolia tests was generally unfavorable to corn growing in Arkansas because the average yield per acre for these years was 3.24 bushels below that of the 45 year average.

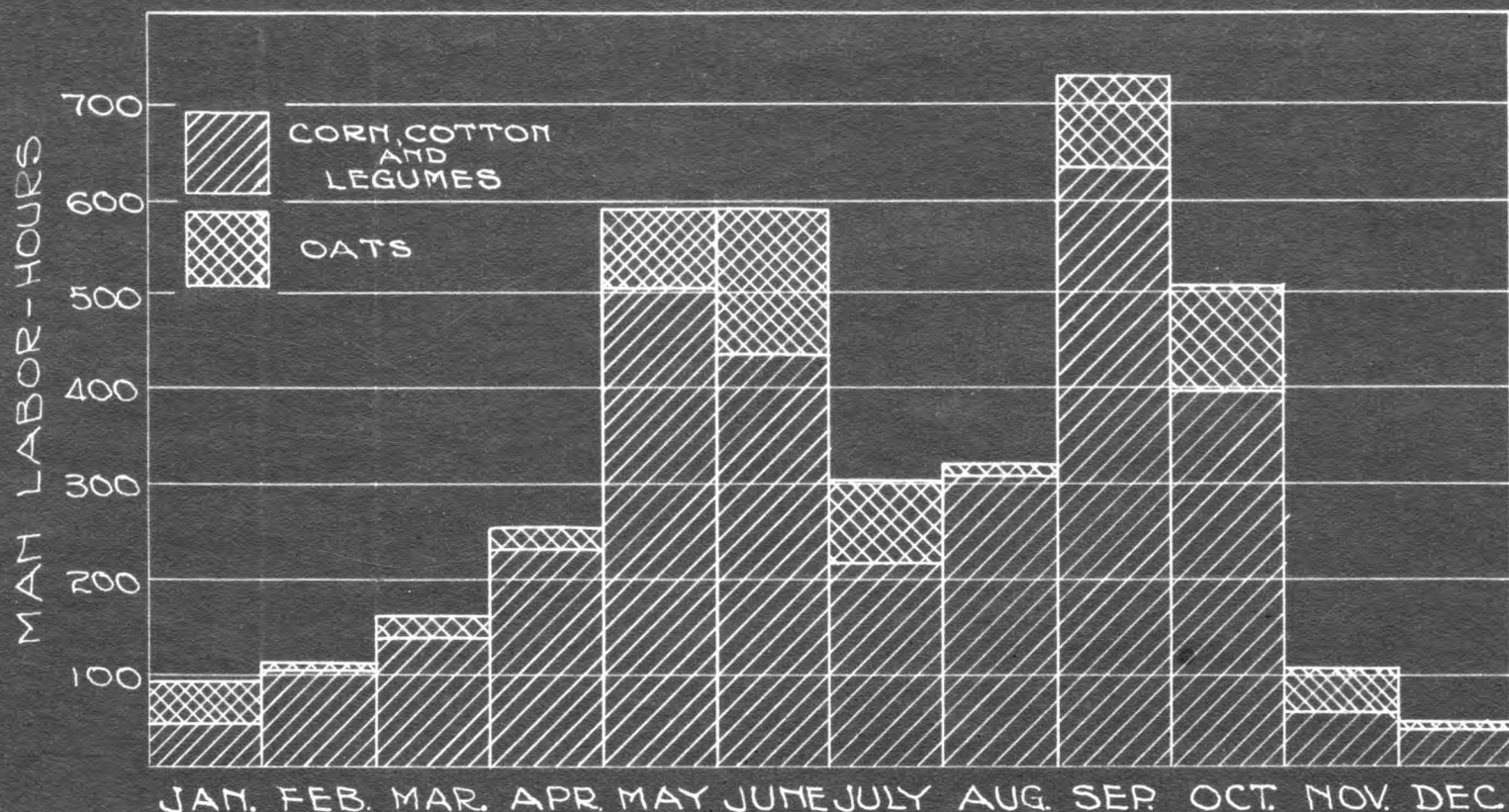
The average yield of oats per acre in the Magnolia tests is nearly twice that of the average for Arkansas for the 6 year period, 1923-1928, that is, 37.47 bushels per acre for the College farm against 20.6 bushels per acre for the whole state. This figure (20.6) bushels per acre is very close to the average for the three years 1920, 1924 and 1927, (the total available authentic oats data for Columbia County), or 20.21 bushels per acre.

When one considers carefully the facts brought forth by the results of the comparative work on corn and oats in the tests at the Agricultural and Mechanical College farm at

Magnolia, taking into consideration the unadaptability of this kind of soil to corn-growing, the fact that oats were made to approximately double the average yield of the state by the use of commercial fertilizers on a comparatively poor upland soil, and the further fact that approximately 75 per cent of the upland Coastal Plains soils of Arkansas are similar in character, one is inclined to agree with agricultural writers, quoted extensively under "Review of Literature" of this study, that the oats crop is a much neglected crop in the South and there is economic justification for devoting to oats a much larger acreage of the land used for feed crops, than has been done in the past.

The Factor of Man Labor Distribution as It Affects the Growing of Oats in the South

An objection frequently voiced by farmers in the vicinity of Magnolia, to growing oats is that oats-growing unbalances the distribution of labor on the farm where cotton is the main cash crop. In this connection they have reference particularly to the concentration of labor in the oats harvesting season, that is, in May and June as it occurs in this region. Figure 4 is worked out for the purpose of ascertaining, as far as possible, whether or not this objection is sustained by the actual facts. It represents the



DISTRIBUTION OF MAN LABOR
CORN, OATS, COTTON AND LEGUMES

AVERAGE, 1923-1929

Agricultural and Mechanical College, Magnolia, Arkansas.

FIG. 5

average monthly distribution of man labor for the seven year period, 1923-1929, and is taken from the records of the Agronomy Department of Agricultural and Mechanical College, Magnolia, Arkansas. The major crops in the rotation system of the college farm are, and have been, throughout the years of these tests, corn, oats, cotton and annual legumes, and have followed each other in the order named. On the average, these crops have been pretty well balanced as to acreage, varying somewhat, more or less, with different crops in different years. The farm includes approximately 160 acres of land in cultivation, which is a somewhat larger acreage than is cultivated on the average farm in Columbia County.⁽²⁰⁾ The average Columbia County farmer also varies somewhat from the practice at the Agricultural and Mechanical College farm in that a higher percentage of the acreage is devoted to cotton growing and a smaller percentage to the growing of legumes than at the College farm. Corn occupies a more important place on the average Columbia County farm than it has on the College farm, when considered from the standpoint of percentage of cultivated land devoted to it.

