ECONOMIC CONSIDERATIONS INVOLVED IN THE USE OF SUMMER FALLOW IN MILO ROTATIONS IN WESTERN KANSAS

by

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B. S., Kansas State College
of Agriculture and Applied Science, 1951

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Economics and Sociology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1956

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THE PROBLEM

In milo production, the alternatives of continuously cropping the land versus rotation with summer fallow present an economic problem. This problem is of particular significance to farmers producing milo in approximately the Western half of Kansas. Summer fallowing is not generally recommended in the Eastern half of the State.[1] Farmers in Western Kansas must decide what portion of their milo acreage should be fallowed.

Fallowing increases the accumulation of soil moisture and helps control weeds. If weeds are not closely controlled through the time period that the land is being fallowed, the possibility of increasing soil moisture is largely lost. The additional soil moisture which is available as a result of proper fallowing will benefit the crop grown on the land the following season. In Western Kansas, lack of available soil moisture at the time it is needed is well known to be the major limiting factor in all grain production. A good stand of sorghums will remove more moisture from the soil during the growing period than is supplied by a normal rainfall during that period.[2] In this area, where inadequate precipitation presents a problem, fallowing increases yields.

Both the level and variability of returns were studied.

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[1] R. I. Throckmorton and H. E. Myers, Summer Fallow in Kansas, Kansas State College Agricultural Experiment Station Bul. 293 (Manhattan, 1941), p. 23.

[2] *Ibid*., p. 18.

The variables affecting the level of returns were believed to be costs, milo prices, and milo yields. The influence of each variable was examined.

This study is restricted to a consideration of a best method over time. It covers only statics, in contrast to a study of flexible farming, where the practices might be changed from year to year in response to the present and anticipated soil moisture and price situations at seeding time. That would be a study in itself, but would have to be preceded by the information reported in a study similar to this.

The results of this study apply particularly to Finney, Thomas, and Ellis counties where yield data were available from controlled experiments. This study was centered around a consideration of the milo after fallow and continuous milo alternatives. This study represents the results obtained from a consideration of a practical problem of milo producers of the area. The yield data available from controlled experiments were used in the model described below, with the aid of the budget method. Thus, economic tools were applied to the problem to obtain a solution of the optimum system for each area.

THE ASSUMPTIONS

Several assumptions are necessary. It was assumed that farmers in this area were making a choice between growing milo after milo continuously or growing milo in alternate years interspaced with fallow. Wheat and forage sorghums are the only other crops of importance in the counties studied. A rotation of wheat and milo or of wheat and milo interspaced with fallow presents special technical problems. Fallow interspaced between forage sorghum and forage sorghum would probably show about the same result as fallow interspaced between milo and milo. However, this study was narrowed to the rotation of fallow interspaced between milo and milo.

A second assumption was that milo was used for grain production only. Milo forage is sometimes utilized as pasture by cattle or sheep after the grain crop has been harvested, or in the event of a grain crop failure. In seasons when wheat pasture is plentifully available, little use will be made of milo forage for pasture purposes. There was a lack of information on the carrying capacity of milo stover for the two cases, milo after milo in comparison with milo after fallow. Therefore, the value of milo pasture was not included in the comparisons.

The problem of erosion, both by water and wind, was assumed to be equal for both milo after fallow and continuous milo. There is a possibility that the use of fallow may increase erosion, particularly by wind, because of the fact that the land has no growing crop on it for an extended length of time. If additional wind erosion as a result of including fallow in the rotation is a problem, it will probably tend to be most severe during the winter and early spring following the fallow season. The problem of erosion was not investigated in this study. However, the problem of wind erosion should not normally become particularly severe if recommended soil management practices are followed.

Land was considered a fixed cost and labor, seed, and machinery costs were considered variable costs. It was assumed that continuous milo and milo after fallow have the same effect on soil fertility. Throckmorton and Myers tend to validate this assumption in the statement, "It has been contended by some that fallowing is more destructive of soil fertility than is continuous wheat, but experimental results do not substantiate this contention."[1]

The technology assumed was that which was determined to be most nearly typical, and consistent with recommended soil management practices, of the technologies employed in each of the three counties in 1954. Costs were adjusted for the time period covered by the study through the use of indexes. The indexes were used to adjust 1947 costs to give costs for other years. This use of indexes implies that technology was constant throughout the period of study. There was a change during this period. However, a change in technology during the period would affect the results of this study only if the changes in technology affected the costs and yields of the two rotations differently. There is nothing to indicate that technological changes would affect the results of the two rotations in a different manner.

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[1] R. I. Throckmorton and H. E. Myers, op. cit., p. 30.

THE ANALYSIS

The Model

To analyze the problem of which method of producing milo was superior, it was necessary to set up a relationship that would reflect quantitatively the influence of each of the relevant variables, costs, milo prices, and yields. The relationship that was chosen was the equality, cost-difference between the methods = the value of the yield-difference. It was assumed that farmers attempt to maximize the returns to their fixed investment.

This relationship was derived as follows: for a firm, total costs are defined as being equal to total receipts. Further, it could be argued that within the firm, total costs = total receipts among the various methods of producing a given product; this relationship is necessary for a producer to be indifferent among alternative methods. For continuous milo, the relation is given by equation (1) and for milo after fallow the relation is given by equation (2).

(1) total variable costs for continuous milo + total fixed costs for continuous milo = total receipts from continuous milo

(2) total variable costs for milo after fallow + total fixed costs for milo after fallow = total receipts from milo after fallow

(3) total variable costs for continuous milo (1) minus total variable costs for milo after fallow (2) = total

receipts from continuous milo (1) minus total receipts from milo after fallow (2)

The fixed costs of production, which include a return to land, to management, and for "risk" bearing, are equal for the two methods of production. Therefore, subtracting (2) from (1) gives the total variable costs of producing continuous milo minus the total variable cost of producing milo after fallow = the difference in receipts between the methods. When the difference in cost is equal to the difference in returns, a producer will be indifferent between the two methods; if the difference in cost is greater (less) than the difference in returns, the choice is fallow (continuous milo).

The acreage under a continuous milo system is double the acreage under a fallow system. Therefore, the cost of producing continuous milo is double the variable cost of producing one crop plus the cost of using a given quantity of land and management two years. The cost of producing fallow is the sum of the variable cost of production plus the cost of using a given quantity of land and management two years. The land area is equal, the cost of using it is likewise equal, and these costs cancel, as stated above. It is assumed that a quantity of management sufficient to produce milo by either method is available. The difference in cost, then, is the difference in variable costs of producing an acre of milo two times by continuous milo methods minus the cost of producing an acre of milo after fallow. This difference will be called the cost-difference.

The yields from continuous milo are also doubled because two years of crops can be grown on a given land area by this method while one crop is being grown after fallow. The difference between the total yields from two crops of continuous milo and from milo after fallow gives what is called the yield-difference. The product of the yield-difference and the price of milo gives the value of the yield-difference.

This relationship may be stated symbolically $2C_c - C_f = p_m (2Y_c - Y_f)$. C_c represents the cost of producing an acre of milo under a continuous milo method of production. C_f represents the cost of producing an acre of milo after fallow, including the cost of fallow. The price of milo is represented by p_m. Y_c represents the yield of continuous milo and Y_f the yield of milo after fallow. Cost-difference refers to the cost of two years of continuous milo ($2C_c$) minus the cost of one year of milo plus the cost of fallowing (C_f). The cost-difference then is that portion of the equation given as $2C_c - C_f$. In producing $2M_c$ (M_c = one crop of continuous milo) that sequence of operations used in production of milo after milo will be performed two times. In producing M_f (milo after fallow) a different sequence of operations will be performed, and the operations will be directed both toward fallowing, which involves tillage operations to keep the land free of weeds, and directly toward the production of milo.

Yield-difference refers to the difference in total yield per acre between two years of continuous milo ($2Y_c$) and one year of milo after fallow (Y_f). The yield-difference then is that portion of the equation given as $2Y_c-Y_f$.

Once any two of the variables are known, the value for the third that would leave a producer indifferent to the alternatives can be determined. If the values of all three variables are known, it will be possible to tell whether fallow is superior to continuous milo, continuous milo is superior to fallow, or fallow and continuous milo return equal profits.

It is known that the sign of p_m is always positive in the real world. It is shown subsequently that the cost-difference is nearly always positive. The only instances in which the cost-difference is not positive are in the cases in which the milo after fallow crop for a given year in a given county was considered to have been harvested and the continuous milo crop for the same year and same county was not considered to have been harvested because of an extremely low or no yield. The result in this situation, so far as cost-differences are concerned, is a negative cost-difference. The number of instances in which this situation occurred is quite low; it was eight for the entire study of the three counties. The handling of cases in which the crop was considered to have been abandoned will be discussed in detail later, and the cost figures are presented in Table 7 in the Appendix.

In the remainder of the cases where the cost-difference is positive, the yield-difference must also be positive, if there is to be a problem regarding selection of alternatives. Other things being equal, the higher the price or the greater the yield-difference, the more favorable continuous milo will be relative to milo after fallow as a method of production. The greater the cost-difference, the more favorable milo after fallow will be relative to continuous milo.

The Application

The model which has been developed is applied to the problem in each of the three counties. With the three variables, price of milo, cost-difference, and yield-difference, all combinations of actual and average values for these three variables result in eight possible combinations. Three of these combinations were selected for further study in each county, and a discussion of each of the three is presented for each county. The model used is applicable to any combination of the three variables, price of milo, cost-difference, and yield-difference which is found to exist at any particular time or place.

Finney County, 1921-1948. The problem in Finney County, as in the other two counties, was confined to a study between the continuous milo and milo after fallow alternatives. The average yields, as determined from the experimental plots, were 25.10 bushels per acre from milo grown after fallow and 15.35 bushels per acre from milo grown in continuous rotation.[1] There is considerable variation in the yield figures which these averages represent. The yields at Garden City for continuous milo varied from 0.0, which occurred nine times, to 59.8 bushels per acre in the span of the twenty-eight years studied. The milo

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[1] A discussion of the plots is presented in the Appendix.

after fallow yields likewise varied from 0.0 occurring eight times, to 66.4 bushels per acre. These variations are discussed in further detail at a later point. The yield-differences, by years, are presented in Table 8 in the Appendix.