The single hatch in the figure represents the sum of the hours of man labor on corn, cotton and legumes, while

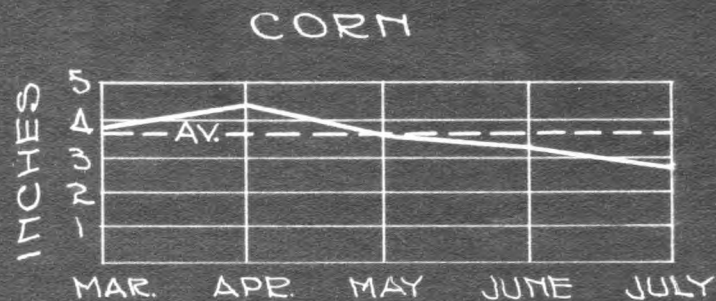
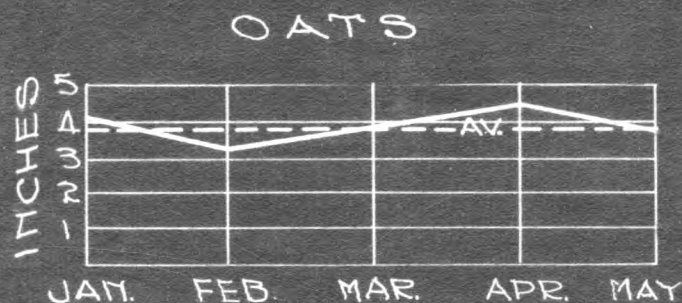
(20) The average farm of Columbia County contains 39.6 acres of improved land--Fourteenth census, 1920. Vol. 6, Part II, page 549.

the double hatch represents the man labor for oats. It may be assumed that the outline of the single hatch columns in the figure would conform approximately to that of an average Columbia County farm of 160 acres of cultivated land with a rotation of corn, cotton and legumes, with perhaps somewhat less equal distribution occurring on the average Columbia County farm because of the excess acreage of cotton which normally occurs. In the figure, we have the labor piling up in the months of May, June, September and October, when the double hatch portions are included. This is off-set by some evening-up of labor distribution in all the other months, more noticeable, however, in the months of January, July and November. The labor on the oats crop in September is due partly to threshing, which, in the case of the College farm, has been delayed purposely until in this month because of the fact that it is desirable to reserve this labor for students who are not in session until this month. Not considering this condition, the labor of threshing could better be done in August, which, if done, would result in a better distribution of man labor than the figure actually shows. Conflict of labor does occur, however, as the farmer contends; in the months of May and June with cotton cultivation and chopping, and in October, and, to some extent in

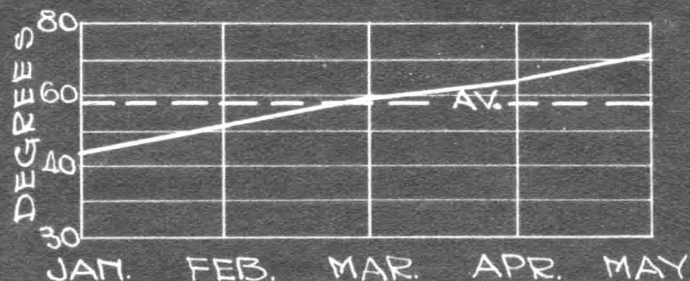
September, with the harvesting of cotton. Although the labor of harvesting oats under farming conditions where improved machinery and power farming is adaptable to a large extent, is not a great obstacle, yet where cotton is the chief money crop, largely cultivated with one-horse implements and requiring considerable hand labor; and more especially where farmers do not own tractors for pulling harvesting machinery, the conflict between oats harvesting and cotton cultivation in May and June, appears to be a disadvantage attendant on oats-growing, if not necessarily an insurmountable one.

Rainfall and Temperature Distribution as Affecting Corn
and Oats Production at Magnolia for the
Six Year Period, 1923-1928

A quite evident advantage in favor of growing oats rather than corn at Magnolia is indicated in Figure 6, a graph showing the monthly distribution of rainfall and temperature for the growing seasons of oats and corn. Although the oats are usually planted in the fall season, (about October 1st), yet only the months of January, February, March, April and May are included in the oats growing season, for, there is never a question of scarcity of rainfall that would hinder this crop during the fall and winter months in this locality. The months of March, April, May, June and



AVERAGE MONTHLY RAINFALL DISTRIBUTION
1923-1928



AVERAGE MONTHLY TEMPERATURE DISTRIBUTION
1923-1928

RAINFALL AND TEMPERATURE DISTRIBUTION
DURING THE GROWING PERIOD OF OATS AND CORN
FIG. 6

July are included in the corn growing season. The curves in Figure 6 are based on the averages for the six year period both for rainfall and temperature distribution.

The average monthly precipitation for the oats growing season is 3.92 inches against an average of 3.7 inches per month for the corn growing season, which is no great variation to be sure. But, as the curves show, the average rainfall rises sharply from February to April, reaching a maximum average of 4.57 inches in April, descending again to a fraction below the average for the whole period in May. It is in the months of April and May, especially the latter, that the drouth hazard for oats would be apt to occur, if at all. During these months, (April and May), the rainfall, for the period covered in this study, has been more plentiful than in any other portion of the oats growing season. A glance at the curve for the corn growing period shows that the monthly average rainfall decreases steadily from April to July, reaching the low average of 2.89 inches for July and 3.4 inches for June. June and July are the drouth-hazard months for corn growing. There is, then, the least rainfall coming at a time in the corn growing season, when it is most needed. Temperature distribution through these two periods is another factor which has considerable bearing upon the supply of moisture for the crops in-so-far as loss

by evaporation may be affected. The mean temperature for the oats-growing season throughout the six year period was 57.7° with a minimum average of 43.9° for January and a maximum average of 70.6° for May, whereas, the corn-growing season had a mean of 70.8° with a minimum average of 57.1° for March, and reaching a maximum average of 81.3° for July. The mean average temperature for the corn growing season is 13.1° higher than that of the oats-growing season.

The most significant fact that appears by study of Figure 6, is the sharply declining precipitation in June and July, coupled with the rising temperature at the same time. The rather frequent summer drouths which are so often destructive to corn crops, especially on the lighter, upland sandy soils, are indicated by these tendencies. Experience in oats growing at Magnolia proves the tendency shown by the precipitation curve for the oats-growing period to be a true one, that is, there is usually ample rainfall in the important months of April and May to insure the oats crop against drouth.

Winter-Killing as a Handicap in the Production of Fall Planted Oats in South Arkansas

The advantages of fall-planted or winter oats over spring oats in the South are so well known that no discussion is necessary. They may be quoted briefly from Farmers'

Bulletin 436 as follows:

"The yields are usually better, the fall-sown oats mature earlier, the land can usually be prepared in better shape in the fall than in the spring, fall seeding interferes less with other work than does spring seeding, poorer land and less fertilizer can be used for the fall-sown crop, and the fall-sown crop furnishes a cover for the soil during the winter and prevents washing-----Winter oats almost invariably yield more than spring oats, owing to their earlier maturity, stronger growth, and greater freedom from diseases. If a part of the stand is lost from winter-killing, the plants which are left stool vigorously, so that the stand at harvest is much better than was apparent in early spring. This earlier maturity often marks the difference between success and failure, as the later maturing grain is more likely to be injured by storms or drouth and by rust and other plant diseases. Oats require comparatively cool weather for their best growth, so that those which mature earliest usually yield best, as the conditions are better suited for their development. The earlier maturity incident to fall seeding also allows the crop to be removed from the land earlier than spring seeding, giving more time for the preparation of the soil, seeding, and growth of the following crop."(21)

Since this treatise deals altogether with fall-planted oats, the hazard of winter-killing is a factor that may influence the acreage planted to oats in the South, more particularly in the upper portion of that section, near the northern borderland where there is more danger of winter-killing. According to Mr. Warburton's sketch map, (22) the eastern portions of Virginia and North Carolina, practically the whole of South Carolina, Florida, Georgia, Alabama,

(21) Warburton, C. W., Winter Oats for the South. Farmers' Bulletin 436--Agronomist in charge of Oat Investigations. Contribution from the Bureau of Plant Industry. Issued April 15, 1911, Revised October, 1917. Page 5.

(22) Ibid. Page 4.