The substitution of the assumed inputs into the model gives: 2(sum of the cost of one waying twice, field cultivating once, drilling, rotary hoeing, seed, combining and hauling continuous milo) minus (sum of the cost of one waying twice, field cultivating twice, rod weeding twice, chiseling twice, drilling, rotary hoeing, seed, combining and hauling milo after fallow) equals $p_m(2Y_c-Y_f)$. The costs for $2C_c$ and C_f partially cancel, and the cost-difference depends upon the remaining costs given in the simplified equation, (sum of the cost of one waying twice, drilling rotary hoeing, seed, combining and hauling two crops of continuous milo) minus the (sum of the cost of chiseling twice, rod weeding twice, combining and hauling one crop of milo after fallow) equals $p_m(2Y_c-Y_f)$.

Price of Milo, Actual; Cost-difference, Actual; Yield-difference, Actual. Using the assumption of actual values of each year for each of the variables, the procedure was to insert the values of the variables into the model for each year. This makes it possible to determine which of the two systems was the most profitable in each year.

Under the conditions assumed, milo after fallow would have been more profitable in 19 of the 28 years. The nine years when continuous milo would have been more profitable occur in the early and late years of the period, with none in the middle of the time span. Three years when continuous milo would have been more profitable are in the early part of the period, and six are in the late part. These years were: 1923, 1924, 1928, 1940, 1941, 1943, 1944, 1945, and 1947.

However, the fact that milo after fallow would have been more profitable in 19 of the 28 years, under the conditions assumed, does not give a complete - or accurate - picture of what the returns to land and management were for the 28 years. In the nine years in which continuous milo would have been more profitable, the returns to continuous milo were far superior to the returns to milo after fallow. Also, 8 of the 19 years in which milo after fallow would have been a better alternative were years in which there was no yield from either continuous milo or milo after fallow. In these eight years, milo after fallow was better only in that the production costs were lower, resulting in a smaller loss to milo after fallow cropping in each of these eight years. The result is that the total returns to land and management for the entire period were appreciably higher with the continuous milo system of cropping.

The average annual returns, per farm, for the entire period were $865.74 for continuous milo and $612.95 for milo after fallow. The average returns per acre per year were $8.66 for continuous milo and $6.13 for milo after fallow. Returns by year and method are presented in Table 10 in the Appendix. Data on prices of milo, yields, and costs are also presented in Tables 6, 8, and 7, respectively, in the Appendix.

Price of Milo, Actual; Cost-difference, Actual; Yield-difference, Average (5.60 bu.). Under these assumptions the model becomes $2C_c - C_f = 5.60\ p_m$. This model enables the determination of the price of milo which would be needed to equate returns to land and management when the cost-difference is known. Or, for any given price of milo, the cost-difference necessary to equate returns can be determined. If both the cost-difference and price are known, the superior system of production can be determined. Using the assumption of average yield-difference (5.60 bushels), continuous milo would be the better choice in any year when the value of the yield-difference (5.60 x price of milo) is greater than the cost-difference of that year.

Under these assumptions, continuous milo would have been superior in every year except one, which was 1932. This was a year in which the price of milo was very low. The average yield-difference, 5.60 bushels, was so great that the value of the yield-difference is greater than the cost-difference, except when the price of milo is extremely low.

The following is an explanation of the computation of cost-differences when average yield-differences are assumed. The average yields of both continuous milo and milo after fallow are sufficiently large that, assuming average yields, the crop would always be harvested. Since the average yield-difference is derived from the continuous milo and milo after fallow yield averages, the cost-difference in any year must be based upon the cost-difference of the two systems, including the full cost of harvesting for each. Under these conditions, the cost-difference is always a positive figure. This applies to all three counties, Finney, Thomas, and Ellis, in any situation where the average yield-difference is used in the analysis. The total costs, including the full cost of harvesting, are shown in Table 7 in the Appendix for all cases in which the crop was assumed not to be harvested and an adjusted harvesting cost was used in determining total costs for the year.

Price of Milo, Average ($0.70); Cost-difference, Average ($1.44); Yield-difference, Actual. Under these assumptions, the model $2C_c - C_f = p_m(2Y_c - Y_f)$ simplifies to $2Y_c - Y_f = 2.16$. This means that under conditions in which the yield-difference is 2.16 bushels per acre, the returns from either of the two alternatives would be equal, given these cost-difference and price relationships. In any year in which the yield-difference is greater than 2.16 bushels, continuous milo would be the better choice. There were 10 years of the 28 when the yield-difference was greater than 2.16 bushels. These years were: 1923, 1924, 1928, 1931, 1940, 1941, 1943, 1944, 1945, and 1947. These are the same years in which continuous milo was superior, assuming actual values for the variables, except for 1931.

Summary. Under the assumptions tested above, milo after fallow was superior in a greater number of years in two of the three tests applied. In the other test applied, continuous milo was superior in every year throughout the period, except one. The returns, for the entire period, were considerably greater for continuous milo than for milo after fallow in Finney County. As continuous milo was superior in only 9 of the 28 years, assuming actual values for the variables, there is an indication that there is less variability in yields from milo after fallow. The average yield-difference is 5.60 bushels per acre greater for continuous milo. The higher returns to land and management from continuous milo indicate that continuous milo would be the recommended production method in Finney County.

<u>Thomas County, 1914-1950</u>. The problem is in selecting between continuous milo and milo after fallow as a superior method of production in Thomas County. The average yields obtained from the experimental plots studied were 25.54 bushels per acre from milo after fallow and 11.54 bushels per acre from continuous milo. Here again, there is a wide variation in the yields obtained, both from milo after fallow and continuous milo. The Colby yields for milo after fallow ranged from 0.0, which occurred seven times, to 66.6 bushels per acre. The yields for continuous milo also ranged from 0.0, which occurred eight times, to 45.0 bushels per acre.

The substitution of the assumed inputs into the model gives: 2(sum of the cost of one waying once, field cultivating once, rod weeding once, drilling, rotary hoeing, seed, combining and hauling continuous milo) minus the (sum of the cost of one waying twice, field cultivating twice, rod weeding once, chiseling twice, spring toothing once, drilling, rotary hoeing, seed, combining and hauling milo after fallow) equals $p_m(2Y_c-Y_f)$. These costs partially cancel, and the cost portion of the equation is simplified. The equation becomes (sum of the cost of rod weeding once, drilling, rotary hoeing, seed, combining and hauling two crops of continuous milo) minus the (sum of the cost of chiseling twice, spring toothing once, combining and hauling one crop of milo after fallow) equals $p_m(2Y_c-Y_f)$.

Price of Milo, Actual; Cost-difference, Actual; Yield-difference, Actual. The conditions for comparison, as set out here, assume the use of actual values of each year for each of the three variables. The procedure used was to insert the values of the variables into the model for each year, 1914-1950. In this manner, it is possible to determine which system was the most profitable in each year.

Under these conditions, milo after fallow would have been more profitable in 28 of the 37 years. The nine years when continuous milo would have been more profitable are scattered fairly evenly throughout the period. However, there is only one year in the 1920's when continuous milo would have been more profitable, and five of the nine occur after 1937. The years when continuous milo would have been more profitable were: 1915, 1919, 1928, 1931, 1938, 1939, 1941, 1944, and 1945.

The average annual returns to land and management under each system are consistent with the smaller number of years when continuous milo would have been superior. The average annual returns per acre were $4.96 for continuous milo and $6.64 for milo after fallow.

Price of Milo, Actual; Cost-difference, Actual; Yield-difference, Average (-2.45 bu.). Using these assumptions the model takes this form: $2C_c-C_f= -2.45\ p_m$ when the values of the variables are inserted. The cost-difference is positive in every case, assuming that the milo was harvested in every case and full costs of harvesting are thus incurred. The price of milo is never negative. Therefore, the value of the average yield-difference is negative for each year in Thomas County. Continuous milo would be superior only if the value of the average yield-difference should be larger than the cost-difference. As the cost-difference has a positive value in each year, and the value of the yield-difference is negative each year, the value of the average yield-difference is never the larger value. Therefore, under these assumptions, milo after fallow would be the superior alternative in every year in Thomas County.

Price of Milo, Average (\$0.78); Cost-difference, Average (\$1.10); Yield-difference, Actual. Using these assumptions, the equation becomes $2Y_c - Y_f = 1.41$ after the average values for the two variables have been inserted into the model. This means that the returns from the two alternatives would be equal when the yield-difference is 1.41 bushels per acre, with these cost-difference and price relationships. There were nine years in Thomas County in which the yield-difference was more than 1.41 bushels per acre, and continuous milo would be the better choice in those years. In the remaining 28 years milo after fallow would have been superior. The nine years when continuous milo would have been more profitable are the same years in which continuous milo was found to have been more profitable under the assumption of actual values for each of the three variables.

Summary. Under all the assumptions tested, milo after fallow was the superior method of producing milo in Thomas County. Using actual values for the three variables, there were 9 of 37 years when continuous milo would have been more profitable. A "complementary" situation appears to exist here. Milo after fallow results in a higher average yield (and higher product value), and it is also a lower cost method of production. The results indicate that milo after fallow would be the recommended production method in Thomas County.

Ellis County, 1914-1954. The problem is the same in Ellis County as in the other two counties studied - the problem of determining whether continuous milo or milo after fallow would have made better returns for the years in which experimental data were available. The average yields from the experimental plots were 16.78 bushels per acre from continuous milo and 31.75 bushels per acre from milo after fallow. In Ellis County, as in the other counties, there was a wide range in the yields obtained under both systems of production. The yields for continuous milo varied from 0.0, which was the case ten years, to as high as 69.7 bushels per acre. The yields for milo after fallow varied from 0.0, occurring six times, to as high as 99.1 bushels per acre.

The substitution of the assumed inputs into the model gives: 2(sum of the cost of one waying once, field cultivating once, spring toothing once, drilling, rotary hoeing, seed, combining and hauling continuous milo) minus the (sum of the cost of one waying twice, field cultivating three times, spring toothing twice, chiseling once, drilling, rotary hoeing, seed, combining and hauling milo after fallow) equals $p_m(2Y_c-Y_f)$. These costs largely cancel, resulting in the simplified equation (sum of the cost of drilling, rotary hoeing, seed, combining and hauling two crops of continuous milo) minus the (sum of the cost of chiseling once, field cultivating once, combining and hauling the one crop of milo after fallow) equals $p_m(2Y_c-Y_f)$.

Price of Milo, Actual; Cost-difference, Actual; Yield-difference, Actual. As in the other two counties, actual values were assumed for each of the three variables. These values were inserted into the model for each year, thus making it possible to determine which of the two methods of production was the most profitable in each year.

Under these conditions, continuous milo would have been more profitable in 21 of the 41 years. Or, to state the proposition conversely, milo after fallow would have been more profitable in 20 of the 41 years. The years when continuous milo would have been more profitable are scattered quite evenly throughout the time period, except that only two of them occurred in the 1930's. These years were: 1914, 1915, 1918, 1919, 1920, 1921, 1924, 1925, 1927, 1928, 1933, 1938, 1941, 1942, 1944, 1948, 1949, 1950, 1951, 1953, and 1954. Here again, several of the years in which milo after fallow was better were years in which neither system produced any yield, and milo after fallow was better only in the sense that losses for each of these years were less.

The average annual returns to land and management were about equal for the two systems, continuous milo showing very slightly better returns for the entire period. The average annual returns per acre were $9.73 for continuous milo and $9.36 from milo after fallow.

Price of Milo, Actual; Cost-difference, Actual; Yield-difference, Average (1.81 bu.). Using these assumptions, the average yield difference is inserted into the model, resulting in this equation: $2C_c - C_f = 1.81p_m$. The cost-difference is positive in every year, assuming that the milo was harvested in every year under both of the two systems of production. Under this set of assumptions, continuous milo was superior in those years when the average yield-difference times the price of milo (value of the average yield-difference) was greater than the cost-difference in the same year. There were 21 years of the 41 when the value of the average yield-difference was greater than the cost-difference, and three years when the two quantities were equal. The years when continuous milo was superior under these assumptions were: 1914, 1916, 1917, 1918, 1919, 1922, 1923, 1924, 1925, 1926, 1929, 1934, 1935, 1936, 1943, 1944, 1945, 1946, 1947, 1952, and 1954. The three years in which the two methods of production would have yielded equal returns were 1915, 1930, and 1939.

Price of Milo, Average ($0.86); Cost-difference, Average ($1.16); Yield-difference, Actual. Under this set of assumptions, the model is $2Y_c - Y_f = 1.35$ after inserting the average values of the two variables into the original model. The returns from the two alternative systems of production would be equal in any year in which the yield-difference is 1.35 bushels per acre. Continuous milo would be the superior choice in those years when the yield-difference is greater than 1.35 bushels per acre. In Ellis County there were 21, of the 41 years studied, when continuous milo was the superior choice of alternatives. These years are the same 21 years in which continuous milo was superior under the assumption of actual values for each of the three variables.

Summary. Under each of the sets of assumptions tested in Ellis County, continuous milo was the more profitable production method in 21 of the 41 years studied. These figures would tend to indicate that the two production alternatives could be expected to be about equally profitable over a relatively long period of years under Ellis County conditions. The average yield-difference (1.81 bu.) would tend to make continuous milo more profitable, but the effect of an average yield-difference favoring continuous milo is largely counter-balanced by the fact that milo after fallow is a lower cost method of production. The results obtained do not indicate that one production method could be recommended over the other as a long-time practice. Under given cost, price, and yield conditions, either milo after fallow or continuous milo could be more profitable in any particular year.

Variability of Yields and Income

The entire analysis so far has been concerned with the three variables, yields, prices received for milo, and costs of production, and how they affect profits (returns to land and management), using the two alternative systems of production. A farm operator who has the problem of making a choice between the two systems would probably be concerned to some degree about the variability of yields and income when making a decision between the two systems. Two alternatives presenting equal total income opportunities over a given time can not be considered to be equally desirable if the income opportunities from one are of considerably greater variability than the income opportunities of the other. The standard deviation[1] is the measure of variability which was used.

Finney County. The standard deviations obtained in Finney County were 35.109 bushels for yields and 1784.91 dollars for returns to land and management under the continuous milo system. The corresponding figures for the milo after fallow system were 21.168 bushels for yields and 1005.70 dollars for returns to land and management. This is an indication that much less variability exists from year to year in both yields and returns under the milo after fallow method of production. The years, or periods, of extremely high (and low) yields and returns tend to be "levelled out" with the use of the milo after fallow method of production. This is an item of some importance

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[1]The standard deviation $= \sqrt{\dfrac{\text{sum of squares} - \dfrac{(\text{sum})^2}{N}}{N-1}}$

to any farmer who is faced with the problem of making a choice between the two production alternatives. The differences in variability between the two systems would carry much weight with some farm operators, and with others this would be a matter of less importance in making their decisions. The standard deviations for the three counties are shown in Table 11 in the Appendix.

The level of income was greater for continuous milo in Finney County. The variability of both yields and income is less under the milo after fallow system. However, the level of income from continuous milo is sufficiently greater than from milo after fallow that few, if any, farmers would be willing to forego the larger income possibilities of continuous milo in order to enjoy the benefit of having less yield and income variability by growing milo after fallow. It is very likely that continuous milo would be selected by most farmers.

Thomas County. In Thomas County the standard deviation figures for yields were 22.642 bushels for continuous milo and 18.651 bushels for milo after fallow. Similarly, the standard deviations obtained for returns to land and management were 253.05 dollars for continuous milo and 234.51 dollars for milo after fallow.

These figures indicate that both yield and return (income) variabilities were lower in Thomas County when milo was grown after fallow. These standard deviations can be interpreted as meaning that there was less variation of both yields and returns over the period of time (37 years) studied if milo after fallow were the alternative chosen. It was pointed out above that the returns to land and management from milo after fallow were higher in Thomas County than from continuous milo. A farmer very probably would select milo after fallow as a superior method.

Ellis County. The yield standard deviations were 35.315 bushels for continuous milo and 24.966 bushels for milo after fallow. The standard deviations for returns to land and management were 292.43 dollars for continuous milo and 200.65 dollars for milo after fallow. These figures indicate, as was the case in the other two counties, that less variability of both yields and income is experienced in the case of milo after fallow as compared to continuous milo.

The returns to land and management (income) were found to be almost equal under either of the two systems of production in Ellis County, the returns from continuous milo being very slightly higher for the entire period. It is doubtful that the returns from continuous milo are sufficiently higher to offset, for most individuals, the greater variability of yields and returns experienced from raising continuous milo. Milo after fallow would be the more probable choice for most farmers. However, some farmers, attaching little importance to the greater variability of continuous milo, could be expected to make the continuous milo choice in the expectation of realizing higher returns over a period of years.

Cumulative Returns

A study of cumulative returns was made because of the large variations in returns experienced through the years which were studied in each county. In addition, conditions of low or high returns show a tendency to exist over a period of several successive years. This is particularly true of very low positive and of negative returns. The returns to land and management were cumulated from each method for each of the three counties studied. The cumulated returns from each method are shown for Finney, Thomas, and Ellis Counties in Table 12 in the Appendix.

Finney County, 1921-1948. The cumulated returns were greater for continuous milo than for milo after fallow throughout the period of time studied, 1921-1948, except for the initial two years. The cumulated returns were greater for milo after fallow in 1921 and 1922, Table 12 (in the Appendix). However, there was a period of eleven successive years, 1929-1939, when the net addition (or subtraction) to cumulative returns was more favorable from milo after fallow each year than from continuous milo. The net addition to cumulative returns for the years 1929-1939 was $-1808.80 from continuous milo and $-293.45 from milo after fallow. The continuous milo rotation was superior during the entire period, but in this particular series of years it resulted in heavier losses than would have been incurred through the use of the milo after fallow rotation. A farm operator would have needed extensive savings at the beginning of this critical period, or other sources of income during this time, in order to remain in business. However, the chances of survival were much more favorable under the milo after fallow system. In this case, a period of years has been selected in which a method - milo after fallow - would permit more farmers to remain solvent through the critical period than could remain in business using the continuous milo method, even though continuous milo is, on the average, more profitable in Finney County. The high returns from continuous milo in the years following this critical period were of little value to those farmers forced into dissolution before the better years came.

Thomas County, 1914-1950. The cumulative returns from continuous milo were greater than from milo after fallow in most of the early years of the period. The cumulative returns from milo after fallow were slightly greater by 1922, and from that time through the remainder of the period the cumulative returns from milo after fallow are greater in each year.

For the 17 year period, 1924-1940, the net addition to returns was $-147.36 from continuous milo and $691.50 from milo after fallow. The failure of the continuous milo system to show a net addition to returns for this period is serious. There were only five years during this adverse period when continuous milo resulted in any net addition to returns. It is unlikely that many farm operators, large or small, raising milo by the continuous milo method could remain in business through an adverse period of such great length. The milo after fallow system, on the other hand, would have resulted in a modest net addition to cumulative returns for the 17 year period. These returns, small as they were, would have brought the farm operator through this adverse period with less reliance upon savings and outside income than if he were producing milo under the continuous milo system.

Ellis County, 1914-1954. The cumulative returns were alternately greater for continuous milo and milo after fallow at different times throughout the period. The cumulative returns to milo after fallow became slightly greater in 1930 and remained greater through 1943. The cumulative returns were greater for continuous milo in 1944 and 1945, and greater for milo after fallow in each of the three following years. By 1949 the cumulative returns became slightly greater for continuous milo, and remained so through the last years of the period.