Mississippi, Louisiana, the eastern portion of Texas and the Southeastern portion of Arkansas are comparatively safe from winter-killing for fall-planted oats. The section in which fall-planted oats may be grown in favorable years includes roughly, Northern and western Virginia, western North Carolina, Tennessee, Kentucky, northeastern and central Arkansas, southern Oklahoma and a portion of Texas. Magnolia, Arkansas, lies practically on the boundary line between the two above-mentioned regions. No reliable data have been discovered as to the percentage of winter-killing of oats that has occurred in Arkansas or in Columbia County. Careful record of winter-killing, however, has been kept of oat crops grown on the Agricultural and Mechanical College farm at Magnolia for the ten-year period, 1920-1929 with the following results:

	<u>Per Cent Winter-Killed</u>
Planted fall, 1920	None
Planted fall, 1921	None
Planted fall, 1922	Trace
Planted fall, 1923	None
Planted fall, 1924	5%
Planted fall, 1925	None
Planted fall, 1926	None
Planted fall, 1927	Trace

Planted fall, 1928	12%
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Planted fall, 1929	75%
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During this period, in only one year of the ten years were oats destroyed by winter-killing in a degree to cause abandonment of the crop (1929). The crop suffered a 12% loss by winter-killing in 1928. Winter-killing was negligible throughout the balance of the period. Observation of oats-growing in Columbia County leads to the belief that this record at the Agricultural and Mechanical College farm is better than that for the County as a whole. Growers who have been careful to plant at the right time and pack or roll the land after planting, keep the excess vegetative growth in check by grazing, and fertilizing at the right time have obtained about the same results as have been obtained at the College farm.

Undoubtedly there is some risk of winter-killing incident to fall-planted oats. Since, however, there is little loss even if they are winter-killed, aside from the seed, the risk does not appear to be great enough to be considered a prohibitive disadvantage. The labor in preparation of the seed bed in the fall for oats will not be entirely wasted if the oats should be killed, for the land will be left in excellent condition for the spring planting of either oats or other crops. The best practice in this section does

TABLE VI. COMPARATIVE COST OF PRODUCTION DATA -- CORN AND OATS -- 1923-1925, TWELVE SOUTHERN STATES, ARKANSAS AND AGRICULTURAL AND MECHANICAL COLLEGE, MAGNOLIA, ARKANSAS

	12 Southern States								Arkansas								Agricultural and Mechanical College							
	1923		1924		1925		Average		1923		1924		1925		Average		1923		1924		1925		Average	
	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats	Corn	Oats
Yield per acre Bu.-----	23.33	25.3	22.1	26.3	20.66	23.4	22.21	25	21	25	22	26	22	21	21.66	24	13.33	25	21.3	40.1	22.2	42.6	18.94	35.9
Value per acre \$-----	23.51	17.48	25.94	20.11	20.55	16.73	23.33	18.11	21.21	14.4	23.54	16.64	21.34	12.18	22.03	14.77	13.46	15.5	22.79	25.66	21.53	24.7	19.29	21.95
Value per Bu. \$-----	1.008	.691	1.145	.765	.995	.714	1.049	.723	1.01	.62	1.07	.64	.97	.58	1.01	.61	1.01	.62	1.07	.64	.97	.58	1.01	.61
Net cost per Bu. \$-----	.969	.688	1.016	.676	1.17	.789	1.05	.717	1.06	.67	.93	.56	.95	.78	.98	.67	.969	.613	1.09	.499	.847	.618	.968	.576
Net cost per A. \$-----	21.97	17.21	22.63	17.47	22.68	18.38	22.42	17.68	22.3	16.87	20.43	14.57	20.89	16.3	21.2	14.91	12.92	15.44	23.25	20.01	18.81	26.36	18.32	20.6
Net prof- it per Bu. \$-----	.039	.003	.129	.089	-.175	-.074	.007	.018	-.05	-.05	.14	.12	.02	-.20	.13	-.13	.041	.007	-.02	.141	.123	-.038	.144	.11
Net prof- it per A. \$-----	1.54	.27	3.31	2.64	-2.13	-1.65	2.72	1.26	-1.09	-1.37	3.11	2.07	.45	-4.12	2.47	-3.42	.54	.06	-.46	5.65	2.72	-1.66	2.80	4.05

U. S. D. A. Yearbooks, 1924, 1925 and 1926.

TABLE VII. CORN VS. OATS - COMPARATIVE COST OF PRODUCTION FOR THE SOUTH ATLANTIC AND SOUTH CENTRAL STATES - 1922 AND 1923

	Cost per Acre(\$)				Yield per Acre(Bu)				Value per Bushel(\$)				Value per Acre(\$)				Profit per Acre(\$)			
	Corn		Oats		Corn		Oats		Corn		Oats		Corn		Oats		Corn		Oats	
	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923
South Atlantic States	25.01	25.57	18.82	19.14	30	30	26	26	.90	1.03	.70	.76	27.00	30.90	18.20	18.98	1.99	3.33	-.62	-.16
South Central States	19.38	21.18	15.65	15.84	26	24	24	25	.84	.98	.60	.61	21.84	23.52	14.40	15.25	2.46	1.64	-1.25	-.59
Averages	22.19	23.37	17.23	17.49	28	27	25	25.5	.87	1.005	.65	.685	24.42	27.21	16.30	17.115	2.225	2.485	-.935	-.375
Two Year Averages	22.78		17.36		27.5		25.25		.9375		.6675		25.81		16.70		2.35		-.655	

not call for the application of any commercial fertilizer before January 15 to February 1, so, there is no danger of loss of fertilizer on winter-killed oats for winter-killing usually occurs before these dates, if at all. At this writing, May 25, 1930, the spring oat crop at the Magnolia Agricultural College farm, planted after the fall crop was winter-killed, shows prospect of yielding thirty or more bushels per acre.

The Value of Fall-Planted Oats as a Winter Cover Crop
and for Grazing

In a humid climate, such as prevails in the South, one of the most disastrous agencies at work in the depletion of soil fertility is leaching of nitrates, which occurs at an excessive rate during the wet winter months when the cultivated fields are mostly bare of growing crops. This loss is particularly dangerous because of the insidiousness of its action. The farmer cannot see it taking place. One of the best means of off-setting this loss of nitrates by leaching, is to plant cover crops in the fall which remain on the soil and grow through the winter. This not only checks leaching of fertility elements but checks surface erosion as well.

Twenty-two years tests in the Broadbalk and Geescraft

fields at Rothamstead show that where soils are left permanently in vegetation, they gain by reason of this vegetation, 91.7# of nitrogen per annum per acre according to the Broadbalk tests, and 60# of nitrogen per annum, according to the figures of the Geescroft field.⁽²³⁾

More directly related to the problem here, however, is the following:

"The greatest loss of nitrates is through leaching. Nitrates are very readily soluble in water. During rains those formed in manure heaps or soil may be carried into drainage systems and lost. That this does occur to a considerable extent is shown by analysis of drainage waters.

"Deherain collected drainage waters from cement tanks with results as given in the following table. The tanks had been filled several years before.

<u>Cropping</u>	<u>N. as nitric nitrogen # per a. in Drainage</u>
Fallow, no cultivation	186.7
Rye grass	2.28
Oats	7.37
Maize	21.60
Wheat followed by vetches	12.60
Wheat	28.70
Fallow, hoed	196.56
Fallow, no cultivation	158.00
Fallow, hoed and rolled	183.20

"-----catch crops are of value in preventing loss of nitrogen in this way."⁽²⁴⁾

Firman E. Bear in his "Soils Management" writes as follows:

"Under field conditions there is considerable oppor-

(23) Russell, Edward J., "Soil Conditions and Plant Growth", Fifth Edition, 1927. Table LX. Page 248.

(24) Mosier & Gustafson, "Soil Physics & Management", 1917. Page 322.

tunity for the loss of nitrates in the drainage water. The most reliable data on such losses are to be found in lysimeter tests of which those of Lyon and Bizzell at Cornell are typical. Soil was transferred from the field to the lysimeters with as little disturbance as possible, the several horizons of soil being replaced as they occurred in the field. The data in these tests indicate that the quantity of available nitrogen is quite definitely related to the crop and its influence on nitrification. The losses are reduced to a minimum where a crop is kept growing on the soil."(25)

The dead, brown cotton fields in the South, during the winter months, present a sorry and lifeless picture to the observer, considered only from the aesthetic standpoint. Far more serious, however, is the waste which is going on when the heavy rains come, and where, on account of comparatively high temperatures, nitrification continues, forming soluble nitrates which drain down through the lower strata and are lost. This valuable plant food element is returned to the soil, if at all, by the farmer when he buys it back in commercial form the following spring at a price of about 20 cents a pound. Using the figures cited above as a criterion, it could be conservatively estimated that 75 to 95 per cent of this waste could be avoided by planting fall and winter crops.