Although continuous milo was slightly superior in returns over the entire period, milo after fallow was slightly superior in returns for the years 1914-1948, Table 12 in the Appendix. This gives little basis for recommending one system of production over the other from the standpoint of returns in Ellis County.

Through an adverse period of years, milo after fallow results in more favorable returns in Ellis County, as was the case in Finney and Thomas Counties. For the period 1929-1940, the net addition to cumulative returns was $-161.00 from continuous milo and $289.44 from milo after fallow. It would appear that there are instances when it would be profitable to summer fallow a portion of the acreage devoted to milo production, even though it may not be a profitable practice under more favorable conditions.

SUMMARY

This study represents the use of economic tools to indicate to milo producers at various locations the comparative results to be expected from producing continuous milo versus milo after fallow.

The influence of yields, milo prices, and production costs on income were studied. Variability of yields and of income from the two systems were compared.

Finney, Thomas, and Ellis Counties were studied in detail because yield data from controlled experimental plots were available. Milo after fallow and continuous milo were compared for each county.

Continuous milo was found to be superior in Finney County, in terms of returns to land and management for the years studied. Milo after fallow was the superior system in Thomas County. In Ellis County the returns to land and management were only very slightly greater from continuous milo than from milo after fallow. The difference in returns is so small that one system can not be recommended over the other as a long-time practice on this basis.

Comparisons of yield and income variability within each of the three counties showed that, in all cases, variability was greater for continuous milo than for milo after fallow.

It is believed that farmers would attach some value to the reduced variability experienced with production after fallow. The amount of value placed on the reduced variability associated with cropping after fallow would vary widely among farmers. In general, it is believed that the choice between the two systems of production is determined largely by the difference in returns to land and management, and that the difference in variability of the two systems has only a rather slight effect on the choice which is made. In Ellis County, the difference in returns to land and management in favor of continuous milo is so small that a farmer might be expected to choose the milo after fallow system because of the lower yield and income variability associated with its use.

A study of cumulative returns was used to indicate a comparison of the two production systems, especially during a period of adverse production conditions. It was found that milo after fallow was superior during distress periods, both in locations where milo after fallow is superior under average conditions and in locations where continuous milo is superior under average conditions.

This study was limited to statics. Superior systems over time were determined.

The fallow problem was found to be of practical importance in the counties studied. Producers of all farm crops under non-irrigated conditions in approximately the Western half of Kansas are faced with the decision of how much land to fallow and whether to plant at a given time on continuously cropped land.

In some counties and under certain conditions the difference in returns between the optimum production method and the alternative was quite large.

ACKNOWLEDGMENTS

The author is very grateful to Professor Dale A. Knight for numerous suggestions and ideas, and for encouragement. Acknowledgment is also given to the Department of Agronomy for the use of yield data from experimental plots, and to Professor James A. Hobbs for assistance in selecting the experimental plots to be used in this study.

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APPENDIX

A Note on Calculation of Costs

The costs for individual years were determined by adjusting 1947 costs by appropriate indexes. Machinery and power costs were adjusted by the index of United States farm machinery costs, labor costs by the index of United States farm wage rates, and fuel costs by the index of United States motor supplies.

The costs are for a crop harvested in a particular year. In the case of a continuous milo crop, the costs are all incurred in the calendar year in which the crop is harvested. In the case of a milo after fallow crop, the fallowing costs for a given crop are the costs of the previous year. The remainder of the land preparation costs, and all seeding and harvesting costs are the costs of the calendar year in which the crop is grown and harvested.

The rates for machinery, power, labor, and fuel were for the time actually in the field; to provide for preparing the machine, traveling to and from the field, and breakdowns, the rates for the four types of costs were increased by 10, 10, 20, and 10 per cent, respectively.

For those years in which the value of a crop was not sufficient to cover the costs of harvesting, costs were adjusted and income was calculated in which the assumption was made that such crops were not harvested. The harvesting costs, (machinery, power, labor, and fuel) were reduced by 60, 60, 30, and 100 per cent, respectively.

Typical inputs were used for each analysis. These are operations believed typically performed by farmers in the areas under study, and consistent with recommended soil management practices. It is recognized that many farmers do not use exactly the combination of field operations chosen. However, the operations chosen present a general picture and are as accurate as any other combinations known. The research, of course, assumes these operations, or others that entail similar costs. Those farmers using operations with costs greatly different from these will need to modify the results to fit their conditions of operation.

A Discussion Concerning the Differences in Results Obtained from the Yield Data of the Three Stations

The results of this research were not entirely consistent between the three counties studied. Two areas of study can be pointed out in which the results were fully consistent between the three counties. Each of the three counties shows a lower variability of both yields and returns from milo after fallow than from continuous milo. The results also indicate that milo after fallow was a superior method of production during a period of adverse conditions, in all three counties. However, on the basis of returns to land and management, the results of this research would indicate a different recommendation between the two alternatives for each of the three counties. In Finney County, continuous milo appears to be the superior system; in Thomas County, milo after fallow, and in Ellis County either of the two systems could be expected to yield approximately equal returns in the long run situation. The question then may arise, Why isn't the same system of production superior in each of the three counties?

A variety of reasons might be given as to why milo is more responsive to fallowing in one location than in another. The finding of a complete set of answers to this question would constitute a rather sizeable study in itself. Some of the factors which may have made fallowing appear to be more beneficial in Thomas County than in Ellis and Finney Counties will be discussed here. No attempt will be made here to establish the relative importance of any of the factors which may have made fallowing appear to be more beneficial in Thomas County.

A large portion of the difference in response to fallowing between Thomas and Ellis Counties can probably be attributed to climatical differences which are associated with the difference in location. Thomas County is in the second tier of counties from the west side of the State. Ellis County is in the fifth tier of counties, which places it in an area of higher average annual rainfall. Less response to fallowing is to be expected under higher average rainfall conditions, other things being equal. The average annual rainfall is 17.81 inches in Thomas County and 22.69 inches in Ellis County.[1] The average annual evaporation rate is also higher at Hays than at Colby, which would tend to make the practice of fallowing less effective at Hays. The average seasonal evaporation of water from

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[1]R. I. Throckmorton and H. E. Myers, _op_. _cit_., p. 6.

a free water surface, April to September inclusive, is 49.0 inches at Hays and 43.2 inches at Colby.[1]

The wide difference in response to fallowing which was experienced between Thomas and Finney Counties is more difficult to explain. In Thomas County the average yield-difference was found to be 2.45 bushels per acre in favor of milo after fallow. The average yield-difference in Finney County was 5.60 bushels per acre in favor of continuous milo. Thus, a positive response to fallow is indicated in Thomas County, and a negative response to fallow, on the average, is indicated in Finney County.

Colby and Garden City are located approximately due north and south of each other, and the average annual rainfall at each place is about the same. The average annual rainfall is 17.81 inches in Thomas County and 18.54 inches in Finney County.[2] The difference in response to fallow can not be attributed to the difference in average annual rainfall.

Three factors remain which could account for the difference in response to fallowing which was experienced between the two locations. The soil texture may be coarser (more sandy) at Garden City than at Colby. A soil which is made up largely of fine particles has a higher moisture retention capacity than has a lighter, sandier type of soil.

The loss of water in surface run-off may be higher at

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[1] _Ibid._, p. 7.

[2] Ibid., p. 6.

Garden City than at Colby. If this is the case, the heavier rate of run-off could be due to either or both of two causes. The topography may be more sloping at Garden City than at Colby. A larger percentage of the average annual rainfall received at Garden City may occur in the form of torrential rains, which would result in a heavier rate of run-off.

It is known that the rate of evaporation is appreciably higher at Garden City than at Colby. The average seasonal evaporation of water from a free water surface, April to September inclusive, is 56.4 inches at Garden City and 43.2 inches at Colby.[1]

A Note on the Experimental Plots from Which Yield Data Were Obtained

All yield data used in the analysis were obtained from controlled experiments conducted at Branch Experiment Stations in the three counties in which the analysis was applied. For the continuous milo yield data at Garden City, the results obtained from Plot A of the MC milo rotation were used. This plot was plowed early in April, then kept free of weeds until it was seeded in the early part of June. The milo after fallow yield data at Garden City were taken from Plots L and M of the MF milo rotation. Plot L was fallowed in even-numbered years, and Plot M was fallowed in odd-numbered years. These plots were plowed about May 1 of the fallow season and kept clean the remainder of the season, and through the following spring until

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[1] Ibid., p. 7.

they were seeded early in June.

At Colby, the yield figures for continuous milo were taken from Plot A, and for milo after fallow from Plots C and D of the MC milo rotation. Plot A was spring plowed about May 15 to 20, then kept free of weeds as the seedbed was being developed to seed the crop. Plot C was fallowed in odd-numbered years, and Plot D was fallowed in even-numbered years. The plot to be fallowed was plowed about May 15 to 20, then clean cultivated through the remainder of the fallow season and the following spring.

The yield data at Hays for continuous milo were obtained from Plot A, and for milo after fallow from Plots C and D of the CC milo rotation. The first field operation on Plot A, following harvest in the fall, was to plow in the spring. Sufficient additional tillage was applied to prepare the seedbed for planting and to control weeds. Plot C was fallowed in odd-numbered years, and Plot D was fallowed in even-numbered years. The plot to be fallowed in a given year was plowed about May 15 to June 1, then kept clean through the growing season. Weed growth was also closely controlled through the following season until planting time.

The yields were obtained at each station from those plots using sequences of field operations which can be recommended for general use in these areas. In selecting the plots from which to use yield data, some attention was also given to selecting those plots on which the field operations were most similar to the field operations typically used in the areas.

Those plots were selected for comparison at each of the three stations on which the field operations for both continuous milo and milo after fallow were most nearly similar in their basic structure. All plots from which yield data were used in this research were spring plowed in the spring following harvest of a crop. This applies to both the continuous milo and milo after fallow plots. The fallow plots were not replowed in the spring following the season in which they were fallowed. Fall plowing is not recommended in the three counties studied, as this practice leaves the soil very vulnerable to erosion, both by wind and water through the winter and early spring.

Table 1. Machinery, power, labor, and fuel costs, per acre, milo after fallow, and continuous milo, Finney County, Kansas, 1947.

Input		Machinery[1]	Power	Labor[1]	Fuel[2]	Seed	Total
				Milo after fallow			
Land preparation and drilling							
One way	10 ft.	$0.13	$0.16	$0.20	$0.17		$0.66
Field Cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
Field Cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
Rod weeder	12 ft.	0.05	0.15	0.15	0.08		0.43
Chisel	16 ft.	0.16	0.10	0.12	0.09		0.47
Chisel	16 ft.	0.16	0.10	0.12	0.09		0.47
One way	10 ft.	0.13	0.16	0.20	0.17		0.66
Rod weeder	12 ft.	0.05	0.15	0.15	0.08		0.43
Drill	14 ft.	0.25	0.12	0.14	0.09		0.60
Rotary Hoe	14 ft.	0.17	0.07	0.11	0.06		0.41
Adjustment		0.13	0.13	0.29	0.10		0.65
Total		$1.39	$1.38	$1.76	$1.13		$5.66
Seed	5 lbs.					$0.22	0.22
Total							$5.88
Harvesting							
Combine	14 ft. self-propelled	$1.95		$0.26	$0.35		$2.56
Haul		0.61		0.26	0.06		0.93
Adjustment		0.26		0.10	0.04		0.40
Total		$2.82		$0.62	$0.45		$3.89
Total, all inputs		$4.21	$1.38	$2.38	$1.58	$0.22	$9.77

Table 1 (concl.).

Input		Machinery[1]	Power	Labor[1]	Fuel[2]	Seed	Total
				Continuous Milo			
Land preparation and drilling							
One way	10 ft.	$0.13	$0.16	$0.20	$0.17		$0.66
Field cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
One way	10 ft.	0.13	0.16	0.20	0.17		0.66
Drill	14 ft.	0.25	0.12	0.14	0.09		0.60
Rotary hoe	14 ft.	0.17	0.07	0.11	0.06		0.41
Adjustment		0.08	0.06	0.16	0.06		0.36
Total		$0.84	$0.69	$0.95	$0.65		$3.13
Seed	5 lbs.					$0.22	0.22
Total							$3.35
Harvesting							
Combine	14 ft. self-propelled	$1.29		$0.18	$0.26		$1.73
Haul		0.41		0.18	0.03		0.62
Adjustment		0.17		0.07	0.03		0.27
Total		$1.87		$0.43	$0.32		$2.62
Total, all inputs		$2.71	$0.69	$1.38	$0.97	$0.22	$5.97

[1]Miller, Frank, Quentin W. Lindsey, and Arthur G. George, Cost of Operating Machinery on Nebraska Farms, University of Nebraska, Agricultural Experiment Station Bul. 391, Lincoln, Nebraska, pp. 27-32, 1948.

[2]Scoville, O. J., and J. A. Hodges, Practices and Costs on Wheat Farms in Western Kansas, 1947, Kansas State College, Agricultural Experiment Station Circular 268, Manhattan, Kansas, pp. 18, 19, and 23, 1950.

Table 2. Machinery, power, labor, and fuel costs, per acre, milo after fallow, and continuous milo, Thomas County, Kansas, 1947.

Input		Machinery[1]	Power	Labor[1]	Fuel[2]	Seed	Total
				Milo after fallow			
Land preparation and drilling							
One way	10 ft.	$0.13	$0.16	$0.20	$0.17		$0.66
Field Cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
Field Cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
Rod Weeder	12 ft.	0.05	0.15	0.15	0.08		0.43
Chisel	16 ft.	0.16	0.10	0.12	0.09		0.47
Chisel	16 ft.	0.16	0.10	0.12	0.09		0.47
One way	10 ft.	0.13	0.16	0.20	0.17		0.66
Spring tooth	16 ft.	0.04	0.09	0.14	0.11		0.38
Drill	14 ft.	0.25	0.12	0.14	0.09		0.60
Rotary hoe	14 ft.	0.17	0.07	0.11	0.06		0.41
Adjustment		0.13	0.12	0.29	0.11		0.65
Total		$1.38	$1.31	$1.75	$1.17		$5.61
Seed	5 lbs.					$0.22	0.22
Total							$5.83
Harvesting							
Combine	14 ft. self-propelled	$1.95		$0.26	$0.35		$2.56
Haul		0.61		0.26	0.06		0.93
Adjustment		0.26		0.10	0.04		0.40
Total		$2.82		$0.62	$0.45		$3.39
Total, all inputs		$4.20	$1.31	$2.37	$1.62	$0.22	$9.72

Table 2 (concl.).

Input		Machinery[1]	Power	Labor[1]	Fuel[2]	Seed	Total
				Continuous milo			
Land preparation and drilling							
One way	10 ft.	$0.13	$0.16	$0.20	$0.17		$0.66
Field cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
Rod weeder	12 ft.	0.05	0.15	0.15	0.08		0.43
Drill	14 ft.	0.25	0.12	0.14	0.09		0.60
Rotary hoe	14 ft.	0.17	0.07	0.11	0.06		0.41
Adjustment		0.07	0.06	0.15	0.05		0.33
Total		$0.75	$0.68	$0.89	$0.55		$2.87
Seed	5 lbs.					$0.22	0.22
Total							$3.09
Harvesting							
Combine	14 ft. self-propelled	$1.29		$0.18	$0.26		$1.73
Haul		0.41		0.18	0.03		0.62
Adjustment		0.17		0.07	0.03		0.27
Total		$1.87		$0.43	$0.32		$2.62
Total, all inputs		$2.62	$0.68	$1.32	$0.87	$0.22	$5.71

[1]Miller, Frank, Quentin W. Lindsey, and Arthur G. George, *op. cit.*, pp. 27-32.

[2]Scoville, O. J., and J. A. Hodges, *op. cit.*, pp. 18, 19, and 23.

Table 3. Machinery, power, labor, and fuel costs, per acre, milo after fallow, and continuous milo, Ellis County, Kansas, 1947.

Input		Machinery[1]	Power	Labor[1]	Fuel[2]	Seed	Total
				Milo after fallow			
Land preparation and drilling							
One way	10 ft.	$0.13	$0.16	$0.20	$0.17		$0.66
Field cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
Field cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
Spring tooth	16 ft.	0.04	0.09	0.14	0.11		0.38
Chisel	16 ft.	0.16	0.10	0.12	0.09		0.47
One way	10 ft.	0.13	0.16	0.20	0.17		0.66
Field cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
Spring tooth	16 ft.	0.04	0.09	0.14	0.11		0.38
Drill	14 ft.	0.25	0.12	0.14	0.09		0.60
Rotary hoe	14 ft.	0.17	0.07	0.11	0.06		0.41
Adjustment		0.12	0.12	0.29	0.11		0.64
Total		$1.28	$1.27	$1.76	$1.21		$5.52
Seed	5 lbs.					$0.23	0.23
Total							$5.75
Harvesting							
Combine	14 ft. self-propelled	$1.95		$0.26	$0.35		$2.56
Haul		0.61		0.26	0.06		0.93
Adjustment		0.26		0.10	0.04		0.40
Total		$2.82		$0.62	$0.45		$3.89
Total, all inputs		$4.10	$1.27	$2.38	$1.66	$0.23	$9.64

Table 3 (concl.).

Input		Machinery[1]	Power	Labor[1]	Fuel[2]	Seed	Total
				Continuous milo			
Land preparation and drilling							
One way	10 ft.	$0.13	$0.16	$0.20	$0.17		$0.66
Field cultivator	15 ft.	0.08	0.12	0.14	0.10		0.44
Spring tooth	16 ft.	0.04	0.09	0.14	0.11		0.38
Drill	14 ft.	0.25	0.12	0.14	0.09		0.60
Rotary hoe	14 ft.	0.17	0.07	0.11	0.06		0.41
Adjustment		0.07	0.06	0.15	0.05		0.33
Total		$0.74	$0.62	$0.88	$0.58		$2.82
Seed	5 lbs.					$0.23	0.23
Total							$3.05
Harvesting							
Combine	14 ft. self-propelled	$1.29		$0.18	$0.26		$1.73
Haul		0.41		0.18	0.03		0.62
Adjustment		0.17		0.07	0.03		0.27
Total		$1.87		$0.43	$0.32		$2.62
Total, all inputs		$2.61	$0.62	$1.31	$0.90	$0.23	$5.67

[1] Miller, Frank, Quentin W. Lindsey, and Arthur G. George, _op. cit._, pp. 27-32.

[2] Scoville, O. J., and J. A. Hodges, _op. cit._, pp. 18, 19, and 23.

Table 4. Costs upon which the cost-difference depends, alternative comparisons, Finney, Thomas, and Ellis Counties, Kansas.

	Remaining Inputs	
M_c or M_f Finney County	Higher cost alternative Two one-wayings + drilling + rotary hoeing + seed + 2 (combining and hauling continuous milo).	Lower cost alternative Two chiselings + two rod weedings + combining and hauling milo after fallow.
M_c or M_f Thomas County	Rod weeding + drilling + rotary hoeing + seed + 2 (combining and hauling continuous milo).	Spring toothing + two chiselings + combining and hauling milo after fallow.
M_c or M_f Ellis County	Drilling + rotary hoeing + seed + 2 (combining and hauling continuous milo).	Chiseling + field cultivating + combining and hauling milo after fallow.

[1]Obtained by cancellation of inputs as listed in Tables 1, 2, and 3.

Table 5. Indexes of costs of summer fallow operations and costs of spring land preparation, seeding, weeding, combining, and hauling.