At the same time that this nitrate loss is going on in the winter, the Southern farmer is feeding expensive feeds

(25) Bear, Firman E., "Soil Management", Table XLV. 1924. Page 135.

to his livestock. Especially do milk cows fall off in production at a time when dairy products bring the best prices, and are most needed for home use, on account of lack of succulent, green feed. The only really important pasture grasses, (Bermuda grass and Carpet grass), are dormant, and furnish no green feed from October 15 to March 15. Oats as a grazing crop may not be expected to produce a great deal of grazing on the poorer classes of sandy soils, as has been found at Magnolia, unless they are fertilized in the fall. Fertilization is not advisable at this time, for reasons which will be stated further on in the discourse. However, after January 1st, ordinarily, considerable grazing is available on fall planted oats. Experience at the Agricultural and Mechanical College, Magnolia, has shown that if the precautions, not to graze too heavily to avoid damaging the stand, not to allow stock in the fields when the soil is too wet, and to take the stock off the fields by March 1, grazing is of benefit to the crop, in that it causes freer stooling, uniformity of growth and generally results in a better and more even stand.

The use of oats in the South as a winter crop and as a grazing crop constitutes a major reason for increasing the acreage as compared to the acreage grown in corn. Many farmers consider the crop worth much more than its cost when used for these purposes alone.

The Relation of Farm Machinery to Oats Production in the South

A major obstacle standing in the way of greater development of oats-growing in the Southern States is the problem of the adaptability of improved machinery to farming conditions in the South. Whether this obstacle be real or fancied in the minds of the farmer, it is perhaps sufficient to outweigh all the advantages of oats growing that may be enumerated. To handle the oats crop so that it may be grown cheaply and utilized in a satisfactory manner, it is necessary that expensive planting, harvesting and threshing machinery be employed. The obstacles to the use of tractors, seeding machinery, harvesters and threshers arise because of the difficulties encountered in: (a) Topography of the land, (b) unadaptability of negro labor to the use of complex machinery, (c) the initial cost of machinery, and (d) the advent of power farming.

Topography of the Land. By far the larger proportion of the upland coastal plains soils are rough or of rolling topography. Much of it presents very sharp hills and abrupt valleys. Nearly all of it is terraced, or should be terraced, to prevent surface-erosion. On most of the soils, especially those of a sandy nature, it is necessary to have the

terraces thrown up very high above the ground level in order to prevent heavy down-pours of rain sweeping them down. Such terraces make it impossible for a seeder or binder to cross them in the operations of seeding and harvesting, but instead the operator must follow the contour of the terraces. This necessitates much turning and loss of time besides imperfect work, and, in the case of harvesting, waste of grain. In the growing of the oats crop at Agricultural and Mechanical College at Magnolia, this objectionable feature has been overcome, to a large extent, on the more gently sloping fields by making the terraces broad and flat just before planting in the fall, trusting that the growth of the grain itself will help to prevent undue erosion in the case of heavy rains during the winter and spring months. It has been found that the binder will go over such terraces easily, making it possible to take in a whole field in one land. Immediately after harvesting, the terraces are then built up again to the normal height. This method of handling the crop has not resulted in more erosion than occurred with other summer-grown row crops. Experience at Magnolia has shown that these machines will operate satisfactorily on most of the sloping fields in this section so long as there are no sharp rises and sudden dips in the contour, such as is presented by the ordinary terrace as found in the fields. An-

other great disadvantage to the use of cumbersome and expensive machinery occurs in the small size of the fields and their general ill-shape. The small size and ill-shape of fields necessitates much turning with consequent loss of time, thus adding greatly to the cost of production. Much of the land is also stony and stumpy. These conditions make it impossible to use grain drills and harvesters successfully. The only alternative, if a farmer cannot provide himself with a binder and thresher or, get access to them, is in the use of a mower and rake, whereby he may handle the crop much in the same manner as a hay crop is handled. Feeding oats in this form, however, is wasteful, and is not recommended if the crop can be threshed.

Unadaptability of Negro Labor to the Use of Complex Machinery. It cannot be said that the negro cannot be taught to use improved farm machinery successfully, but few farmers would trust the average negro farm laborer with an expensive machine which requires intelligence and initiative to operate. It may be that the Southern farm negro has not been accustomed to using anything but the simplest types of implements, and that with practice, he might learn to use them successfully, but most Southern farmers will agree that there is a certain carelessness and shiftlessness in the negro farm laborer which makes it unlikely that he can ever be

trusted to operate complex machines until they become much more nearly automatic and "fool proof" than improved farm machinery is at present.

Initial Cost of Machinery. Even more discouraging for oats-growing in the South, than the factors of unfavorable topography of land and unadaptability of labor to complex machinery, is the factor of initial cost of machinery. The capitalization and size of the average Arkansas farm will not warrant the purchase of the minimum machinery necessary to handle the oat crop successfully, unless there is opportunity to care for a good portion of the machinery expense in harvesting and threshing crops for his neighbors. According to the Agricultural Census of 1925, the average size of farm in Arkansas, in the county with the highest capitalization per farm in the State, was 139.3 acres per farm, with 91 acres in cultivation, and a capital value of land and buildings per farm of \$6,475.00. The county with the smallest average size farm (Jefferson county) had an average of 36.6 acres per farm with 25.4 acres in cultivation with a capital value of land and buildings of \$2,149 per farm. The lowest average capital value of land and buildings per farm was found in Newton County with an average value of \$1,296.00 per farm, with an average acreage per farm of 102.9 acres of which 25.1 acres was in cultivation. The average size of

the Columbia county farm for 1925 was 74.9 acres with 33.8 acres in cultivation and an average capital value of land and buildings of \$1,854. The machinery equipment necessary to handle the oat crop efficiently, including a tractor, seeding machinery and a binder which will take care of the crop up to the time it is ready to be threshed will cost something like two-thirds of the average capitalization of Columbia County land and buildings per farm, or around \$1250.00. A small thresher will cost an additional \$600 to \$1000. Only the largest and most favorably situated farms of the county could afford any such investment in machinery unless they could make use of it to handle the oats crops of neighboring farms. The farm machinery necessary for the cultivation of the crops on the average cotton farm in hill land counties of Arkansas is largely of the simple, one-horse type and represents a very small percentage of the total investment per farm. Community cooperation in the use of seeding, harvesting and threshing machinery occurs as a logical way out of this difficulty. A tractor-drawn binder may be expected to harvest 100 to 200 acres of oats in a season and a \$1000 thresher could thresh 1000 acres. Unfortunately, the Southern cotton farmer is apparently so habituated to such a deep-rooted individualism in his farming operations that it seems a hopeless task to expect a

great amount of cooperative effort in his productive enterprises. Many farmers in each community would be willing to invest in this necessary machinery if they could be assured that a sufficient acreage of oats would be planted to make their investment pay. Many farmers in Columbia County have expressed themselves as being willing to plant a definite acreage of oats each year if they could be assured that they could have access to harvesting and threshing machinery. But they are not sufficiently interested as yet, to exercise the cooperative effort required to bring about such a condition.

The Advent of Power Farming. Motorized farming, which is already a reality in the corn belt and more particularly in the plains lands of the wheat belt, is an aspect of the agricultural situation which is likely to profoundly influence Cotton Belt farming in the near future. In 1926, the last year of a great surplus of cotton, when the price ranged around 12 cents per pound, the average Arkansas cotton producer suffered a loss of something like 2 or 3 cents per pound. Government estimates show that it costs the average cotton farmer about 14 or 15 cents per pound to grow cotton. In that year (1926) there was a great expansion of cotton acreage in Western Texas and Oklahoma, and by the use of tractors and two and four-row implements in preparation

of land and cultivation together with the use of the cotton sled for harvesting, one farmer was enabled to grow as much as 200 acres of cotton. Even with low yields and poor grades of the staple these western farmers produced their cotton at a cost of 6 to 8 cents per pound. The cotton producers in the strictly Cotton Belt states separate themselves into two classes, based on the type of soils cultivated by each class. There is the delta or river bottom class and the hill farmer. These two classes of cotton producers have for years used essentially the same methods in production, each relying mainly on negro labor, and much of the work of cultivation being done by one-horse implements and by hand. The only advantage that the delta or plantation farmer has had over the hill farmer has been in his more fertile soil. This advantage is off-set somewhat by the advantage of the hill farmer in his cheaper land and also by the fact that the hill farmer generally uses fewer negroes, depending more upon his own labor and that of his family. The advent of power farming in the delta sections rapidly approaches. The delta and bottom lands are level and rows can be straight, the fields are large, and it is possible to prepare the land, plant and cultivate the entire crop with tractors and without any hand labor. The application of power-farming methods to cotton production will

practically cut the cost of production in half. The hill farmers' use of power-drawn machinery, because of the terraces which necessitate crooked and point rows in the fields, is limited to some application of tractor power in the preparation of the seed bed only. He must continue to use one-horse methods and much hand chopping and hoeing. This trend toward the use of tractors in Arkansas farming is shown by a comparison of the tractor statistics of 1920 with those of 1925. The 1921 yearbook reports 1500 tractors on farms in Arkansas in 1920.⁽²⁶⁾ The Agricultural census of 1925 reports 3,520 tractors on farms in Arkansas. The number of tractors on farms more than doubled in this 5 year period. The number of tractors reported on farms in Columbia County (called the best hill-land cotton county in the State), is six. There were at least six tractors on farms in Columbia County in 1920, and there are not more than ten at this time, (1930). The 1930 statistics are not yet available, but they will furnish some interesting comparisons as to the use of tractors in delta and hill counties.

This discussion of the possible use of tractors in cotton production on the level bottom lands signifies a very unenviable position for the hill-land cotton producer unless

(26) Baker, E. O., "Graphic Summary of Agriculture", 1921 U. S. D. A. Yearbook, Page 505.

a way can be found to reduce his cost of production of row crops in proportion to that which is possible for the delta farmer. The only way in sight at present is in the use of more commercial fertilizers, and this method applies also to the delta farmer. It is attended also by considerable risk. Oats, rye, barley and legumes and other hay crops are the only crops which can be handled throughout by the use of motor-drawn machinery on the hill-land farms. Row crops are not adapted to their use in cultivation. If the hill farmers are to make use of motor-drawn machinery in the production of feed crops, oats as compared to corn, stand in a favorable position.

Corn vs. Oats--Insect Pests and Diseases as Factors of Production

Discussing corn production in the Cotton Belt, W. J.

Spillman writes as follows:

"There are also difficulties to overcome in the way of insect pests and fungous diseases of the corn crop which are fostered by the warm climate of the region."(27)

Among the destructive insect pests of corn, of long standing in the Cotton Belt are the corn weevil, cut worms, the corn ear worm and bud worms. The weevil is universally

(27) Spillman, W. J., "Distribution of Types of Farming in the United States", Specialist, Bureau of Agricultural Economics, Farmers' Bul. No. 1289, May, 1923, Page 14.

distributed in the South, reaching great importance in damage to corn in the Gulf Coast region. Its damage has been alleviated somewhat by developing and growing types of corn whose ears are closely and tightly covered by the husks and by the growing of flint varieties in the southernmost portions of the Cotton Belt. However, there is no method of completely controlling this pest. The corn ear worm is also universally distributed in the Cotton Belt, and does its damage by feeding on the outer end of the ear when it is in the roasting ear stage. Its prevalence varies somewhat from year to year and also from section to section. It is more likely to occur in freshly cultivated lands and in fields near timber. It does not materially reduce the yield, but causes some of the kernels at the end of the ear to rot, making it almost impossible for the South to produce shelled corn of No. 1 grade. The cut worm occurs more or less locally, attacking the plants shortly after their emergence from the ground and sometimes damaging or completely destroying the stand. Cut worms are subject to control by clean cultivation of the previous crop, crop rotation and fall and winter plowing, which destroys the insect while it is in hibernation. The bud worm rarely does damage to corn except the late-planted crops and is more or less local in its attacks. There is no control for it, however.

Of more recent appearance as pests of the corn crop are wire worms and cane beetles. These insects are rapidly infesting this section of the State and in a few communities of very sandy soil in Columbia County, the infestations of the wire worm have made it practically impossible to grow corn for the past few years. It has not been reported as being widely distributed in the South. The so-called "wire worm" is the larva of one of the click beetles and does its damage by cutting off the feeder roots of the plant, beginning its attack shortly after the corn emerges and continuing throughout the growing period. Plants attacked may live but rarely produce any grain. It is particularly insidious for the reason that the crop may be well advanced before its damage is detected, usually making it too late for planting other crops. No control has been discovered for this pest other than the general one of rotation of crops, which means, in this case, the elimination of the corn crop until the pest disappears. Since the wire worm is known to thrive on other crops, even on cotton in badly infested spots, it is difficult to be specific as to the possibility of controlling it by any means that would be practical. The cane beetle is an insect pest not known to have attacked corn in this locality before 1925. It was discovered and identified as a corn pest on the Agricultural and Mechanical College farm at

Magnolia simultaneously with other discoveries throughout Columbia County. It was formerly known to attack sugar cane only and is a serious pest of that crop in Louisiana and in other portions of the cotton belt where sugar cane is grown, including a limited cropping in southern Arkansas. It attacks the young plant by burrowing into the stem just under the surface of the ground, sometimes destroying the plant entirely but more often biting about half-way through the stem, resulting in a deformed growth which has no chance to produce grain. In 1928, this pest destroyed practically one-half of a field of corn on the College farm at Magnolia. It may or may not become a serious insect pest of the corn crop, of widespread importance in the Cotton Belt. No serious attempt has been made to control it.

Little experimental work has been done in the South in the investigation of fungous diseases of corn. A stem infection has been observed on the College farm at Magnolia which appears to be almost invariably attended by an ear or ears which are light and chaffy, having chalky-like grains. Recent studies of the appearance of this condition in the Corn Belt states indicate that this is not a diseased condition but that it is due to some deficiency of mineral elements in the soil. This may well be true of the soils of Columbia County. Corn smut is the most wide spread fungous

disease of corn in the Cotton Belt, and it is not excessively difficult to control.

The Parish Agricultural demonstration agent of East Baton Rouge Parish, Louisiana was heard recently to make the statement that "infestations of rust are making it practically impossible to produce satisfactory yields of oats in the lower part of that state." (28) This is perhaps true of most of the Gulf Coast Region. But for most of the Cotton Belt, rust-proof varieties of oats are not seriously affected by rust except in wet and warm spring seasons. In only one year of the seven years trial at Magnolia has rust infection resulted in any apparent reduction of the yield. The only other fungous disease of oats of any importance in the South is loose smut. It can be easily eliminated at a cost of about 1 1/2 cents per bushel, by treating the seed with formaldehyde before planting.

The "green bug" Aphis occasionally attacks the oat crop in the northern portion of Oklahoma and perhaps in Texas, occurring in periods of six or seven years and sometimes totally destroying the crop. In dry years, the chinch bug perhaps damages the crop in these states. Neither of these pests have been reported as doing any damage in the more hu-

(28) Quoting G. C. Smith, Parish Agricultural Demonstration Agent, East Baton Rouge Parish, Baton Rouge, Louisiana.

mid portions of the Cotton Belt. In fact, the oats crop appears to be singularly free from insect pests and fungous diseases of a serious nature in the Cotton Belt. As compared to corn, it occupies an advantageous position in this respect. It is possible of course, that if the crop should become more widely grown, more such pests would appear.