Year	Summer Fallow Operations[1]			Spring Land Preparation Seeding, Weeding, Combining, and Hauling[1]		
	Machinery and Power	Labor	Fuel	Machinery and Power	Labor	Fuel
	U.S. Farm machinery costs	U.S. Farm wage rates	U.S. Motor supplies	U.S. Farm machinery costs	U. S. Farm wage rates	U.S. Motor supplies
1914	48	25	59	48	24	59
1915	48	24	59	50	24	63
1916	50	24	63	53	27	69
1917	53	27	69	59	34	93
1918	59	34	93	75	42	120
1919	75	42	120	78	49	127
1920	78	49	127	80	58	126
1921	80	58	126	78	37	109
1922	78	37	109	69	37	94
1923	69	37	94	72	41	97
1924	72	41	97	75	43	101
1925	75	43	101	75	43	107
1926	75	43	107	75	44	111
1927	75	44	111	75	44	99
1928	75	44	99	75	44	97
1929	75	44	97	74	45	96
1930	74	45	96	73	42	91
1931	73	42	91	73	33	77
1932	73	33	77	69	25	77
1933	69	25	77	67	21	75
1934	67	21	75	70	24	80
1935	70	24	80	72	25	80
1936	72	25	80	73	27	81

Table 5 (concl.).

Year	Summer Fallow Operations[1]			Spring Land Preparation Seeding, Weeding, Combining, and Hauling[1]		
	Machinery and Power	Labor	Fuel	Machinery and Power	Labor	Fuel
	U.S. Farm machinery costs	U.S. Farm wage rates	U.S. Motor supplies	U.S. Farm machinery costs	U.S. Farm wage rates	U.S. Motor supplies
1937	73	27	81	74	31	82
1938	74	31	82	76	31	81
1939	76	31	81	76	30	79
1940	76	30	79	74	31	77
1941	74	31	77	75	36	80
1942	75	36	80	79	47	85
1943	79	47	85	82	63	88
1944	82	63	88	84	76	90
1945	84	76	90	85	86	90
1946	85	86	90	88	92	91
1947	88	92	91	100	100	100
1948	100	100	100	116	105	111
1949	116	105	111	130	102	113
1950	130	102	113	133	101	115
1951	133	101	115	144	112	121
1952	144	112	121	149	120	122
1953	149	120	122	150	123	124
1954	150	123	124	152	122	126

[1] U. S. Department of Agriculture, Bureau of Agricultural Economics, The Farm Cost Situation, March, 1953, p. 2, and March, 1955, p. 2.

Table 6. Cost of milo seed and prices received by farmers for milo, Finney, Thomas, and Ellis Counties, Kansas.

Year	Cost of Seed[1]			Price of Milo[2]		
	5 lbs. Finney	5 lbs. Thomas	5 lbs. Ellis	1 bu. Finney	1 bu. Thomas	1 bu. Ellis
1914		$ .09	$ .09		$ .50	$ .50
1915		.09	.09		.50	.46
1916		.09	.08		1.00	1.00
1917		.18	.18		1.35	1.50
1918		.24	.27		1.45	1.60
1919		.26	.29		1.13	1.50
1920		.20	.27		.75	.77
1921	$ .13	.13	.14	$ .33	.40	.35
1922	.06	.07	.06	.72	.75	.70
1923	.13	.13	.12	.72	.76	.76
1924	.13	.14	.14	.78	.85	.89
1925	.14	.15	.16	.85	.75	.80
1926	.15	.13	.14	.62	.75	.74
1927	.11	.13	.13	.55	.53	.58
1928	.10	.09	.10	.57	.52	.60
1929	.10	.09	.11	.65	.65	.65
1930	.12	.12	.12	.70	.75	.60
1931	.12	.13	.11	.23	.25	.25
1932	.04	.04	.04	.15	.20	.20
1933	.03	.04	.04	.35	.30	.35
1934	.06	.05	.06	.76	.76	.76
1935	.14	.14	.14	.65	.78	.80
1936	.12	.14	.14	.74	.74	.74
1937	.13	.13	.13	.53	.58	.59
1938	.09	.10	.11	.36	.40	.40
1939	.06	.07	.07	.58	.56	.57
1940	.10	.10	.10	.37	.40	.40

Table 6 (concl.).

Year	Cost of Seed[1]			Price of Milo[2]		
	5 lbs. Finney	5 lbs. Thomas	5 lbs. Ellis	1 bu. Finney	1 bu. Thomas	1 bu. Ellis
1941	$ .07	$ .07	$ .07	$ .48	$ .50	$ .54
1942	.09	.09	.10	.60	.54	.63
1943	.11	.10	.11	1.16	1.16	1.18
1944	.21	.21	.21	.85	.88	.87
1945	.15	.16	.16	1.16	1.15	1.16
1946	.21	.21	.21	1.25	1.25	1.28
1947	.22	.22	.23	1.93	1.95	2.02
1948	.34	.35	.36	1.06	1.10	1.10
1949		.20	.20		.86	.91
1950		.15	.16		1.03	1.04
1951			.19			1.34
1952			.24			1.57
1953			.28			1.16
1954			.21			1.30

[1]Price received by farmers in previous year for 5 lbs., doubled.

[2]Unpublished data, Department of Economics and Sociology, Kansas State College

Table 7. Annual costs, per acre, milo after milo, milo after milo doubled, milo after fallow, and milo after milo doubled less milo after fallow, Finney, Thomas, and Ellis Counties, Kansas.

Year	Finney County, 1921-1948				Thomas County, 1914-1950				Ellis County, 1914-1954			
	C_c	$2C_c$	C_f	$2C_c-C_f$	C_c	$2C_c$	C_f	$2C_c-C_f$	C_c	$2C_c$	C_f	$2C_c-C_f$
1914					$1.74[1]	$3.48	$2.93[1]	$0.55	$2.48	$4.96	$4.23	$0.73
1915					2.61[1]	5.22	4.39[1]	0.83	2.59	5.18	4.35	0.83
1916					1.95[1]	3.90	3.19[1]	0.71	2.77	5.54	4.63	0.91
1917					3.38	6.76	5.49	1.27	3.37	6.74	5.45	1.29
1918					4.30	8.60	6.94	1.66	4.32	8.64	6.91	1.73
1919					4.60	9.20	7.65	1.55	4.60	9.20	7.62	1.58
1920					4.70	9.40	7.95	1.45	4.75	9.50	7.96	1.54
1921	$4.35	$8.70	$7.36	$1.34	4.15	8.30	7.35	0.95	4.13	8.26	7.30	0.96
1922	3.83	7.66	6.47	1.19	3.66	7.32	6.46	0.86	3.63	7.26	6.38	0.88
1923	4.09	8.18	6.58	1.60	3.89	7.78	6.56	1.22	3.86	7.72	6.50	1.22
1924	4.25	8.50	6.88	1.62	4.05	8.10	6.87	1.23	4.03	8.06	6.80	1.26
1925	4.32[1]	8.64	7.02[1]	1.62	4.11[1]	8.22	7.01[1]	1.21	4.10[1]	8.20	6.96[1]	1.24
1926	3.13[1]	6.26	4.91[1]	1.35	2.89[1]	5.78	4.88[1]	0.90	2.88[1]	5.76	4.83[1]	0.93
1927	4.23	8.46	6.98	1.48	4.04	8.08	6.98	1.10	4.02	8.04	6.92	1.12
1928	4.20	8.40	6.88	1.52	3.98[1]	7.96	6.85	1.11	3.97	7.94	6.80	1.14
1929	4.16[1]	8.32	6.83[1]	1.49	2.76[1]	5.52	6.79	-1.27	3.96	7.92	6.76	1.16
1930	2.91[1]	5.82	4.65[1]	1.17	3.87	7.74	6.67	1.07	3.85[1]	7.70	6.61	1.09
1931	3.81[1]	7.62	6.34	1.28	3.64	7.28	6.33	0.95	2.49[1]	4.98	6.24	-1.26
1932	2.44[1]	4.88	5.83	-0.95	2.27[1]	4.54	5.81	-1.27	2.25[1]	4.50	5.73[1]	-1.23
1933	3.33[1]	6.66	5.53	1.13	3.18	6.36	5.51	0.85	3.15	6.30	3.64[1]	2.66
1934	2.47[1]	4.94	3.83[1]	1.11	2.29[1]	4.58	3.79[1]	0.79	2.27[1]	4.54	3.74[1]	0.80
1935	2.62[1]	5.24	4.06[1]	1.18	2.45[1]	4.90	4.04[1]	0.86	2.42[1]	4.84	3.99[1]	0.85
1936	2.66[1]	5.32	4.13[1]	1.19	2.50[1]	5.00	4.12[1]	0.88	2.47[1]	4.94	4.06[1]	0.88
1937	2.72[1]	5.44	4.24[1]	1.20	2.56[1]	5.12	4.22[1]	0.90	2.53[1]	5.06	6.16	-1.10
1938	2.73[1]	5.46	4.29[1]	1.17	3.73	7.46	6.30	1.16	3.69	7.38	4.23[1]	3.15
1939	2.68[1]	5.36	4.26[1]	1.10	3.66	7.32	6.27	1.05	2.48[1]	4.96	4.18[1]	0.78
1940	3.78	7.56	6.21	1.35	3.62	7.24	6.19	1.05	2.47[1]	4.94	4.13[1]	0.81

Table 7 (cont.).