Response of the Oats Crop to Commercial Fertilizers

The most important factor responsible for the high average yield of oats in the seven year trials at Magnolia, (37.47 bushels per acre) is undoubtedly that of large applications of commercial fertilizers. This factor has been responsible, largely, for the greater per acre cost of production than has been found elsewhere. But it has resulted in profit, whereas applications of large quantities of commercial fertilizers to the corn crops in these years has resulted in loss. The facts are borne out quite conclusively in the tests at Magnolia and they point out beyond a question of doubt that, given a sandy upland soil of this locality, poor in natural mineral elements and lacking in organic matter, oats is one of the most responsive crops to commercial fertilizers that can be grown, and with the same treatment as corn on this kind of soil can be expected to more than double the yield of corn. With all the hazards in the pro-

duction of fall oats, including winter-killing, drouth, diseases, etc., experience has shown that, under the conditions which prevail at Magnolia, the oats crop is a far more profitable feed crop than corn. In the year of the highest average yield of oats obtained at Magnolia, 1926, when the average for fifty acres was 52.8 bushels per acre, several acres of wet land was included in this test where, due to drowning the yield dropped down to almost nothing. What was considered the best two acres in this crop was measured off and threshed separately. It yielded 262 1/4 bushels (32# to bushel) or an average for the two acres of 131 1/8 bushels per acre. This is the record yield for the Cotton Belt, so far as has been ascertained. In the year 1925 fertilizer tests at Magnolia showed a yield of 88 bushels per acre with an application of 600 pounds of ^{N--P--K} 5--8--2.33 fertilizer per acre against a yield of 17 bushels per acre with no fertilizer. This resulted in a gain by use of fertilizer of \$32.10 per acre, grain alone considered, at the December 1 market price for Arkansas. In the test of 1926, an application of 500 pounds of commercial fertilizer resulted in a yield of 64 bushels per acre against a yield of 21.6 bushels per acre for the plot which received no fertilizer, resulting in a gain by use of fertilizer of \$15.87 per acre. Using the data in Table I, we find that the net profit due to

using an average of 125 pounds of sulphate of ammonia per acre averaged \$11.49 per acre. Quoting L. A. Markham in the Progressive Farmer we have the following statement:

"At the Alabama station it was found that a profit of from \$4 to \$6 per acre could be expected from the application of 60 to 100 pounds of nitrate of soda per acre, to fall oats when prices are normal." (29)

In the 8th Annual Report of Arkansas crops for the year 1926 by the Arkansas Cooperating Crop Reporting Service the following statement is made regarding oats:

"While the average yield for the State is set at 22 bushels per acre, there was a very heavy yielding section in the rice country with fall-sown oats. The Southern part of Arkansas County in the neighborhood of Gillett had approximately 3500 acres which brought an average threshed yield of 59 1/8 bushels per acre. The highest yield on a 45 acre field ran to 101 1/4 bushels per acre." (30)

Nothing is said of commercial fertilizers in this statement but, with these yields, it may be taken for granted that liberal applications of fertilizers were applied. Remarkably high yields of corn have been obtained in the South also by use of large quantities of commercial fertilizers, but not on soils which were not well supplied with organic matter, and on no such large acreages as have been reported for oats except on the choicest and most fertile and expensive bottom lands, such as would not be at all a-

(29) Markham, L. A., "Making the Oat Crop Pay", The Progressive Farmer, August 19, 1916. Page 1003.

(30) Jeffries, T. Wade, Field Specialist, Bouten, Chas. S., Statistician, Eighth Annual Report of Arkansas Crops-1926.

dapted to oats-growing because the excessive organic matter would cause excessive growth of straw with consequent losses by lodging.

In computing cost of production of corn and oats in United States Department of Agriculture Yearbooks for the years 1923, 1924 and 1925 we find that an average of \$5.45 per acre is charged against the corn crop as land rental whereas a land rental of only \$4.70 per acre is charged against the oats crop in the twelve Southern States, or only 86% as much for oats as for corn. The corresponding averages for these years for Arkansas are a land rental charge for corn of \$5.63 per acre against a rental charge of \$4.07, or only 72% as much for oats as for corn. The question might occur as to why this difference in land rental. Does this bear out the quotations of this study, that oats have not been given an equal chance with corn? In other words, does it mean that these statistics of rental charges were gathered where corn and oats were grown on the same farm, and that in placing capital values on the corn land and oat land, of the same farm, the farmer recognized a difference in the capital values of the land on which the crops were being grown? In answer to these questions a letter from Dr. J. A. Dickey, Rural Economics and Sociology Department, University of Arkansas, is quoted:

"Regarding your question as to why the rent for corn is more than the rent for oats in Arkansas, I would say it is because the land in oats in Arkansas, on the average, has a less value per acre than the land in corn. I arrived at this conclusion by looking at the counties in which there is a large acreage of oats and then observing the land values for corresponding counties. Oats are grown largely in counties with low land values, such as Washington, Benton, Arkansas, Franklin, Madison and Prairie, while the acreage of corn is rather uniform throughout the State. Consequently, with oats being concentrated in the counties of low land values or land values below the average for the state, corn is found in all counties, especially those counties with high land values such as Mississippi County."(31)

Timeliness of the Oats Crop Harvest, Coincident with the Farmers' Need for Feed

Many farmers of the South, particularly those in the marginal class and practically all renters, rarely are supplied with sufficient feed to carry them through the cropping season. Feed they must have, for their work animals at least, although cows and hogs, if any, can be, and generally are, turned out to pick up a living as best they can. Grain and hay for the mules must be bought at high prices, usually on credit at a high rate of interest. Going into debt for feed for work animals makes the industry of raising cotton, for which there is no certainty of price, a precarious business. These marginal farmers' most urgent need of feed for their work animals comes at about the time of the harvest season

(31) Dickey, Dr. J. A., Letter from., Dept. of Rural Economics and Sociology, University of Arkansas, Fayetteville, Arkansas.

for fall planted oats. Bankers of the South base their loans to farmers very largely upon their ability to go through the cropping season without having to buy feed for their livestock. A typical instance of the value of the oats crop in this connection is quoted from a letter on page 28 of this study.

Catch Crops and Oats Production

From the standpoint of soilbuilding on Southern upland soils, the practice of planting catch crops following the harvesting of fall-planted oats, and turning them under as green manure, offers one of the best means. Particularly, is this true where legumes are planted and turned under, for they not only supply organic matter but nitrogen as well, both of which are deficient in most Southern upland soils. Unfortunately little of such crops are ever actually wholly plowed under, but are harvested for feed instead, making a double draft each year on the meagre fertility of the soil.

Since fall-planted oats in the South are usually harvested by June 1, there is ample time, with the long growing season, to produce another crop of almost any of the annual legumes such as cowpeas, soybeans, mung beans, etc., or, Sudan grass, sorghum for hay or, even a crop of corn. Oc-

asionally it has occurred at Magnolia that the best crops of corn produced on the College farm, have followed as a catch crop after oats. Continuous records of the cost of production, yields and returns of catch crops grown after oats on the College farm at Magnolia have not been kept because some of them have been plowed under as green manure and some have been pastured, and in such cases the establishment of a definite return would necessarily be somewhat theoretical. For the years 1923 and 1924, however, all catch crops following oats were sold and a complete record of costs, yields, and returns are on file. These catch crops included Sudan grass, cowpeas and corn. The average profit per acre from these crops, (land rental excluded from cost) was \$7.06 per acre. In 1927 a crop of corn and soybeans (inter-row) was planted after oats. It was sold for its cost and used for grazing with beef cattle, resulting in a gain only in-so-far as the crop residues and croppings from the cattle added fertility to the soil. In 1929, a catch crop of ten acres of corn and cowpeas was grown after oats at a cost of \$5.00 per acre, and sold for \$15.00 per acre, resulting in a profit of \$10.00 per acre. This field made a profit of \$15.00 per acre on the oat crop preceding the catch crop, making a total profit for the year of \$25.00 per acre. In other years, some of the catch crops have not

proved so profitable, owing to late summer and early fall drouths. There were instances of almost total failures, in which cases, the crops were plowed under or pastured. As a whole, however, catch crops have been profitable, furnishing legume and grass hays, green manure and early fall pasture and, not least important perhaps, affording employment for farm labor in their cultivation and harvesting at a time of year when there is usually little farm work to do on the average general cotton farm. The advantages of growing catch crops, which is a part of the rotation system which includes oats, may be summarized as follows: (1) They make it possible to grow two crops per year on the same land, (2) Hay and roughage can be grown which would otherwise have to be bought, (3) They furnish opportunity for building up the fertility of the soil by turning under green manure crops, (4) they furnish fall and early winter pasture and (5) they favor a better balanced distribution of farm-labor.

Corn vs. Oats--Feeding Value for Horses and Mules

Almost innumerable authorities agree in general terms, that oats is superior to corn as a feed for horses and mules, just as most Southern agricultural writers agree that oats could be made a more profitable crop than corn on most of the soils of the Cotton Belt if given a fair chance. Quot-

ing the standard authority on feeds and feeding, Henry and Morrison have the following to say:

"Oats are the safest of all feeds for the horse, due to the hull, which, tho furnishing little nutriment, gives the grain such bulk that not enough can be eaten at one time to cause digestive trouble from gorging. In the stomach, oats form a loose mass, which is easily digested, while such heavy feeds as corn tend to pack, causing colic. This grain, so keenly relished by horses, is the standard with which all other concentrates are compared." (32)

Among the many others who praise oats as an ideal feed for horses are such as the following:

"Oats traditionally constitute the banner horse feed of the world. Their bone and muscle-building ingredients also make this grain most valuable for feeding young stock, as well as feeding breeding stock-----
-----Oats are not directly comparable with corn as a fattening feed on account of their bulkiness and different composition. For breeding stock, oats are superior to corn, as they are relatively richer in protein and mineral matter. Oats contain more crude fiber than any of the other common feed grains. Their greatest usefulness is in feeding horses, for which there is no better feed. Commonly speaking, for horse feeding 2 bushels of oats are equal to one bushel of corn." (33)

In spite of these general statements as to the superiority of oats over corn for feeding horses, it does not appear that it is borne out by statistical evidence. Quoting from Henry and Morrison again we have:

"Fortunately, both practical and scientific trials alike teach that other single grains or mixtures of concentrates may be substituted for oats without injury to the condition,

(32) Henry and Morrison, "Feeds and Feeding", Eighteenth Edition. Page 301.

(33) Ball, C. R., Stanton, T. R., et al, "Oats, Barley, Rye, Rice, Etc." 1922 U.S.D.A. Yearbook, 1922, Pages 472 and 483.

wind, endurance or even the spirit of the horse. The Arab steed, so renowned for mettle and endurance, is fed no oats, but chiefly barley. After experiments covering 35 years, involving the feeding of 16,000 omnibus horses in Paris and some 17,000 French army horses, Lavalard, the great French authority on the nutrition of the horse, concluded that the substitution of other feeds for oats, while effecting a great saving, had not in the slightest lowered the productive power of the horses." (34)

McC Campbell, of Kansas Agricultural Experiment Station furnishes some interesting experimental evidence, somewhat contradictory to the common belief that oats is superior to corn as a feed for growing horses:

"To determine whether good draft colts could be grown without oats McC Campbell fed 2 lots of high grade draft colts at the Kansas station from weaning until they were 2 1/2 years old. The first lot consumed during this time per head, 5,198 pounds of oats, 4,673 pounds alfalfa hay, 528 pounds corn stover, and 576 pounds straw, with rather scant pasture in summer. They gained .96 pounds per head daily on this oats-alfalfa hay ration. The other lot, fed no oats, each consumed 3,639 pounds corn, 1300 pounds bran and 260 pounds linseed meal, with the same amounts of roughage as the first lot. Their gain was slightly greater, being 1.02 pounds per head daily, showing this concentrate mixture to be entirely satisfactory as a substitute for oats. The entire cost for feed and other expenses for the two years, including labor and veterinary services, was \$128.84 per colt for the first lot and \$117.90 for the lot fed no oats. Adding to this the sum of \$50.00, which was estimated as the cost of a colt at weaning time from mares used for farm work, the total cost of a colt at 2 1/2 years was \$178.84 and \$167.90 for the respective lots under pre-war conditions. At the close of the trial the station was offered \$200.00 a head for the colts." (35)

There seems to be general agreement among authorities that (1) Oats are safer for horses than any other grain,

(34) Henry & Morrison, "Feeds and Feeding", Eighteenth Edition. Page 302.

(35) Ibid. Page 327.

(2) oats are the most palatable of all grains for horses,
 (3) where a single grain ration is used for feeding horses, oats are the most satisfactory, but usually more expensive than corn. But, concerning the rather commonly accepted belief that no other grain can be substituted for oats in horse feeding that is equally as satisfactory as oats, Woll concludes as follows:

"Corn is the main substitute for oats as a horse feed; a large number of stations have studied the question of the relative value of the two grains for this purpose. The general results of this work is to the effect that corn is a safe and satisfactory horse feed, and that the best method of feeding is to give a mixture of the two grains. This gives better results than corn alone and, in general, makes a cheaper ration than oats as a sole concentrate. In discussing concentrates for horses, Gay says: 'When its general use in the Corn Belt States is considered, much of the prejudice of the eastern feeders loses weight. The average Iowa horse, for instance, is produced by a dam which was raised on corn, and had no other grain during the period of carrying and suckling her foal. The foal receives a little cracked corn or even cob corn for his first bite, with the amount gradually increased until he is allowed 20 to 40 ears per day at maturity. In spite of this fact, when these very horses come East, top our markets, and pass under the management of the city stable boss, corn is absolutely prohibited as dangerous to feed; yet it requires a long time to induce and teach some of these horses to eat anything else.'"
 (36)

The facts seem to show that about the only basis for a choice between corn and oats as a grain ration for horses and mules is that of cost. Since 1 bushel of corn is equal to about 2 bushels of oats in feeding value, it is correctly

(36) Woll, F. W., "Productive Feeding of Farm Animals,"
 Second revised Edition. Page 287.

assumed that corn is a cheaper feed than oats, when average costs of production of the two crops are considered both in the Corn Belt and in the Cotton Belt. At Magnolia, however, considering grain alone, and not including calculation of the feeding value of oat straw against stover, oats has proved a cheaper feed than corn. According to Henry and Morrison's calculations of the comparative value of the two grains in net energy therms per 100 pounds, (37) the results of the seven years trials at Magnolia are as follows:

	<u>Net Energy Therms</u>	<u>Per Cent</u>
Average per acre--Corn(grain)	85,655,808	73 —
Average per acre--Oats(grain)	116,314,112	100

This represents a gain of 27% in the feeding value of the oats (grain) produced per acre over that of corn (grain) produced per acre.