Year	Finney County, 1921-1948				Thomas County, 1914-1950				Ellis County, 1914-1954			
	C_c	$2C_c$	C_f	$2C_c-C_f$	C_f	$2C_c$	C_f	$2C_c-C_f$	C_c	$2C_c$	C_f	$2C_c-C_f$
1941	$3.89	$7.78	$6.32	$1.46	$3.71	$7.42	$6.29	$1.13	$3.68	$7.36	$6.22	$1.14
1942	4.25	8.50	6.80	1.70	4.06	8.12	6.78	1.34	4.02	8.04	6.72	1.32
1943	4.61	9.22	7.42	1.80	4.39	8.78	7.36	1.42	3.09[1]	6.18	7.30	-1.12
1944	4.99	9.98	8.00	1.98	4.78	9.56	7.96	1.60	4.73	9.46	7.90	1.56
1945	5.10	10.20	8.29	1.91	4.90	9.80	8.26	1.54	4.85	9.70	8.18	1.52
1946	5.36	10.72	8.68	2.04	5.13	10.26	8.63	1.63	3.69[1]	7.38	8.55	-1.17
1947	5.97	11.94	9.52	2.42	5.71	11.42	9.47	1.95	5.67	11.34	9.40	1.94
1948	6.81	13.62	10.79	2.83	6.53	13.06	10.75	2.31	6.48	12.96	10.66	2.30
1949					6.82	13.64	11.46	2.18	6.76	13.52	11.34	2.18
1950					6.87	13.74	11.70	2.04	6.82	13.64	11.58	2.06
1951									7.40	14.80	12.36	2.44
1952									7.74	15.48	13.00	2.48
1953									7.86	15.72	13.27	2.45
1954									7.84	15.68	13.35	2.33

Table 7 (concl.).

Year	Finney County, 1921-1948				Thomas County, 1914-1950				Ellis County, 1914-1954			
	C_c	$2C_c$	C_f	$2C_c-C_f$	C_c	$2C_c$	C_f	$2C_c-C_f$	C_c	$2C_c$	C_f	$2C_c-C_f$
1914					$2.50[2]	$5.00	$4.27[2]	$0.73				
1916					2.80[2]	5.60	4.68[2]	0.92				
1926	$4.39[2]	$8.78	$7.11[2]	$1.67	4.15[2]	8.30	7.08[2]	1.22	$4.14[2]	$8.28	$7.03[2]	$1.25
1929					3.96[2]	7.92	6.79	1.13				
1930	4.07[2]	8.14	6.70[2]	1.44								
1931									3.60[2]	7.20	6.24	0.96
1932	3.49[2]	6.98	5.83	1.15	3.32[2]	6.64	5.81	0.83	3.30[2]	6.60	5.73	0.87
1933									3.15	6.30	5.44[2]	0.86
1934	3.55[2]	7.10	5.72[2]	1.38	3.37[2]	6.74	5.63[2]	1.06	3.35[2]	6.70	5.63[2]	1.07
1935	3.72[2]	7.44	5.99[2]	1.45	3.55[2]	7.10	5.97[2]	1.13	3.52[2]	7.04	5.92[2]	1.12
1936	3.78[2]	7.56	6.09[2]	1.47	3.62[2]	7.24	6.08[2]	1.16	3.59[2]	7.18	6.02[2]	1.16
1937	3.85[2]	7.70	6.25[2]	1.45	3.69[2]	7.38	6.23[2]	1.15	3.66[2]	7.32	6.16	1.16
1938	3.88[2]	7.76	6.32[2]	1.44					3.69	7.38	6.26[2]	1.12
1939	3.82[2]	7.64	6.29[2]	1.35					3.62[2]	7.24	6.21[2]	1.03
1940									3.59[2]	7.18	6.12[2]	1.06
1943									4.37[2]	8.74	7.30	1.44
1946									5.09[2]	10.18	8.55	1.63

[1]Represents cases where the cost of harvesting was greater than the value of the crop. The milo crop was considered to be abandoned, and an adjusted harvesting cost was used in these cases in computing total costs. The computation of the adjusted harvesting cost is discussed in the text.

[2]Represents total cost, including full cost of harvesting. These are cases in which the milo crop was considered to be abandoned, and an adjusted harvesting cost was used in computing total costs actually incurred.

Table 8. Annual yields, milo after milo, milo after fallow doubled, milo after fallow, and milo after milo doubled less milo after fallow, Finney, Thomas, and Ellis Counties, Kansas.

Year	Finney County, 1921-1948				Thomas County, 1914-1950				Ellis County, 1914-1954			
	Y_c	$2Y_c$	Y_f	$2Y_c-Y_f$	Y_c	$2Y_c$	Y_f	$2Y_c-Y_f$	Y_c	$2Y_c$	Y_f	$2Y_c-Y_f$
1914					0.0	0.0	0.0	0.0	21.7	43.4	32.2	11.2
1915					11.4	22.8	12.4	10.4	48.1	96.2	57.5	38.7
1916					0.0	0.0	0.0	0.0	3.0	6.0	20.4	-14.4
1917					3.4	6.8	6.9	-0.1	4.9	9.8	37.6	-27.8
1918					7.1	14.2	21.2	-7.0	9.3	18.6	11.0	7.6
1919					27.6	55.2	31.6	23.6	35.4	70.8	38.3	32.5
1920					18.3	36.6	47.6	-11.0	46.2	92.4	78.0	14.4
1921	16.2	32.4	33.5	-1.1	15.7	31.4	34.0	-2.6	33.4	66.8	58.4	8.4
1922	11.4	22.8	22.6	0.2	17.0	34.0	42.2	-8.2	12.9	25.8	42.0	-16.2
1923	36.7	73.4	35.5	37.9	30.9	61.8	66.6	-4.8	2.7	5.4	41.7	-36.3
1924	41.9	83.8	49.3	34.5	4.7	9.4	33.6	-24.2	20.1	40.2	33.6	6.6
1925	7.2	14.4	21.9	-7.5	6.0	12.0	15.2	-3.2	11.4	22.8	19.0	3.8
1926	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1927	10.2	20.4	27.4	-7.0	5.0	10.0	16.9	-6.9	39.0	78.0	48.8	29.2
1928	51.2	102.4	66.4	36.0	11.2	22.4	16.2	6.2	49.5	99.0	74.1	24.9
1929	8.8	17.6	36.8	-19.2	1.7	3.4	17.2	-13.8	20.9	41.8	65.0	-23.2
1930	0.0	0.0	0.0	0.0	14.8	29.6	37.6	-8.0	8.4	16.8	35.0	-18.2
1931	25.9	51.8	47.2	4.6	32.9	65.8	43.1	22.7	5.0	10.0	32.8	-22.8
1932	0.0	0.0	0.0	0.0	0.0	0.0	51.7	-51.7	0.0	0.0	62.4	-62.4
1933	7.9	15.8	22.1	-6.3	6.7	13.4	16.9	-3.5	14.5	29.0	4.8	24.2
1934	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 8 (concl.).

Year	Finney County, 1921-1948				Thomas County, 1914-1950				Ellis County, 1914-1954			
	Y_c	$2Y_c$	Y_f	$2Y_c-Y_f$	Y_c	$2Y_c$	Y_f	$2Y_c-Y_f$	Y_c	$2Y_c$	Y_f	$2Y_c-Y_f$
1935	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1936	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1937	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1938	0.0	0.0	0.0	0.0	6.7	13.4	10.0	3.4	5.7	11.4	2.1	9.3
1939	0.0	0.0	0.0	0.0	10.9	21.8	17.9	3.9	0.0	0.0	0.0	0.0
1940	9.0	18.0	9.9	8.1	9.0	18.0	19.5	-1.5	0.0	0.0	0.0	0.0
1941	34.5	69.0	49.1	19.9	45.0	90.0	64.1	25.9	15.0	30.0	26.6	3.4
1942	5.5	11.0	20.2	-9.2	16.4	32.8	31.9	0.9	42.1	84.2	59.7	24.5
1943	14.3	28.6	14.7	13.9	13.8	27.6	32.2	-4.6	0.0	0.0	4.3	-4.3
1944	59.8	119.6	63.1	56.5	38.6	77.2	53.4	23.8	69.7	139.4	99.1	40.3
1945	16.9	33.8	28.8	5.0	19.3	38.6	34.5	4.1	9.8	19.6	24.1	-4.5
1946	4.1	8.2	16.0	-7.8	10.5	21.0	34.3	-13.3	0.0	0.0	29.5	-29.5
1947	41.9	83.8	47.2	36.6	9.8	19.6	27.6	-8.0	5.3	10.6	13.8	-3.2
1948	26.3	52.6	53.6	-1.0	15.3	30.6	42.2	-11.6	29.1	58.2	34.1	24.1
1949					12.2	24.4	31.6	-7.2	24.8	49.6	42.4	7.2
1950					5.2	10.4	34.7	-24.3	30.9	61.8	44.8	17.0
1951									32.8	65.6	47.9	17.7
1952									8.1	16.2	21.7	-5.5
1953									24.5	49.0	46.0	3.0
1954									3.7	7.4	5.3	2.1
Average	15.35	30.69	25.10	5.60	11.54	23.09	25.54	-2.45	16.78	33.56	31.75	1.31

Table 9. The number of years continuous milo was superior, Finney, Thomas, and Ellis Counties, Kansas, specified assumptions regarding milo prices, yield-differences, and cost-differences.