Comparative Utility of Corn and Oats to Southern Farms-
A Factor Tending to Prohibit Oats Growing

What the farmer actually does is far more important than what he is advised to do by agricultural enthusiasts. It has been shown that most agronomic authorities of the South believe, or have believed that the oats crop has been discriminated against in choice of land, cultural methods and

(37) Henry and Morrison, "Feeds and Feeding", Ch. XVIII, Page 287.

fertilization as compared to the corn crop. It is probably true that neither crop has received the attention in the South, that would result in an approach to the highest possible yields or the greatest profits for either crop. In a discussion of oats J. F. Duggar makes the following statement:

"The low average yield of oats is largely due to the fact that this grain is often sown on land too poor for other profitable use." (38)

In the same text, regarding corn growing he says:

"-----in the sandy and hilly country, corn is generally planted in the narrow bottoms, which constitute the best corn land of these regions." (39)

Evidence that there may have been a change in the practice so far as favoring corn with the advantage of better land as compared to oats, is offered as follows:

"The average yield per acre of corn and oats is not truly representative of the possibilities of production in this state. Since cotton is the main cash crop grown in the greater portion of Arkansas, there is only a limited acreage of corn or oats grown except for home consumption on the premises, and these crops receive secondary consideration in all respects, including the selection of the land on which they are grown, fertilization and cultivation. Corn and oats are crops grown for feed and not for the market in 70 of the 75 counties. There are many instances in which corn is given major consideration, that yields of 75 to 90 bushels are recorded, and oats yields of more than 100 bushels per acre are of record." (40)

(38) Duggar, J. F., Southern Field Crops, Rev. Ed. 1925, Page 10.

(39) Ibid. Page 117.

(40) Page, Earl, Arkansas Crops, 11th Annual Report, For the year 1929. Published April, 1930, Introductory.

What has actually happened in the Southern States, so far as the farmers' practice in growing corn and oats is concerned is well summarized by W. J. Spillman as follows:

"Most Cotton States grow some oats, mainly as a winter crop, but for the last fifty years the average yield of oats in the more humid of these states has been from 13 to 17 bushels per acre. This is only about half the yield obtained in Wisconsin, Minnesota, Illinois and Iowa, where the bulk of the commercial oat crop is grown. The small acreage of oats in this region is, therefore, easily understood. It is so far from a market for oats that the crop is not a possibility as a general source of cash income. As a supply crop -- that is, as a crop for use on the home farm, -- it cannot compete with corn, which produces more feed to the acre." (41)

The most convincing experimental evidence that oats can compete with corn, successfully, in the production of feed to the acre, is that furnished in the seven years trials at Magnolia Agricultural and Mechanical College. One is led to the belief that there are fundamental reasons yet undisclosed in this study, why the farmers have not given oats a more important place in their scheme of farming in the South. These reasons must be sufficient to outweigh all the superior qualities of oats as discussed in the foregoing in making comparisons to corn. In justice to the intelligence of the average farmer, it must be agreed that his farm practice is generally based on his own conclusions as to what is the best for him to do within the range of his possibility and

(41) Spillman, W. J., "Distribution of Types of Farming"-- Consulting Specialist, Bureau of Agricultural Econ. Farmers' Bulletin No. 1289, Page 12.

adaptability. If one turns to the farmer himself to discover his attitude in regard to corn and oats-growing, it is typically shown by a casual interview with Mr. J. F. Nipper, a Columbia County general farmer, of slightly above average success;

1. He agrees that the oats crop has not been given a fair chance so far as his own experience is concerned, and believes that is the general rule among Southern farmers.
2. Estimates his yield of corn by counting wagon loads. Has only a general idea as to yields and costs of production but believes that it costs him as much as the market value of the corn.
3. Plants enough acreage of corn to insure making enough for his needs in case of a decrease in yields due to drouth or other causes because, quoting him, "I've got to have corn."

When one has to have a thing, it means that that commodity possesses a high degree of utility to him. Utility is a quality possessed by corn for the Southern farmer, far superior to oats. Corn, to the Southern farmer is not only bread but meat to him as well, for he depends largely upon his corn as a fattening ration for his hogs. It is also feed for his work animals. Oats, so far as he is concerned,

can be utilized as feed for work animals only. Another great advantage that corn has over oats, to the Southern farmer is in the fact that corn after maturity, may be left in the field until it suits his pleasure to harvest it, not interfering with the harvesting of the cotton crop which, being the main cash crop, is all-important and must receive first attention. He has no machinery for crushing or grinding oats so that they may be used as feed for dairy cows or hogs.

As a last consideration, yet an important one, the Southern farmer has been long habituated to considering corn as an essential part of his crop rotation. His habits do not change quickly. He is slower to perceive advantages of change perhaps, than the Northern or Western farmer. The corn crop can be cultivated in his small fields with simple and inexpensive farm machinery and he looks with suspicion upon innovations which might complicate the comparatively simple manner of farm operations to which he has been long accustomed.

SUMMARY AND CONCLUSIONS

1. There has been a steady decline in the acreage of corn grown in the southern states since 1920, based on the percentage of the total corn acreage grown in the United States.

2. Many southern agricultural authorities believe or, have believed that oats have not been given a fair chance in the South as compared to corn.
3. Corn has had a higher value per acre than oats in the United States as a whole, in the twelve southern states and in Arkansas for the thirty-six year period, 1893-1928.
4. The data at hand indicate that the cost per acre of producing corn is higher, on the average, in all parts of the United States than is the cost per acre of producing oats.
5. The difference between the value per acre of corn and of oats is greater, taking the United States as a whole than it is in the twelve southern states or, in Arkansas.
6. There has been a slightly greater increase in the acreage of oats grown in the United States as a whole over the last thirty-six year period as compared to the increase in the acreage of corn.
7. Fluctuations in the oats-corn acreage ratio in the twelve southern states during the period, 1895-1929 indicate that southern farmers do not regard oats as a crop of permanent importance in the South.
8. Where corn and oats have been compared as to profit-producing ability, under experiment station conditions in

southern states, the profits from oats have been superior to those from corn, but the data are insufficient to warrant a conclusion.

9. The data obtained in comparing the profit-producing ability of corn and oats at the Agricultural and Mechanical College, Magnolia, Arkansas for the seven year period, 1923-1929 indicate that oats is a more profitable crop than corn under the conditions which prevailed during that period at that place.
10. In the use of commercial fertilizers on corn and oats, the point of diminishing returns is reached more quickly with corn than with oats under the conditions of the Agricultural and Mechanical College farm at Magnolia, Arkansas for the period 1923-1929.
11. Increasing the cost of production per acre for oats above the average for the twelve southern states and for Arkansas by heavier applications of commercial fertilizers than is commonly used, has resulted in increasing the profit per acre and in reducing the cost per bushel on the Agricultural and Mechanical College farm at Magnolia, Arkansas during the seven year period of the trials.
12. The growing of oats in rotation with cotton involves a conflict in man labor during the months of May and June

and in September and October.

13. The drouth hazard is much greater for corn than for oats during those portions of their respective growing periods when the requirements for moisture is greatest, as revealed by the climatological record of rainfall and temperatures for the six year period, 1923-1928.
14. Winter-killing is not a serious handicap in the production of fall-planted oats at the latitude and altitude of Magnolia, Arkansas if the proper practices are observed.
15. Lack of adequate farm machinery and unadaptability of farm organization and farm labor to its use is a handicap to oats production in the South.
16. Oats have had a distinct advantage over corn in freedom from insect pests and fungous diseases during the period of the trials involved in this study.
17. The slight advantage that oats may have over corn as a feed for mules and horses would not warrant a change in the present practice of southern farmers so far as acreage devoted to the two crops is concerned.
18. From the standpoint of feed value for mules and horses alone, the oats crops grown at Magnolia during the seven year period 1923-1929 were more than 25% more valuable than the corn crops, considering grain alone.

19. The poorer the soil, especially in organic matter, the greater will be the advantage of oats over corn in yielding and profit-producing ability on the upland Coastal Plains soils of Arkansas, at or below the latitude and altitude of Magnolia, Arkansas.
20. The conclusions as to the comparative profit-producing ability of corn and oats on the upland Coastal Plains soils of Arkansas would have been more dependable and accurate if the study had extended over a longer period of time and, if it had been approached from the research standpoint in its beginning.

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