County	Period	Model	Price of Milo: actual Cost-difference: actual Yield-difference: actual	Price of Milo: actual Cost-difference: actual Yield-difference: average	Price of Milo: average Cost-difference: average Yield-difference: actual
Finney	1921-48	$2C_c - C_f = p_m(2Y_c - Y_f)$	9	27	10
Thomas	1914-50	$2C_c - C_f = p_m(2Y_c - Y_f)$	9	0	9
Ellis	1914-54	$2C_c - C_f = p_m(2Y_c - Y_f)$	21	21	21

Table 10. Annual returns from milo, per farm, milo after fallow and continuous milo, Finney, Thomas, and Ellis Counties, Kansas.[1]

Year	Finney County 1921-1948		Thomas County 1914-1950		Ellis County 1914-1954	
	M_f	M_c	M_f	M_c	M_f	M_c
1914			$-43.95	$-52.20	$118.70	$167.40
1915			27.15	92.70	221.00	390.72
1916			-47.85	-58.50	157.70	4.60
1917			57.37	36.30	509.50	79.60
1918			357.00	179.85	106.90	211.20
1919			420.87	797.64	498.30	970.00
1920			416.25	270.75	521.00	616.48
1921	$184.75	$ 99.60	93.75	63.90	131.40	151.20
1922	490.10	437.80	377.85	272.70	230.20	108.00
1923	949.00	2233.40	660.84	587.82	251.92	-36.16
1924	1578.70	2843.20	325.35	-1.65	231.04	277.18
1925	579.75	180.00	65.85	11.70	82.40	100.40
1926	-245.50	-313.00	-73.20	-86.70	-48.30	-57.60
1927	404.50	138.00	29.66	-41.70	213.84	372.00
1928	1548.40	2498.40	23.61	55.32	376.60	514.60
1929	854.50	156.00	65.85	-82.80	354.90	192.50
1930	-232.50	-291.00	322.95	216.90	143.90	23.80
1931	225.80	214.70	66.67	137.55	19.60	-49.80
1932	-11.00	-244.00	67.95	-68.10	67.50	-45.00
1933	110.25	-56.50	-6.60	-35.10	-36.40	38.50
1934	-191.50	-247.00	-56.85	-68.70	-37.40	-45.40

Table 10 (concl.).

Year	Finney County 1921-1948		Thomas County 1914-1950		Ellis County 1914-1954	
	M_f	M_c	M_f	M_c	M_f	M_c
1935	$-203.00	$-262.00	$ -60.60	$ -73.50	$ -39.90	$ -48.40
1936	-206.50	-266.00	-61.80	-75.00	-40.60	-49.40
1937	-212.00	-272.00	-63.30	-76.80	-16.76	-50.60
1938	-214.50	-273.00	-34.50	-31.50	-42.30	-28.20
1939	-213.00	-268.00	56.31	73.32	-41.30	-49.60
1940	-127.35	-45.00	24.15	-0.60	-41.30	-49.40
1941	862.40	1267.00	386.40	563.70	81.44	88.40
1942	266.00	-95.00	156.69	143.88	308.91	450.06
1943	481.60	1197.80	449.88	348.54	-22.26	-61.80
1944	2281.75	4584.00	585.48	875.64	783.17	1118.18
1945	1255.90	1450.40	471.22	518.85	197.76	130.36
1946	566.00	-23.50	513.67	239.85	292.10	-73.80
1947	4078.80	7489.70	665.25	402.00	184.76	100.72
1948	2301.30	2106.80	535.05	309.00	268.50	510.60
1949			235.74	110.16	272.44	316.16
1950			360.62	-45.42	350.12	506.32
1951					518.26	731.04
1952					210.69	99.54
1953					400.90	411.20
1954					-64.60	-60.60
Acres of milo harvested per year	50	100	15	30	10	20

[1]The annual returns were obtained by multiplying the acres of milo by the returns per acre. The per acre returns were obtained by multiplying the yield by the price of milo and subtracting costs for machinery, power, labor, fuel, and seed. The returns are a return to land and management.

Table 11. The standard deviation for yields and returns, continuous milo and milo after fallow, Finney, Thomas, and Ellis Counties, Kansas.

Measure	Finney County 1921-1948		Thomas County 1914-1950		Ellis County 1914-1954	
	M_c	M_f	M_c	M_f	M_c	M_f
Yields,[1] bu.	35.109	21.168	22.642	18.651	35.315	24.966
Returns, per farm, dollars	1784.913	1005.696	253.053	234.510	292.427	200.649

[1]The yield standard deviations for continuous milo are based upon the use of 2 acres of land, and for milo after fallow are based upon the use of 1 acre of land.

Table 12. Cumulative returns from milo, per farm, milo after fallow and continuous milo, Finney, Thomas, and Ellis Counties, Kansas.

Year	Finney County 1921-1948		Thomas County 1914-1950		Ellis County 1914-1954	
	M_f	M_c	M_f	M_c	M_f	M_c
1914			$ -43.95	$ -52.20	$ 118.70	$ 167.40
1915			-16.80	40.50	339.70	558.12
1916			-64.65	-18.00	497.40	562.72
1917			-7.28	18.30	1006.90	642.32
1918			349.72	198.15	1113.80	853.52
1919			770.59	995.79	1612.10	1823.52
1920			1186.84	1266.54	2133.10	2440.00
1921	$ 184.75	$ 99.60	1280.59	1330.44	2264.50	2591.20
1922	674.85	537.40	1658.44	1603.14	2494.70	2699.20
1923	1623.85	2770.80	2319.28	2190.96	2746.62	2663.04
1924	3202.55	5614.00	2644.63	2189.31	2977.66	2940.22
1925	3782.30	5794.00	2710.48	2201.01	3060.06	3040.62
1926	3536.80	5481.00	2637.28	2114.31	3011.76	2983.02
1927	3941.30	5619.00	2666.94	2072.61	3225.60	3355.02
1928	5489.70	8117.40	2690.55	2127.93	3602.20	3869.62
1929	6344.20	8273.40	2756.40	2045.13	3957.10	4062.12
1930	6111.70	7982.40	3079.35	2262.03	4101.00	4085.92
1931	6337.50	8197.10	3146.02	2399.58	4120.60	4036.12
1932	6326.50	7953.10	3213.97	2331.48	4188.10	3991.12
1933	6436.75	7896.60	3207.37	2296.38	4151.70	4029.62
1934	6245.25	7649.60	3150.52	2227.68	4114.30	3984.22

Table 12 (concl.).

Year	Finney County 1921-1948 M_f	Finney County 1921-1948 M_c	Thomas County 1914-1950 M_f	Thomas County 1914-1950 M_c	Ellis County 1914-1954 M_f	Ellis County 1914-1954 M_c
1935	$6042.25	$7387.60	$3089.92	$2154.18	$4074.40	$3935.82
1936	5835.75	7121.60	3028.12	2079.18	4033.80	3886.42
1937	5623.75	6849.60	2964.82	2002.38	4017.04	3835.82
1938	5409.25	6576.60	2930.32	1970.88	3974.74	3807.62
1939	5196.25	6308.60	2986.63	2044.20	3932.94	3758.02
1940	5068.90	6263.60	3010.78	2043.60	3891.64	3708.62
1941	5931.30	7530.60	3397.18	2607.30	3973.08	3797.02
1942	6197.30	7435.60	3553.87	2751.18	4281.99	4247.08
1943	6678.90	8633.40	4003.75	3099.72	4259.73	4185.28
1944	8960.65	13217.40	4589.23	3975.36	5042.90	5303.46
1945	10216.55	14667.80	5060.45	4494.21	5240.66	5433.82
1946	10782.55	14644.30	5574.12	4734.06	5532.76	5360.02
1947	14861.35	22134.00	6239.37	5136.06	5717.52	5460.74
1948	17162.65	24240.80	6774.42	5445.06	5986.02	5971.34
1949			7010.16	5555.22	6258.46	6287.50
1950			7370.78	5509.80	6608.58	6793.82
1951					7126.84	7524.86
1952					7337.53	7624.40
1953					7738.43	8035.60
1954					7673.83	7975.00
Acres of milo harvested per year	50	100	15	30	10	20

ECONOMIC CONSIDERATIONS INVOLVED IN THE USE OF SUMMER FALLOW IN MILO ROTATIONS IN WESTERN KANSAS

by

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of Agriculture and Applied Science, 1951

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Economics and Sociology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1956

This study represents the use of economic tools to indicate to milo producers at various locations the comparative results to be expected from producing continuous milo versus milo after fallow.

It was assumed that farmers in this area were making a choice between growing milo after milo continuously, or growing milo in alternate years interspaced with fallow. A second assumption was that milo was grown for grain only. The problem of erosion was assumed to be equal for both milo after fallow and continuous milo. Land was considered a fixed cost and labor, seed, and machinery costs were considered variable costs. It was assumed that continuous milo and milo after fallow have the same effect on soil fertility. The technology assumed was that which was determined to be most nearly typical of the technologies employed in each of the three counties in 1954. Indexes were used to adjust 1947 costs to give costs for other years.

This study was limited to statics. Superior systems over time were determined.

The influence of yields, milo prices, and production costs on income were studied. The relationship of these three variables may be stated symbolically,

$$2C_c - C_f = p_m(2Y_c - Y_f).$$

Cost-difference refers to the cost of two years of continuous milo ($2C_c$) minus the cost of one year of milo plus the cost of fallowing (C_f). The price of milo is represented by p_m. Yield difference refers to the difference in total yield per acre between two years of continuous milo ($2Y_c$) and one year of milo after fallow (Y_f).

Finney, Thomas, and Ellis Counties were studied in detail because yield data from controlled experimental plots were available. Milo after fallow and continuous milo were compared for each county.

Continuous milo was found to be superior in Finney County, in terms of returns to land and management for the years studied. Milo after fallow was the superior system in Thomas County. In Ellis County, the returns to land and management were only very slightly greater from continuous milo than from milo after fallow. The difference in returns is so small in Ellis County that one system cannot be recommended over the other as a long-time practice on this basis.

Variability of yields and of income from the two systems were compared. Comparisons of yield and income variability within each of the three counties showed that, in all cases, variability was greater for continuous milo than for milo after fallow. In general, it is believed that the choice between the two systems of production is determined largely by the difference in returns to land and management, and that the difference in variability of the two systems has only a rather slight effect on the choice which is made. In Ellis County, the difference in returns to land and management in favor of continuous milo is so small that a farmer might choose the milo after fallow system because of the lower yield and income variability associated with its use.

A study of cumulative returns was used to indicate a comparison of the two production systems, especially during a period of adverse production conditions. It was found that milo after fallow was superior during distress periods, both in locations where milo after fallow was superior under average conditions and in locations where continuous milo was superior under average conditions.

The fallow problem was found to be of practical importance in the counties studied. Producers of all farm crops under non-irrigated conditions in approximately the western half of Kansas are faced with the decision of how much land to fallow. In some counties and under certain conditions the difference in returns between the optimum production method and the alternative was quite large.